

CDI2SIM

# **BSM and Device Simulator**

User Manual



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# 1. Introduction

This document provides the necessary information to put the CDI2 BSM Simulator (BSMS) and the CDI2 Device Simulator (DS) into operation and to conduct test sequences with pre-stored test sets. Furthermore, the user shall be able to apply the provided tool-set to run the acceptance test procedures for the BSMS/DS and for CDI2 compliant BSMs and devices later.

The document consists of specific chapters for the BSMS and for the DS and of chapters, which are common to both.



Figure 1: BSM Simulator and Device Simulator



# 2. References

### [Ref 1.]

Common Detector Interface 2 (CDI2) Specifications v2.7C, 21 March 2022 https://www.ecb.europa.eu/euro/pdf/CDI2\_version\_2.7C\_Final.pdf

### [Ref 2.]

Common Detector Interface 2 (CDI2) Specifications v2.7B, 29 January 2020 https://www.ecb.europa.eu/euro/pdf/CDI2\_version\_2.7B\_Final.pdf

### [Ref 3.]

Detector Test Rig User Manual "6.27 User manual ADAPTOR 2 test transport V3.docx"

### [Ref 4.]

Banknote Displacement Detector User Manual "6.15.2 User manual Banknote displacement detector V2.docx"

### [Ref 5.]

Banknote Displacement Detector User Manual (Detector casing) "6.50 User manual Banknote displacement detector (Detector casing).pdf"

### [Ref 6.]

CDI2 Device - PC Implementation User Manual, Version 1.3 / 26.6.2019 "CDI2-Device-PC-Implementation-v13-20190626.pdf"

## 2.1. Terms and abbreviations

DEV	CDI2 Device (CS, IEU or Detector)	
Flutter Detector	Used in this document for <i>Banknote Displacement Detector</i> , an external device based on laser triangulation that supports the qualification of the BSM's transport characteristics. It is provided with the DS.	
JSON	JavaScript Object Notation Is an open-standard file format that uses human-readable text to transmit data objects consisting of attribute–value pairs and array data types (or any other serializable value). It is a very common data format used for asynchronous browser–server communication.	
Lua	Is a lightweight, multi-paradigm programming language designed primarily for embedded use in applications.	
REST	Representational State Transfer Is an architectural style that defines a set of constraints to be used for creating web services.	



SS	Simulator Setup
Test Case	Specific configuration on DS and/or BSMS to test aspects of the CDI2 specification
Test Case Parameter	Configuration detail of a Test Case. E.g.: number of banknotes

For additional terms and abbreviations used in this document, please refer to the corresponding chapters in the CDI2 specifications [Ref 1.] as well.

This is the list of abbreviations as used in the CDI2 Specification (excerpt from [Ref 1.]).

AU	Aggregation Unit
BFA	Belt Free Area
BN	Banknote
BNID	Banknote ID
BP	Banknote Present
BSM	Banknote Sorting Machine
BSMS	BSM Simulator
CLE	Colour Linearity Error
CN	Controlled Node
CS	Camera System
DET	Detector
DET DMB	Detector Detector Machine Bus
DET DMB DN	Detector Detector Machine Bus Digital numbers
DET DMB DN DN rms	Detector Detector Machine Bus Digital numbers DN root mean square
DET DMB DN DN rms DR	Detector Detector Machine Bus Digital numbers DN root mean square Data Range
DET DMB DN DN rms DR DSNU	Detector Detector Machine Bus Digital numbers DN root mean square Data Range Dark Signal Non-Uniformity
DET DMB DN DN rms DR DSNU EEU	DetectorDetector Machine BusDigital numbersDN root mean squareData RangeDark Signal Non-UniformityExternal Evaluation Unit
DET DMB DN DN rms DR DSNU EEU ESP	DetectorDetector Machine BusDigital numbersDN root mean squareData RangeDark Signal Non-UniformityExternal Evaluation UnitExternal Service Port
DET DMB DN DN rms DR DSNU EEU ESP EU	DetectorDetector Machine BusDigital numbersDN root mean squareData RangeDark Signal Non-UniformityExternal Evaluation UnitExternal Service PortEvaluation Unit



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GVSP	GigE Vision Stream Protocol
IDB	Image Data Bus
IEU	Image Evaluation Unit
IR	Infrared
LP	Line Pairs
MN	Managing Node
MTF	Modulation Transfer Function
MU	Measurement Unit
PL	POWERLINK
PRNU	Photo Response Non-Uniformity
RGB	Red, Green, Blue
SNR	Signal to Noise Ratio
ТАР	Timed Air Pulses
тс	Transport Clock
TS	Transport Simulator
TTS	Transport Timing Signals

# 3. BSM Simulator

## 3.1. Overview



Figure 2: BSMS Rack Components

# 3.2. Packaging List

- BSMS main cabinet includes 1G network switch, 10G network switch, VisionBox Lemans, BSM Node Controller, three 100M 8-port Hubs, Powerlink Gateway, Profitap 100 Network Sniffer
- Power Cords
   2x US (Type B NEMA 5-15) and 2x Europe (Type F, CEE 7/4) version for Laptop and BSMS
- Dell Laptop with UK QWERTY keyboard layout
- TS Trigger Cable, D-sub DE-9 male/DE-9 female
- TS Serial Cable, D-sub DE-9 male/DE-9 female
- TTS cables, 9x10m, 1x20m, D-sub HD DE-15 male/DE-15 male
- DMB cables, RJ-45 patch cord, green, 16x10m
- IDB cables, RJ-45 patch cord, red, 2x10m, 1x20m
- DMB RJ-45 to M12 D-coded plug cables, 1x10m, 1x15m
- IDB RJ-45 to M12 X-coded plug cable, 1x20m
- RJ-45 patch cable, yellow, for BSMS-GUI PC
- USB cable, grey, Type A  $\rightarrow$  Type B
- TS Trigger breakout box, D-sub DE-9 male/DE-9 female



- TS Trigger extension cable 2m, D-sub DE-9 male/DE-9 female
- USB Sticks with disk images (Recover Stick) and installation packages (Data Stick) for full software recovery
- This user manual



### **3.3.** Main Modules and Front View

At normal operation all external connections are made at the rear panel (see 3.4) and the rack doors are closed. Figure 4 shows the position of the main functional units of the BSMS, as seen from the front when the front door has been opened.



Figure 3: BSMS Front View

- (1) Network Switch 1G for Simulation Control Network NETGEAR ProSAFE GS724Tv4
- (2) Network Switch 10G for IDB NETGEAR ProSAFE XS712Tv2
- (3) BSM Node Controller (see 3.6)
- (4) BSM Simulation Computer
   VisionBox "LeMans", 8-core ARM Cortex-A72
   Imago Technologies, <u>www.imago-technologies.com</u>
- (5) 8-port HUB for DMB \*)0AC808.9-1, B&R Industrial Automation GmbH, <u>www.br-automation.com</u>
- (6) USB Hub \*)
- (7) POWERLINK TCP/IP Gateway \*)X20HB8815, B&R Industrial Automation GmbH, <u>www.br-automation.com</u>

\*) Components (5), (6) and (7) are mounted on a top-hat rail covered by an aluminium plate. They are not visible without removing the cover.



All internal cables of the simulator are factory assembled already. User access to the cables is not needed during normal operation, except for service, repair or special test configurations. An overview about the cabling on the front panel is shown in Figure 4.



Figure 4: BSMS Front Side Cables

- (1) Simulation Control Network, grey, to rear connector PC LAN (see 3.4)
- (2) Simulation Control Network, grey, to VisionBox and BSM Node Controller
- (3) IDB connections, red, to rear connectors IDB 1-8 (see 3.4)
- (4) 10G network connection IDB switch to Visionbox, orange fibre cable
- (5) TTS connections, grey, to rear connectors TTS 1-9 (see 3.4)
- (6) DMB connection to HUB (see Figure 3/(5))
- (7) Trigger connection to Transport Simulator, grey, to rear panel connector TRIG
- (8) VisionBox power supply
- (9) VisionBox console, grey, rear panel connector CONSOLE (see 3.4)
- (10) VisionBox SD card slot
- (11) VisionBox external triggers, not used

### 3.4. Rear Panel Connectors



#### Figure 5: BSMS Rear Panel

- (1) PC LAN Network connection to Laptop
- (2) CONSOLE
   Console of VisionBox, serial RS-232, for debugging purposes, left unconnected
- (3) TRIG Trigger input for connecting the Transport Simulator [see 3.5.2]
- (4) SERIAL Control interface for the Transport Simulator, serial RS-232 [see 3.5.3]
- (5) IDB10G Network ports for the Image Data Bus
- (6) DMB100M Network ports for the Data Machine Bus, Powerlink industrial field bus
- (7) Mains Switch Power supply master switch
- (8) POWER Main inlet, IEC-60320 C14
- (9) TTS

TTS trigger connectors, BSM side [see 3.5.1]

(10) SNIFFER

USB Type B, Laptop connection for three USB devices (via an USB hub), connects to the ProfiTap network sniffer, an USB-to-Serial interface and an USB-2-LAN Network Interface, [see 12.3]



# 3.5. Connectors and Pinning

## 3.5.1. Transport Timing Signals (TTS)

The TTS connector complies to [Ref 1.] chapter 5 Transport Timing Signals (TTS).

Pin	Name
1	BP+
6	BP-
3	TC+
8	TC-
9	RESET
14	READY
11	+5V
5	reserved
7	reserved
10	reserved
12	reserved
2	GND
4	GND
13	GND
15	GND

Table 1 : TTS, D-Sub HD 15-pin

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# 3.5.2. Transport Simulator Trigger (TRIG)

Pin	Signal	Direction	Description	Electrical
1	TS_TRIGGER_P	Input	Trigger Pulse:	RS-422
6	TS_TRIGGER_N	(from TS to BSMS)	One pulse per banknote	with 100 Ohm termination
				at receiver
7	TS_CLOCK_P	Input	Transport Clock:	RS-422
8	TS_CLOCK_N	(from TS to BSMS)	Clock Signal is	with 100
			synchronous to	Onm
			transport speed.	at receiver
4	TS_JAM_P	Input	Not used	RS-422
9	TS_JAM_N	(from TS to BSMS)		with 100
				Ohm
				termination
				at receiver
5	GND	Power	Signal Ground	

Table 2 : Transport Simulator Trigger, D-Sub 9-pin

### **3.5.3.** Transport Simulator Control (SERIAL)

Pin	Signal	Direction	Description	Electrical
2	RxD	Input		RS-232
		(from TS to		
		BSMS)		
3	TxD	Output		RS-232
		(from		
		BSMS to		
		TS)		
5				Ground

Table 3 : TTS, D-Sub HD 15-pin

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# 3.6. BSM Node Controller

The BSM node controller is housed in a 19" rack unit, occupying 2 height units (2U). The device is already cabled inside the rack and user access to its connectors is not required usually.



Figure 6: BSM Node Controller Front Panel

- (1) BSM side TTS port 1
- (2) BSM side TTS port 2
- (3) BSM side TTS port 3
- (4) BSM side TTS port 4
- (5) BSM side TTS port 5
- (6) BSM side TTS port 6
- (7) BSM side TTS port 7
- (8) BSM side TTS port 8
- (9) BSM side TTS port 9
- (10) LAN 1G, Simulation Control
- (11) Serial Console, for debugging purposes
- (12) General purpose digital IO, for debugging purposes
- (13) Powerlink Node ID, bits [3:0], must be set to "0" on BSM
- (14) Configuration Switch
- (15) Powerlink Network
- (16) Device side TTS, not used at BSM
- (17) Trigger input from Transport Simulator
- (18) Sync, not used
- (19) Serial, not used



# 4. BSM Simulator Light

### 4.1. Overview

The BSMS Simulator Light has the same functionality as the original BSM Simulator but for fewer CDI2 devices. It simulates all signals and commands to operate a reduced set of CDI2 devices (1CS and 2 DET or 3 DET). Differences are explained as follows and depictured in Figure 7.

- (1) It does not include the 10G Network Switch to connect a CS (Camera System) as well as IEUs (Image Evaluation Unit) to the BSM Simulation Computer. Instead, only a single CS can be connected.
- (2) Only a single 10G IDB port is available at the rear end of the BSMS Simulation Computer.
- (3) Only 3 TTS ports are provided instead of 9.
- (4) Only 8 DMB ports are provided instead of 16.



Figure 7: BSMS Light Rack Components / Differences

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## 4.2. Packaging List

- BSMS Light 19" 8HE trolley rack
  - 1G 5-port network switch
  - o BSM Simulation Computer
  - o BSM Node Controller
  - o 100M 8-port Hub
  - Powerlink Gateway
  - o USB Hub
- Cable box
  - Power Cords for BSMS 1x US (Type B NEMA 5-15) and 1x Europe (Type F, CEE 7/4)
  - o TS Trigger Cable, D-sub DE-9 male/DE-9 female, 10m
  - o TS Serial Cable, D-sub DE-9 male/DE-9 female, 10m
  - TTS cables, D-sub HD-15 male/HD-15 male, 1x10m, 1x3m
  - DMB cables, RJ-45 patch cord, green, 2x10m
  - IDB cable, RJ-45 patch cord, red, 1x10m
  - DMB RJ-45 to M12 D-coded plug cable, green, 1x10m
  - $\circ$  ~ IDB RJ-45 to M12 X-coded plug cable, red, 1x20m ~
  - o RJ-45 patch cable for BSMS-GUI PC, yellow, 3m
  - o TS Trigger extension cable, D-sub DE-9 male/DE-9 female, 2m
  - $\circ$  TTS Trigger extension cable incl. gender-changer, D-sub HD-15 male/HD-15 male, 3m
  - Flutter detector trigger cable, 10m
  - o USB extension cable, 10m
- Suitcase
  - Profitap 100 Network Sniffer incl. 1x USB cable, Type A/ B & 1x 0,25m patch cable green
  - Digital Scope Unit (USB)
  - TS Trigger breakout box, D-sub DE-9 male/DE-9 female
  - TTS Trigger breakout box, D-sub HD-15 male/HD-15 female
  - USB to serial cable
  - USB network interface
  - $\circ$   $\;$  USB Stick with installation packages for software recovery
  - $\circ \quad \text{This user manual} \quad$
- Dell Laptop (GUI PC for Testing)



### 4.3. Main Modules and Front View

Figure 2 shows the position of the main functional units of the BSMS Light, as seen from the front when the front lid has been removed.



Figure 8: BSMS Light Front View

- (1) BSM Simulation Computer Kontron KISS 1U Short V3 CFL
- (2) BSM Node Controller
- (3) Network Switch 1G for Simulation Control Network\*)RS Pro, Compact Ethernet, 5 Port Gigabit Switch, 189-0537
- (4) USB Hub \*)
- (5) POWERLINK TCP/IP Gateway \*)X20HB8815, B&R Industrial Automation GmbH, <u>www.br-automation.com</u>
- (6) 8-port HUB for DMB \*)0AC808.9-1, B&R Industrial Automation GmbH, <u>www.br-automation.com</u>
- (7) 24V Power Supply \*)OPS1040.0, B&R Industrial Automation GmbH, <u>www.br-automation.com</u>

\*) Components (3-7) are mounted on a top hat section rail.

All internal cables of the simulator are factory assembled already. An overview about the cabling on the front panel is shown in Figure 4.



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#### Figure 9: BSMS Light Front Side Cables

- (1) Simulation Control Network, grey, to BSM Simulation Computer
- (2) Simulation Control Network, grey, to BSM Node Controller
- (3) Chained 24V Power Supply to peripherals on top hat section rail
- (4) TTS connector
- (5) Trigger connector to Transport Simulator
- (6) DMB connection, green to BSM node Controller
- (7) DMB connection, green, to Powerlink Gateway



## 4.4. Rear Panel Connectors



Figure 10: BSMS Rear Panel

- (1) POWER Main inlet, IEC-60320 C14
- (2) Mains Switch Power supply master switch
- (3) Maintenance door, open to access 10G IDB port of BSM Simulation Computer



# 5. Device Simulator

# 5.1. Overview



Figure 11: DS Rack Components

# 5.2. Packaging List

- DS main cabinet includes 1G network switch, VisionBox Lemans, 4 x Device Node Controller, Profitap 100 Network Sniffer
- Power cords 2x US (Typ B NEMA 5-15) and 2x Europe (Typ F, CEE 7/4) version for Laptop and DS
- Dell Laptop with UK QWERTY keyboard layout
- DMB RJ-45 to M12 D-coded connector cables, 9x2m
- IDB RJ-45 to M12 X-coded connector cables, 1x1m
- RJ-45 patch cable, yellow, for BSMS-GUI PC
- USB cable, grey, Type A  $\rightarrow$  Type B
- USB active extension cable, 10m (for Flutter Detector)
- Transport case including
  - Picoscope USB scope (including 2 probes and USB cable)
  - TTS breakout box, D-sub HD DE-15 male/DE-15 female
  - TTS extension cable 2m, D-sub HD DE-15 male/DE-15 female
  - USB Sticks with disk images (Recover Stick) and installation packages (Data Stick) for full software recovery
  - o This user Manual

- Shipping box including
  - Flutter Detector in CS casing
  - Flutter Detector in DET casing
  - o CDI2 CS empty casings
  - o CDI2 DET empty casings
  - o CDI1 Device Simulator case (if applicable)



## 5.3. Main Modules and Front View

At normal operation all external connections are made at the rear panel (see 5.4) and the rack doors are closed. Figure 12 shows the position of the main functional units of the DS, as seen from the front when the front door has been opened.



Figure 12: DS Front View

- (1) DS Node Controller (see 5.5), CN 1-4
- (2) DS Node Controller (see 5.5), CN 5-8
- (3) Network Switch 1G for Simulation Control Network NETGEAR ProSAFE GS724Tv4
- (4) DS Node Controller (see 5.5), CN 9-12
- (5) DS Node Controller (see 5.5), CN 13-16
- (6) DS Simulation Computer
   VisionBox "LeMans", 8-core ARM Cortex-A72
   Imago Technologies, <u>www.imago-technologies.com</u>



All internal cables of the simulator are factory assembled already. User access to the cables is not needed during normal operation, except for service, repair or special test configurations. An overview about the cabling on the front panel is shown in Figure 13.



Figure 13: DS Front Side Cables

- (1) DMB connections, green, to rear connectors DMB 1-16 (see 5.4)
- (2) TTS connections, grey, to rear connectors TTS 1-9 (see 5.4)
- (3) Simulation Control Network, black, to VisionBox and DS Node Controllers
- (4) IDB connection, red, to rear connectors IDB 1 (see 5.4)
- (5) VisionBox power supply
- (6) VisionBox console, grey, rear panel connector CONSOLE (see 5.4)
- (7) VisionBox SD card slot
- (8) VisionBox external triggers, not used



# 5.4. Rear Panel Connectors





- (1) PC LAN Network connection to Laptop
- (2) CONSOLE Console of VisionBox, serial RS-232, for debugging purposes, left unconnected
- (3) SNIFFER

USB Type B, Laptop connection for ProfiTap network sniffer

(4) IDB

10G Network ports for the Image Data Bus, port 1 is connected, port 2 is unused

(5) DMB

100M Network ports for the Data Machine Bus, Powerlink industrial field bus

- (6) Mains Switch Power supply master switch
- (7) POWER Main inlet, IEC-60320 C14
- (8) TTSTTS trigger connectors, Device side [see 5.4.1]



### 5.4.1. Transport Timing Signals (TTS)

The TTS connector complies to [Ref 1.] chapter 5 Transport Timing Signals (TTS).

Pin	Name
1	BP+
6	BP-
3	TC+
8	TC-
9	RESET
14	READY
11	+5V
5	reserved
7	reserved
10	reserved
12	reserved
2	GND
4	GND
13	GND
15	GND

Table 4 : TTS, D-Sub HD 15-pin



# 5.5. Device Node Controller

The Device node controller is housed in a 19" rack unit, occupying 2 height units (2U). One Device node controller incorporates four identical nodes (Node n, Node n+1, Node n+2 and Node n+3), each independent from each other. Four such 19" units are installed in the DS rack, providing 16 device nodes at all.

The Device node controllers are cabled inside the rack and user access to its connectors is usually not required.



Figure 15: Device Node Controller Front Panel

- (1) LAN 1G, Simulation Control
- (2) Serial Console, for debugging purposes
- (3) General purpose digital IO, for debugging purposes
- (4) Powerlink Node ID, bits [3:0]
  - "0" ... Node ID = 1 "1" ... Node ID = 2

...

- "F" ... Node ID = 16
- (5) Configuration Switch
- (6) Powerlink Network
- (7) Powerlink LEDs
- (8) Device side TTS
- (9) TTS Ready (RDY) and Power (PWR) LED
- (10) Trigger, not used
- (11) Sync, not used



# 6. GUI-PC Laptop

Each simulator is delivered with a laptop to interact with the simulation instance itself and to conduct testing procedures. The laptop has Microsoft Windows 10 installed and provides the tools listed in Section 11.4.

The main feature used is the internet browser to access the Test Controller GUI [9.2].

Figure 16 shows a typical DS desktop, with icons for the most relevant tools and programs.



Figure 16: GUI PC Desktop

- (1) PuTTY tools [12.4]
- (2) WinSCP [12.2]
- (3) LibreOffice
- (4) WireShark [12.1]
- (5) Transport Simulator Tool [12.6]
- (6) Flutter Detector Tool [12.11]
- (7) PicoScope [12.5]
- (8) Firefox browser
- (9) Notepad++ text editor
- (10) Edge internet browser
- (11) Shortcut to C:\CDI2
- (12) Shortcut to C:\CDI2-Installation
- (13) Shortcut to C:\Acceptance Tests
- (14) Restart test controller [11.2]

Version 1.10 / 23.01.2025

User-Manual-CDI2SIM-v1r10-tracked.docx



# 6.1. CDI2 Folders

CDI2 specific files are stored in following folders.

C:\CDI2-Installation

This folder contains all installation packages and tool sets for both the Windows PC and the Linux computers. This folder is provided as part of the delivery and shall be treated read-only. Installation of any component will use files/packages from this folder.

#### Recover scripts for Windows

Windows\002\_InstallCDI2-SW.bat

This batch script can be used to recover the CDI2 specific windows installation on the GUI-PC, but keeping windows untouched. It installs the required programs and recreates the *C*:\*CDI2* folder.

#### Windows\003\_InstallCDI2-plugins.bat

This batch script can be used to update the Wireshark CDI2 plugins automatically.

### C:\CDI2

This folder contains the tools for the Windows PC.

01-Logo	Images for desktop background		
05-LibreOffice-Tools	Tools for flutter analyses, image quality analyses and generator for DS		
	testcases		
07-PicoScope	Settings files for the PicoScope USB scope		
08-DNB-Tools	Control tool for the transport simulator and the flutter detector tool		
11-EvalChartTools	Tools for analysing testchart images		

<b> </b>   <b>⊠ ! ?</b> <del>.</del>	CDI2				-	×
File Home	Share View	View				~ 🕜
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Clipt	poard	Organize	New	Open	Select	
← → • ↑ ]	$\rightarrow$ This PC $\rightarrow$ OS (C:) $\rightarrow$	CDI2 >		~ Ū	Search CDI2	P
> 📥 Quick accore	Name	^	Date modified	Туре	Size	
2 A Quick access	📜 01-Logo		7/31/2018 3:49 PM	File folder		
> 🝊 OneDrive	05-OeBS-Te	ools	7/31/2018 3:49 PM	File folder		
> 🧢 This PC	07-PicoSco	pe	7/31/2018 3:49 PM	File folder		
	08-DNB-To	ols	7/31/2018 3:49 PM	File folder		
> 🧅 USB Drive (D:)	11-EvalCha	rtTools	7/31/2018 3:49 PM	File folder		
> 🗳 Network						
5 items						8EE 📧



### 6.2. CDI2 Software and USB Sticks

A set of two USB Sticks is provided for the recovery of the Windows based GUI-PC. The "Recover Stick" is bootable and contains a full disk image, whereas the "Data Stick" contains all files to recover the CDI2 specific installation in folders *C*:\*CDI2-Installation* and *C*:\*CDI2*.

For an update of the simulator software on the Linux computers in the BSMS/DS rack refer to the instructions in chapter 7.2.4.

The "Recover Stick" contains a full disk image and it shall be used in emergency cases only, e.g. if the windows system is broken or when a disk is to be replaced. To recover the disk image, first boot from the "Recover Stick", follow the screen menu to start the Acronis True Image tool. Use F12 at boot to select the USB stick as boot device (UEFI BOOT: UEFI: SanDisk, Partition 1). Select the provided True Image backup file from same stick, select target partitions on disk C: and start the restore process. Please note, that this procedure deletes all files on the GUI-PC. If possible, do not recover all partitions, try to recover only the windows partition first.

The "Data Stick" contains following folders

#### CDI2-Development

contains development data, not needed for normal operation

CDI2-Installation

all files needed to install the CDI2 specific programs on the GUI-PC and on the BSMS/DS racks

CDI2-Manuals

contains user manuals

To recover or restore the CDI2 specific installation follow these steps.

- 1. backup and remove existing folders C:\CDI2-Installation, C:\CDI2-Manuals and C:\CDI2 (if applicable)
- 2. copy folder CDI2-Installation to C:\CDI2-Installation
- 3. copy folder *CDI2-Manuals* to *C:\CDI2-Manuals*
- 4. navigate to C:\CDI2-Installation\Windows
- 5. close open applications, if applicable, e.g. WinSCP, PicoScope
- 6. double-click and *run 002\_InstallCDI2-SW.bat*

Follow the given instructions, use "spacebar" to continue when "Press any key to continue ..." is displayed. See Figure 17, Figure 18 and Figure 19.

The installation of windows programs (e.g. WinSCP, PicoScope, Firefox) opens the tool specific dialogs. Guide the installation of each tool specifically, default settings are sufficient in most cases.

- 7. Check if *C:\CDI2* has been created.
- 8. Reboot computer
- 9. navigate to C:\CDI2-Installation\Windows
- 10. double-click and run 003\_InstallCDI2-plugins.bat
- 11. Follow the given instructions, use "spacebar" to continue when "Press any key to continue ..." is displayed.
- 12. check if tool installation was successful refer to chapters 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.8 and 12.11

CDI2SIM: Error! Use the Home tab to apply Titel to the text that you want to appear here. User Manual









Figure 18: 002\_InstallCDI2-SW.bat (continued 1)



Figure 19: 002\_InstallCDI2-SW.bat completed



# 7. Putting it into Operation

## 7.1. Cable Connections

Connect the Transport Simulator, BSMS and DS as shown in Figure 20 using the supplied cables. The standard cables for DMB, TTS and IDB are 10m in length. Refer to chapters 3.3 and 5.3 for the details on rear panel connectors as well.



Figure 20: Connection diagram

For the DMB and TTS connections a 1:1 scheme is used. This means, that each BSMS connector has a corresponding connector on the DS side. BSMS/DMB[1-16] are connected to DS/DMB[1-16] and BSMS/TTS[1-9] are connected to DS/TTS[1-9].



# 7.2. Startup and Basic Operation

Use this procedure for basic startup from power off:

- 1. Switch on the power supply of TS, BSMS and DS, make sure the Laptops are starting as well. Wait for about 2 minutes boot time.
- 2. BSMS: wait until the browser can connect to the simulator start page (10.111.200.70). Refer to chapter 9.2 for details.
- 3. DS: wait until browser can connect to the simulator start page (10.111.200.71). Refer to chapter 9.2 for details.

Test Transport Simulator Control

- 1. Make sure the TS control on the control panel mounted at the TS is set to "Online"
- Start the transport simulator tool [refer to 12.6], select proper serial port, select desired speed, e.g.
   4.0 m/s, start transport and stop transport. The transport simulator shall follow the issued commands.

For detailed instructions for using the TS refer to [Ref 3.]

### 7.2.1. Running a Test Case

Typically running a test consists of the following steps:

- 1. Select a test set
- 2. (optional) Change parameters
- 3. Activate
- 4. Start
- 5. Monitor Output
- 6. (optional) Stop
- 7. Download Results

Use Abort if test does not respond to Stop.

### 7.2.2. Shutdown

To perform a controlled shutdown, select the test set "<u>BSMS-999 Shutdown</u>" or "<u>DS-999 Shutdown</u>", activate and start it. The status output will be updated for every device that has started the shutdown sequence. The GUI will become unreachable as soon as the Simulation Computer initializes its shutdown sequence. Wait at least two minutes after starting the test set. Then switch the mains switch to the off position.



### 7.2.3. Retrieve Version Information

To retrieve all software versions installed on the various components select, activate and start the test set "<u>BSM-003 Get Version Infos</u>" or "<u>DS-003 Get Version Infos</u>".

At completion of the testcase the status message shows the version string of the detected software, e.g. BSM Version = SW\_CDI2SIM\_V27\_20200129 (Figure 21).

Detailed version information can be downloaded. Open the download archive and open folder *"IDB\_BSM/log"* on the BSMS or *"IDB\_DEV/log"* on the DS.

It contains files "versions-summary.txt" and "versions.log".

#### "versions-summary.txt"

Shows the version information in an easy-to-read compact form (Figure 22).

#### "versions.log"

Contains the raw information of the package managers, with sections for each component with a list of all installed CDI2 related packages. This file is mainly provided for debug purposes.

	BSM Simulator
List of all Testcases:	
BSIVIS_DEV-003 HTTP	and additional services
BSMS_DEV-005 State	Iransitions which Errors
BSMS_DEV-000 Powe	nink Errors vare Update
BSMS_DEV-010 TTS E	rror
BSMS_DEV-014 TTS R	leset
BSMS_DEV-G01_CS In	iternal Trigger
BSMS_DEV-G01_DET	Internal Trigger
BSMS_DEV-G01_IEU I	nternal Trigger
BSMS_IEU-002 IDB Er	ror n Infos
Test Case Descripti Test Case Paramete	on ers
Status overview	1
Node ID Role	CDI2 Status Test Status
Controller	r PASSED BSM version = SW_CDI2SIM_V27_20200129




1 Simulator : BSM Software Tag : 'SW\_CDI2SIM\_V27\_20200129' odule: VisionBox nodecontroller : 1.0-1-gb3409ce : 1.0-14-g424fc7c : 1.1-28-g217084d : 1.0-14-g2811ba1 testcontroller\_bsm cdi2-testcases visionbox\_setup\_bsm idb tools odule: MN cdi2setup : 1.0-3-gecacb4d Modu : 1.2-r0.0 Calsetup : 1.2-r0.0 nodecontroller : 1.0-1-gb3409ce-r0.0 bsm-sim : 1.1-453-g16ea7cbf-r0.0 kernel-module-oplkcnc5armintf-4.14.126-rt62-ltsi-altera : V2.7.0-68-g9f8aaab1-r0.0 kernel-module-oplkmnc5armintf-4.14.126-rt62-ltsi-altera : V2.7.0-68-g9f8aaab1-r0.0 device-sim : 1.1-453-g16ea7cbf-r0.0 : 1.1-453-g16ea7cbf-r0.0 13 14 15 16 17 18 19 20 21 22 : V2.7.0-66-gd2e5f1b8-r0.0 : V2.7.0-64-gc367afcf-r0.2 pcp-load-cn2 pcp-load-cn : V2.7.0-66-gd2e5f1b8-r0.0 : V2.7.0-64-gc367afcf-r0.1 pcp-load-mn2 pcp-load-mn

Figure 22: Compact version information version-summary.txt example

- (1) Component information with software tag string
- (2) Module name
- (3) Package name and version
- (4) Module name



# 7.2.4. Simulator Software Update

The software installation of the simulators consists of a Windows system on the GUI-PC and the actual simulation software of the Linux nodes in the BSMS/DS racks.

This chapter describes to update of the Linux nodes. For an update or recovery of the Windows based GUI-PC refer to chapter 6.2.

The software installations on the Linux nodes use standard package managers *dpkg* and *opkg*. *dpkg* is used on the VisonBox and *opkg* on the node controllers. Thus, a specific software version consists of a set of *.deb* (for *dpkg*) and *.ipk* (for *opkg*) packages. When a software update is supplied, the desired software packages are provided and a detailed description of how to install the packages is included.

For the installed system and for future updates, above packages are packed together with a selfextracting installer into a single installer file. So, the user can run the full installation by issuing a single command (see 7.3 for a detailed installer description).

A software delivery package contains a *CDI2-Installation*\*Linux* folder with all installation files, including a self-extracting installer to update the system with a single command.

Self-extracting installer

.\UpdateScripts\cdi2-installer-<version\_tag>.run

#### Node Controllers

.\EnclustraPackages	contains all software packages (.ipk)
.\EnclustraImage	SD card image for initial installation

#### VisionBox

.\VisionBoxPackages	contains all software packages (.deb)
.\VisionBoxImage	files for initial installation

#### VisionBox x86

.\ x86_64_packages	contains all software packages (.deb)
.\x86_64_Ubuntu_Installation	files for initial Ubuntu installation

Use the following steps to install a specific software release on the BSMS/DS racks. The described procedure can be used to recover the pre-installed version or to install future updates. If desired, the update procedure can be used to switch between older and newer versions and vice-versa as well.

#### **Important Note**

User specific simulator settings (e.g. tc-correction value, chapter 7.8) are kept in the global file */usr/share/cdi2/testcontroller/default-params.json*. The software update process keeps this file and does not overwrite it. Nevertheless, it is recommended to make a backup of this file before running a software update, e.g. download it with WinSCP to the GUI PC.

CDI2SIM: Error! Use the Home tab to apply Titel to the text that you want to appear here.



Execute the self-extracting installer on the BSM/DS VisionBox simulation computer as shown in the following examples.

#### Full installation on VisionBox platform ./cdi2-installer-SW\_CDI2SIM\_V27CB\_20221205\_x86VB.run -- --BSM ./cdi2-installer-SW\_CDI2SIM\_V27CB\_20221205\_x86VB.run -- --DEV On an x86 platform the sudo is needed to provide root privileges to the installer sudo ./cdi2-installer-SW\_CDI2SIM\_V27CB\_20221205\_x86VB.run -- --BSM sudo ./cdi2-installer-SW\_CDI2SIM\_V27CB\_20221205\_x86VB.run -- --DEV

Please see 7.3 for a detailed installer description.

# Software Update Step-by-Step Instructions

In following, step-by-step instructions to update a simulator are given. As an example, the update of a BSMS is described, with the execution of the *cdi2-installer-SW\_CDI2SIM\_V27CB\_20221205\_x86VB.run* update package on the BSMS VisionBox computer (10.111.200.70). The update of a DS is equivalent, except that the update package is executed on the DS VisionBox (10.111.200.71). See chapter 8 for login information details.

### Step 1: Connect to the VisionBox

Use WinSCP (chapter 12.2) to connect to the BSM VisionBox. On the login screen (Figure 23) select the BSM VisionBox site (1) and do a Login (2).



Figure 23: WinSCP login screen



#### Step 2: Upload the installation file

Figure 24 shows the WinSCP screen after successful connection to the VisionBox computer.

Navigate to the local folder (1) and to the remote folder */root*/tmp (2). Upload the respective installer file *cdi2-installer-SW\_CDI2SIM\_V27CB\_20221205\_x86VB.run* (3) to the remote folder (4). Use the right-click command or drag&drop to upload the file.

UndateScripts - VisionBox DS - WinSCP				_					
🖶 🚝 😺 synchronize 📴 🕼 🕼 🕼 Queue 🖌 Iransfer Settings Default 🔹 💋 🕈									
Local Mark Files Commands Session Options Remote Help									
VisionBox DS 🗙 🚅 New Session									
🚘 D: DATAPART1 🔹 🚰 🔹 🛐 🔹 🖛 🔹 💼 🔂		2	- tmp • 🚰 • 🔽 • 🗢 • 🔁 🔁 🔂 Find	Files 👫					
🛿 🕼 Upload 👻 📝 Edit 👻 🗶 🖓 Properties 📑 New	v - 🛛 🛨 🖃		🛿 🚰 Download 👻 📝 Edit 👻 🐋 🖓 Properties 🎽 New 🗸		V				
D:\CDI2\Delivery_SW_CDI2SIM_V27CB_00221205_x86VB\CDI2-I	nstallation\Linux\UpdateSc	ripts\	/root/tmp/						
Name	Size Type	Cha	Name	Size	Changed				
<b>t</b>	Parent direct	ory 12.0	<b>t</b>		12.01.2023 14:11				
cdi2-installer-SW_CDI2SIM_V27CB_20221205_x86VB.run	66.593 KB RUN-Datei	22.1	cdi2-installer-SW_CDI2SIM_V27CB_20221205_x86VB.run	66.593 KB	22.12.2022 16:18				
3			0		,				
0 B of 65.0 MB in 0 of 1		-	0 B of 65.0 MB in 0 of 1		-				
			· · · · · · · · · · · · · · · · · · ·	SFTP-3	0:02:02				

Figure 24: Upload Installer File

#### Step 3: Open console and start the installer script

Open an ssh console on the Visionbox, either use WinSCP (5) or open a standalone PuTTY console.

Watch the new PuTTY window and enter password to complete login. Then use the following shell commands to run the software update.

₽ 10.111.200.71 - PuTTY ₽ login as: root	-	×
a login as: root		
Proot@10.111.200.71's password: Linux dev-sim-visionbox 4.1.8-rt8-00789-gc246e52-dirty #3 SMP PREEMPT Tue Jul 31 05:44:32 UTC 2018 aarch64		^
The programs included with the Debian GNU/Linux system are free software; the exact distribution terms for each program are described in the individual files in /usr/share/doc/*/copyright.		
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent permitted by applicable law. Last loging Wed Dec 21 09:39:08 2022 from 10 111 200 81		
root@dev-sim-visionbox:-/tmpf 1s -lrt total 66600		
-rw-rr- 1 root root 68191194 Dec 22 15:18 cdi2-installer-SW CDI2SIM V27CB_20221205_x86VB.run root@dev-sim-visionbox:-/tmp# chmod a+x cdi2-installer-SW CDI2SIM V27CB_20221205_x86VB.run root@dev-sim-visionbox:-/tmp# ./cdi2-installer-SW CDI2SIM_V27CB_20221205_x86VB.run		
Verifying archive integrity 100% MD5 checksums are OK. All good. Uncompressing CDI2 Tools SW_CDI2SIM_V27CB_20221205_x86VB 100% Unknown or missing options:		
Must specify eitherBSM,DEV orNODE		
SYNOPSIS cdi2-installer.run <installer_options></installer_options>		
DESCRIPTION Unified installer for CDI2 tools. Supports both simulator models, BSMS (BSM Simulator) and DEV (DS Device Simulator). Host platform is detected automatically and can be either VisionBox (arm64) or Intel (x86-64) The self-extractor installs host (.deb packges) and hode(s) (.ikp packages) automatically. It provides options for host-only and node-only installation. Node local is supported too.		
BSM		~

Figure 25: PuTTY shell



List files in directory, make sure that *cdi2-installer-<sw\_tag>.run* is listed

ls -lrt

Make *cdi2-installer-<sw\_tag>.run* executable

chmod a+x cdi2-installer-<sw\_tag>.run

Check the integrity of the archive

./cdi2-installer-<sw tag>.run --check

Run the installation on an BSM

./cdi2-installer-<sw\_tag>.run -- --BSM | tee bsm.run.log

The installer determines the platform and asks for confirmation. Once confirmed, watch the installation progress for successful completion (see Figure 26). The update process will need about 5 minutes. At the end of the installation process a reboot of all nodes is requested. Thus, a "connection closed" alert is asserted by PuTTY. All output text during the install processes is stored in *bsm.run.log* also. Download the file to the GUI-PC (e.g. with WinSCP) and keep it for reference.

After reboot the new software is up and running. Check the installed software versions according 7.2.3 and double-check the global settings in */usr/share/cdi2/testcontroller/default-params.json* (see chapter 7.8)

```
root@bsm-sim-visionbox:~/tmp# ./cdi2-installer-SW_CDI2SIM V27CB 20221205 x86VB.run
-- -- BSM
Verifying archive integrity... 100%
                                      MD5 checksums are OK. All good.
Uncompressing CDI2 Tools SW CDI2SIM V27CB 20221205 x86VB 100%
Platform/architecture=arm64
Hostname=bsm-sim-visionbox
   Static hostname: bsm-sim-visionbox
         Icon name: computer
        Machine ID: f72ca990d2864af5a8dcb7b59e36e8a5
           Boot ID: eeaa9211accb4085ab527c5f2e276c08
 Operating System: Debian GNU/Linux 9 (stretch)
            Kernel: Linux 4.1.8-rt8-00789-gc246e52-dirty
      Architecture: arm64
Do you wish to start installation [y/N]? y
Checking install files .....
Starting package installation .....
DEB installation .....
. . .
```

Figure 26: Installation progress



# 7.3. Unified Self-Extracting Installer

The install script is a self-extracting file made with the *makeself* tool (see <u>https://makeself.io</u>). It contains all required .ipk and .deb packages and an installation script. It extracts the packages to a temporary folder and runs the installation script with the proper package manager commands to complete the installation automatically.

### 7.3.1. Makeself Options

*makeself* options are useful for checking the integrity of the archive or extract individual package files for debugging purposes.

Examples:

./cdi2-installer-<sw\_tag>.run --check
Checks the integrity of the archive.

./cdi2-installer-<sw\_tag>.run --info
Provide version infos.

./cdi2-installer-<sw\_tag>.run --target ./packages --noexec Extracts the archive into to a target directory, e.g. ./packages, but does install anything. The option is used to extract the contained .ipk and .deb packages into single files.

./cdi2-installer-<sw\_tag>.run --help
Print the makeself help message.

# 7.3.2. Installer Options

The unified installer is suited for BSMS and DS. The installer is to be started on a BSMS/DS VisionBox computer. It supports two platforms, VisionBox (arm64) and x86 PC with Ubuntu. It installs the local packages first and continues to update the DMB nodes (mn, cn00, cn01, ...) remotely. Commandline options can be used to parametrize the installation process, e.g. exclude DMB node controllers from installation or prevent reboot.

If executed on a DMB node controller, the installer can be directed to install just .ipk packages (see 0).

Please note that installer options are preceded by an extra '--'.

Running the installer without options will print a help text.

```
cdi2@bsm-sim-visionbox:~$ ./cdi2-installer-SW_CDI2SIM_V27CB_20221205_x86VB.run
Verifying archive integrity... 100% MD5 checksums are OK. All good.
Uncompressing CDI2 Tools SW_CDI2SIM_V27CB_20221205_x86VB 100%
Unknown or missing options:
Must specify either --BSM, --DEV or --NODE
SYNOPSIS
cdi2-installer.run -- <installer_options>
DESCRIPTION
42/169 Version 1.10/23.01.2025 User-Manua
```

CDI2SIM: Error! Use the Home tab to apply Titel to the text that you want to appear here.



```
Unified installer for CDI2 tools.
       Supports both simulator models, BSMS (BSM Simulator) and DEV (DS Device Simulator).
       Host platform is detected automatically and can be either VisionBox (arm64) or Intel (x86-
64)
       The self-extractor installs host (.deb packges) and node(s) (.ipk packages) automatically.
       It provides options for host-only and node-only installation. Node local is supported too.
       <installer_options> are:
         --BSM
              Install BSM Simulator (!!! select platform carefully !!!!)
         --DEV
             Install Device Simulator (!!! select platform carefully !!!!)
         --host-only
              Install host packages only (.deb)
         --node-only
              Install node(s) packages only (.ipk)
         --NODE
              Install on node locally (.ipk), installer shall be started on a node (e.g. cn00)
         --no-reboot
              Do not reboot host after .deb installations
         --help
              show this help
MAKESELE
      The installer is built with the makeself tool. Use makeself options for more specific
functions.
      Examples:
          obtain makeself help
             cdi2-installer.run --help
          list version info
            cdi2-installer.run --info
          extract packaged files into a folder, without installing
             cdi2-installer.run --noexec --target cdi2-packages
EXAMPLES
       ./cdi2-installer.run -- --BSM
       ./cdi2-installer.run -- --DEV
       ./cdi2-installer.run -- --DEV --host-only --no-reboot
       ./cdi2-installer.run -- --DEV --node-only
       ./cdi2-installer.run -- --NODE
```

The default setting performs a full installation. Options --host-only and --node-only can be used for selective installation on either host (VisionBox) or nodes (DMB node controller). Use --no-reboot to prevent host rebooting at the end of the installation.

For debugging and testing purposes you can unpack installer using following options:

./cdi2-installer-SW\_CDI2SIM\_V27CB\_20221205\_x86VB.run --noexec --target cdi2-packages

This command unpacks the content into target folder *cdi2-packages*. Refer to *cdi2-packages* /*extract\_unified.sh*, which is the actual installation script. Use it to see examples for specific installation commands.

# 7.3.3. Stand-Alone DMB Node Controller Installation

The unified installer can be instructed to perform a local install on a DMB node controller, instead running it on the BSMS/DS VisionBox computer. This allows software installation on stand-alone node controllers, including Enclustra EB1 boards (see 0), without the need for a BSMS/DS VisionBox computer.

Use the ftp tool to copy the installer to the node and run the installer with the --NODE option. It will install the .ipk packages locally and reboot. Please note that the update will need about 5 minutes usually.



If installed on an Enclustra EB1, the Node ID must be configured manually, as the EB board is missing the rotary switch hardware. Create a new file named NODE\_ID with the desired number in the home directory.

e.g. set Node ID = 2 (Node 3)

```
cd
echo "2" > NODE ID
```

#### 7.3.4. Setup Stand-Alone Mode

A DMB node controller can be configured to run in stand-alone mode, e.g. if operated as a stand- alone detector, without a simulator attached to it. In this case the node can be configured for automatic device-sim startup, using a systemd service.

Setup a systemd service named *device-sim* to run *device-simulator.sh*:

Create file /lib/systemd/system/device-sim.service

```
# - - - - -
                                               _____
#
#
 device-sim.service
#
# Systemd service unit configuration for the CDI2SIM device simulator
#
# (c)2018 AIT
# -
          _____
[Unit]
Description=CDI2 Device Simulator
After=network.target
[Service]
Type=simple
User=root
WorkingDirectory=/home/root/
ExecStart=/home/root/device-simulator.sh
ExecStop=/usr/bin/pkill -9 device-sim
Restart=on-failure
[Install]
WantedBy=multi-user.target
Create an autostart script for the device simulator, device-simulator.sh
#!/bin/bash
die() { echo "$@" 1>&2 ; exit 1; }
if [ -z "$1" ]; then
       source /etc/cdi2/system.conf || die "failed to open cdi2 configuration"
       NODEID=$CDI2 NODEID
else
       NODEID=$1
fi
NODEID=$((NODEID + 1))
TCDIR=/home/root/cdi2-testcases/DS_BSM-G01
cd $TCDIR
INFO=(cat META.json | grep device infos | sed 's/"\(.*\)",/\1/')
SCRIPT=$(cat META.json | grep script | sed 's/.*: "\(.*\)",/\1/')
MAC=(cat META.json | grep 00:60 | sed 's/"\(.*\)",/\1/')
```

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#### TTS\_SUPPORT=0

```
device-sim -v9 --node-id $NODEID \
    --rt-cpu-affinity 1 \
    --result-dir /var/tmp \
    --log-dir /var/tmp \
    --config config_device.xml \
    --device-info $INFO \
    --test-file $SCRIPT \
    --mac-address $MAC \
    -t$TTS SUPPORT
```

#### Set file executable

chmod a+x device-simulator.sh

Above device-simulator.sh runs a testcase in a certain folder (see variable TCDIR).

Create the desired testcase in */home/root/cdi2-testcases/DS\_BSM-G01*. The folder shall be formatted the same way as created by the testcontroller in folder */var/tmp*, when a testcase is activated. Easiest way, run the desired testcase from the GUI on another simulator and copy */var/tmp/DS\_BSM-G01*.

root@cn00:~# ls /var/tmp/DS\_BSM-G01 config\_device.xml device\_sorting\_test.lua META.json ui\_parameters.lua device\_infos log RESULTS.json

Alternately, adapt device-simulator.sh to your specific needs.

Finally, start/reload/enable the services and reboot.

systemctl daemon-reload systemctl start device-sim systemctl status device-sim

# enable your service (if not enabled already)

systemctl enable device-sim

#### # node reboot

root@cn00:~# reboot

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# 7.3.5. Common Installation Issues

#### Issue (A) - device-sim fails to start

If *device-sim* fails to start on a DMB node controller, this can be caused by a missing kernel module *oplkcnc5armintf*. Use lsmod to check if *oplkcnc5armintf* present.

root@cn00:/var/tmp#	lsmod		
Module	Size	Used	by
oplkcnc5armintf	46788	0	
atsha204_i2c	7394	0	
root@cn00:/var/tmp#			

If not present, most commonly the *cdi2setup* service failed. Use following command the check and reenable cdi2setup.

root@cn00:/var/tmp# systemctl status cdi2setup

cdi2setup.service - CDI2 Simulator System Configuration
 Loaded: loaded (/lib/systemd/system/cdi2setup.service; enabled; vendor preset: enabled)
 Active: active (exited) since Mon 2022-05-16 07:33:44 UTC; 1 weeks 0 days ago
 Process: 1270 ExecStart=/usr/sbin/cdi2setup.sh (code=exited, status=0/SUCCESS)
 Main PID: 1270 (code=exited, status=0/SUCCESS)
 CGroup: /system.slice/cdi2setup.service

#### Enable cdi2setup service, if not enabled

root@cn00:/var/tmp# systemctl enable cdi2setup

#### Reboot node

root@cn00:/var/tmp# reboot

#### Issue (B) - update to earlier version fails

Switching back to an early version (e.g. SW\_CDI2SIM\_V27\_20200129) can fail, due to a file system is mounted read-only. This is caused by a later introduced feature to check the file system at boot time.

In such a case the system will not operate correctly, nor it can be updated to a newer version.

The situation can be fixed by remounting the file system correctly.

Use script fix-ro-mount.sh (provided in folder

*Delivery\_SW\_CDI2SIM\_V27CB\_20221205\_x86VB\CDI2-Installation\Linux\UpdateScripts*) or create with following content,

#### #!/bin/sh

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echo "fix ro mount issue after re-installation of SW\_CDI2SIM\_V27\_20200129."

```
mount -o remount,rw tmpfs /sys/fs/cgroup
mount -o remount,rw /dev/sdal /
systemctl restart testcontroller
systemctl restart nodecontroller
cat <<EOX > /etc/fstab
/dev/sda1 / auto defaults 1 1
proc /proc proc defaults 0 0
EOX
```

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cat /etc/fstab

#### Run script

chmod a+x fix-ro-mount.sh
./fix-ro-mount.sh

#### Reboot node

reboot

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# 7.4. Intel x86 VisionBox Hardware Replacement

Starting with software version **SW\_CDI2SIM\_V27CB\_20221205\_x86VB**, the BSM/DEV simulation computer "VisonBox LE MANS" may be substituted by an "Intel x86 PC" platform.

The installation on the new platform is fully compatible (e.g. unified installer, use same IP addresses), thus allowing a 1:1 hardware replacement. Please note, that only one platform, either "VisionBox LE MAN" or "Intel x86 PC" may be active, at the same time.

The Intel x86 PC shall be the preferred hardware for future developments due to following features:

- Use of commercially available standard computer
- Use of commercially available 10G network cards
- Use standard Linux Ubuntu software OS
- IDB sender/receiver performance up the maximum line rate of 10 Gbps
- DDR main memory > 4GB (e.g. use 64GB to store more banknote images)

An upgrade of existing simulator hardware to Intel x86 PC is recommend, if IDB date rate > 6Gbps shall be utilized.

The software setup consists of two steps

- 1. first install and setup Ubuntu
- 2. install CDI2 software

# 7.4.1. Linux Ubuntu Installation

Install Ubuntu 22.04.1 LTS from a bootable USB stick as described in the <u>tutorial</u>. Reference copies of the *ISO installation media* and *balenaEtcher* program used to create a bootable USB stick have been preserved in folder x86\_64\_Ubuntu\_Installation.

It is recommended to select UTC as neutral timezone during installation. Ubuntu discourages direct root access, thus a user cdi2 (with password cdi2) must be created to allow administrative access to the machine.

After the base system has been installed, prepare the cdi2 user for remote SSH access by creating a RSA key pair in ~/.ssh:

```
$ ssh-keygen
```

If your site policy allows internet access during installation, install additional SW needed for administration and CDI2 requirements:

```
$ cd x86_64_Ubuntu_Installation
$ sudo ./offlineinstall.sh --install-online
```

For offline installation, reference copies of these debian packages and their dependencies have been stored in folder x86\_64\_Ubuntu\_Installation/packages.

```
$ cd x86 64 Ubuntu Installation
```

```
$ sudo ./offlineinstall.sh --install
```

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# 7.4.2. CDI2 Installation

for common CDI2 software setup follow instructions in chapter 7.2.4

Please note, in Ubuntu the sudo command is needed to provide root privileges to the installer

Example:

```
sudo ./cdi2-installer-SW_CDI2SIM_V27CB_20221205_x86VB.run -- --BSM
sudo ./cdi2-installer-SW_CDI2SIM_V27CB_20221205_x86VB.run -- --DEV
```

# 7.4.3. Qualified Hardware

Software tools generally support Intel x86\_64 PC platforms running Ubuntu OS. The tools have been installed and tested on following platforms:

- Option (1) DELL Precision 3930
- Option (2) Kontron KISS 1U Short V3 CFL (recommend)

# Network Adapters for 10Gbps IDB

Network adapters for 10GbE can be either use SFP+ or 10GbE BASE-T RJ-45. For compatibility reasons, the BSMS can be equipped with SFP+ and the DS with 10GbE BASE-T adapters.

As CDI2 specifies 10GbE BASE-T for IDB, both computers may use 10GbE BASE-T network cards as well. In this case the BSMS will use a RJ-45 port on the 10G network switch instead SPF+.

### **General Hardware Requirements**

- Intel i7-9700E (8 Core / 2.6GHz) or better
- PCIe 3.0 (8GT/s)
- Intel X550 or X710 LAN Card 10GbE BASE-T

### Hardware Recommendation

- Use Kontron KISS 1U Short V3 CFL
- Use 10GbE BASE-T network cards for both BSMS and DS, so that both use the same hardware configuration.

# Option (1)

DELL Precision 3930 Rack XCTO Base

- Intel Core i7-9700,(8 Core, 12MB Cache, 3.0Ghz, 4.8 Ghz Turbo w/UHD Graphics 630)
- 64 GB, 2 x 32 GB, DDR4-UDIMM-Arbeitsspeicher no ECC
- SATA-SSD-Festplatte (Klasse 20), 2,5", 512 GB
- Dell Intel X710-T2L Dual Port 10GbE BASE-T Adapter, PCIe Full Height
   <u>https://www.dell.com/en-us/shop/dell-intel-x710-t2l-dual-port-10gbe-base-t-adapter-pcie-full-height-customer-install/apd/540-bcsc/networking</u>



#### Important:

Unfortunately, the mechanical dimensions of the DELL Precision 3930 (max. depth) exceed the size of the simulator racks. Regular mounting is not possible w/o keeping the back door open. From the mechanical perspective, the Kontron KISS 1U Short V3 CFL is the preferred option.

# Option (2)

Kontron KISS 1U Short V3 CFL

https://www.kontron.com/en/products/kiss-1u-short-v3-cfl/p155747

- 1HE Rackmount PC, Front silver
- Intel i7-9700E (8 Core / 2.6GHz) with Cooler
- 64GB DIMM DDR4
- 1x SSD 1TB
- 1TB SSD M.2 2280
- Intel X550 LAN Card 10GbE BASE-T (2x 10 GBits/sec.)



Figure 27: Kontron KISS Configuration



# 7.4.4. VisonBox LE MANS substitution

A simulator, BSMS or DS, can be easily upgraded to an x86 platform. The VisionBox LE MAN can be directly substited by an x86 system, e.g. Kontron KISS. As network interfaces use the same IP settings, just connect the network cables according Figure 28.



Figure 28: Kontron KISS Network Connections

- (1) Simulation Network (10.111.200.xxx)
- (2) IDB Network 10G



# 7.5. CDI Version 2.7C/2.7B Compatibility

The latest CDI2 Version 2.7C [Ref 1.] introduced additional XML attributes, making it incompatible to the previous CDI2 Version 2.7B [Ref 2.] in this respect.

New attributes in *device\_info.xml*, *device\_config.xml* and *<storage\_file>.xml* are swUpdateTimeout, gvspPixelFormat and gvspPayloadSize.

The simulator supports Version 2.7C by default but provides an option to support CDI2 Version 2.7B compatibility.

#### How to instruct the simulator to run in 2.7B compatibility mode

Command line parameter for 2.7B compatibility

#### bsm-sim / device-sim

--cdi-version-switchover 2.7

Instructs the simulator to run in 2.7B compatibility mode. The simulator will ignore XML attributes swUpdateTimeout, gvspPixelFormat and gvspPayloadSize when reading XML content and will not generate them when writing XML content. Affected files are *device\_info.xml, device\_config.xml* and *<storage\_file>.xml*.

#### Manual edit of default-params.json file

The 2.7B compatibility mode of the simulators is activated by means of command line parameters. As the default parameters are stored in the *default-params.json* file, this file can be modified to activate the 2.7B compatibility mode.

The following string pair must be added to each instance in *default-params.json* to supply the proper command line option to the simulator modules (bsm-sim and device-sim).

"--cdi-version-switchover", "2.7"

Navigate to this folder on the BSMS/DS VisionBox with WinSCP (chapter 12.2) or any favourite tool.

/usr/share/cdi2/testcontroller

Make a backup copy of the *default-params.json* and replace it by the *default-params-27b.json* file or edit file accordingly.

After changing the *default-params.json* the Test Controller needs to be restarted, as described in 11.2.



# Example of standard *default-params.json* (2.7C mode):

{					
	"BSM SIM" :		I	"rt-cpu-affinity",	"1", "tc-correction", "0"],
	"DMB_DEVICE_01"	:	I	"rt-cpu-affinity",	"1" ],
	"DMB_DEVICE_02"	:	I	"rt-cpu-affinity",	"1" ],
	"DMB_DEVICE_03"	:	I	"rt-cpu-affinity",	"1" ],
	"DMB_DEVICE_04"	:	I	"rt-cpu-affinity",	"1" ],
	"DMB DEVICE 05"	:	I	"rt-cpu-affinity",	"1" ],
	"DMB DEVICE 06"	:	I	"rt-cpu-affinity",	"1" ],
	"DMB_DEVICE_07"	:	I	"rt-cpu-affinity",	"1" ],
	"DMB_DEVICE_08"	:	I	"rt-cpu-affinity",	"1" ],
	"DMB_DEVICE_09"	:	I	"rt-cpu-affinity",	"1" ],
	"DMB_DEVICE_10"	:	I	"rt-cpu-affinity",	"1" ],
	"DMB DEVICE 11"	:	I	"rt-cpu-affinity",	"1" ],
	"DMB DEVICE 12"	:	I	"rt-cpu-affinity",	"1" ],
	"DMB_DEVICE_13"	:	I	"rt-cpu-affinity",	"1" ],
	"DMB_DEVICE_14"	:	I	"rt-cpu-affinity",	"1" ],
	"DMB_DEVICE_15"	:	I	"rt-cpu-affinity",	"1" ],
	"DMB_DEVICE_16"	:	I	"rt-cpu-affinity",	"1" ]
}					

#### Example of *default-params.json* for 2.7B mode:

	"BSM SIM" :	E	"rt-cpu-affinity",	"1",	"tc-correction", "0", "d	di-ve	rsion-switchover",
"	2.7" 1,						
	"DMB_DEVICE_01" :	I	"rt-cpu-affinity",	"1",	"cdi-version-switchover",	"2.7"	1,
	"DMB_DEVICE_02" :	E	"rt-cpu-affinity",	"1",	"cdi-version-switchover",	"2.7"	1,
	"DMB_DEVICE_03" :	E	"rt-cpu-affinity",	"1",	"cdi-version-switchover",	"2.7"	1,
	"DMB DEVICE 04" :	E	"rt-cpu-affinity",	"1",	"cdi-version-switchover",	"2.7"	1,
	"DMB_DEVICE_05" :	I	"rt-cpu-affinity",	"1",	"cdi-version-switchover",	"2.7"	1,
	"DMB_DEVICE_06" :	E	"rt-cpu-affinity",	"1",	"cdi-version-switchover",	"2.7"	1,
	"DMB_DEVICE_07" :	E	"rt-cpu-affinity",	"1",	"cdi-version-switchover",	"2.7"	1,
	"DMB_DEVICE_08" :	E	"rt-cpu-affinity",	"1",	"cdi-version-switchover",	"2.7"	1,
	"DMB_DEVICE_09" :	E	"rt-cpu-affinity",	"1",	"cdi-version-switchover",	"2.7"	1,
	"DMB_DEVICE_10" :	E	"rt-cpu-affinity",	"1",	"cdi-version-switchover",	"2.7"	1,
	"DMB_DEVICE_11" :	I	"rt-cpu-affinity",	"1",	"cdi-version-switchover",	"2.7"	1,
	"DMB_DEVICE_12" :	E	"rt-cpu-affinity",	"1",	"cdi-version-switchover",	"2.7"	1,
	"DMB_DEVICE_13" :	E	"rt-cpu-affinity",	"1",	"cdi-version-switchover",	"2.7"	1,
	"DMB_DEVICE_14" :	E	"rt-cpu-affinity",	"1",	"cdi-version-switchover",	"2.7"	1,
	"DMB_DEVICE_15" :	E	"rt-cpu-affinity",	"1",	"cdi-version-switchover",	"2.7"	1,
	"DMB_DEVICE_16" :	I	"rt-cpu-affinity",	"1",	"cdi-version-switchover",	"2.7"	1

}



# 7.6. Simulated Sorting Test

Use this procedure on BSMS and DS to simulate sorting of 1,000 banknotes, using the internal trigger source.

- BSMS: Select test set "<u>BSMS\_BSM-G01 Sorting</u>", set Test Case Parameters "Trigger Source" to Internal, "Manual Mode" to False and "Number of Banknotes" to 1,000, activate and start the test set
- 2. DS: Select, activate and start test set "DS\_BSM-G01 Sorting"
- BSMS: Wait until sorting of 1,000 banknotes has been completed Check: After the test, the BSMS shows test result "PASSED" Check: After the test, the DS shows test result "PASSED"

# 7.7. Actual Sorting Test with Transport Simulator

Use this procedure on BSMS and DS to perform sorting of 100 banknotes, using the transport simulator as external trigger source.

- 1. Insert a blank sheet into the transport of the TS
- 2. BSMS: Select test set "<u>BSMS\_BSM-G01 Sorting</u>", set Test Case Parameters "Trigger Source" to *External*, "Manual Mode" to *True* and "Number of Banknotes" to 100, activate and start the test set
- 3. DS: Select, activate and start test set "DS\_BSM-G01 Sorting"
- 4. BSMS: Use TS control tool [refer 12.6] to set speed to 3.0 m/s and start transport. Wait until TS has reached nominal speed
- BSMS: Press "Continue" to start sorting and wait until sorting of 100 banknotes has been completed. Use TS control tool [refer 12.6] to stop transport.
   Check: After the test, the BSMS shows test result "PASSED".

Check: After the test, the BSMS shows test result "PASSED"

# 7.8. Speed Compensation of the Transport Simulator

The transport simulator clock output may deviate from the actual speed of the banknote due to slippage. The BSMS incorporates a digital PLL (phase locked loop) circuit to compensate this speed deviation. The default setting of the BSMS is 1:1, which means the clock of the transport simulator is taken as source for the CDI2 transport clock without speed change.

The BSMS offers an option to store a speed compensation factor globally, so that it is applied to any test automatically. Setting of the factor is usually required only once, but the factor is specific for any TS and might vary in time also.

To apply speed compensation, in the first step use the instructions in Acceptance Test Procedure "BSMS - TS transport speed and TC accuracy (BSMS-005)" to find the desired correction factor.



Once the correction factor is known, the BSMS is configured to use this factor permanently for all tests. To change the factor, perform the following steps:

- 1. Connect to the BSMS VisionBox using WinSCP [see 12.2]
- 2. Navigate to the folder /usr/share/cdi2/testcontroller/
- 3. Right click on the file *default-params.json*
- 4. Click Edit
- 5. In the opened file change the value after *-tc-correction* to the desired correction.
  E. g. to slow down the TC output of the BSMS by 4.2% the line should look as follows:

```
"BSM_SIM": ["--rt-cpu-affinity", "1", "--tc-correction", "-4.2"]
```

The correction value is limited to the range of -10% to +10%.

6. Restart test controller to make above settings active [see 11.2]



# 8. IP Addresses and Login Information

To access the components of the simulator system it might be needed to login on a component. This section provides details on the credentials and connection options to achieve this.

# 8.1. Login Credentials

Device	Username	Password
GUI PC	CDI2	cdi2
VisionBox	root	vision
VisionBox x86 Ubuntu	cdi2	cdi2
Node Controller	root	<no password=""> (empty password string)</no>
NETGEAR ProSAFE GS724T (1G)	<no username=""></no>	password
NETGEAR ProSAFE XS712T (10G)	<no username=""></no>	password



# 8.2. IP Address Plan

Name	IP	BSMS	DS	Port/Service
Device Node Controller 1	10.111.200.50		$\boxtimes$	22:ssh, 80:http, 3000:http
Device Node Controller 2	10.111.200.51		$\boxtimes$	22:ssh, 80:http, 3000:http
Device Node Controller 3	10.111.200.52		$\boxtimes$	22:ssh, 80:http, 3000:http
Device Node Controller 4	10.111.200.53		$\boxtimes$	22:ssh, 80:http, 3000:http
Device Node Controller 5	10.111.200.54		$\boxtimes$	22:ssh, 80:http, 3000:http
Device Node Controller 6	10.111.200.55		$\boxtimes$	22:ssh, 80:http, 3000:http
Device Node Controller 7	10.111.200.56		$\boxtimes$	22:ssh, 80:http, 3000:http
Device Node Controller 8	10.111.200.57		$\boxtimes$	22:ssh, 80:http, 3000:http
Device Node Controller 9	10.111.200.58		$\boxtimes$	22:ssh, 80:http, 3000:http
Device Node Controller 10	10.111.200.59		$\boxtimes$	22:ssh, 80:http, 3000:http
Device Node Controller 11	10.111.200.60		$\boxtimes$	22:ssh, 80:http, 3000:http
Device Node Controller 12	10.111.200.61		$\boxtimes$	22:ssh, 80:http, 3000:http
Device Node Controller 13	10.111.200.62		$\boxtimes$	22:ssh, 80:http, 3000:http
Device Node Controller 14	10.111.200.63		$\boxtimes$	22:ssh, 80:http, 3000:http
Device Node Controller 15	10.111.200.64		$\boxtimes$	22:ssh, 80:http, 3000:http
Device Node Controller 16	10.111.200.65		$\boxtimes$	22:ssh, 80:http, 3000:http
BSM Node Controller	10.111.200.66	$\boxtimes$		22:ssh, 80:http, 3000:http
VisionBox BSMS	10.111.200.70	$\boxtimes$		22:ssh, 80:http, 3000:http
VisionBox DS	10.111.200.71		$\boxtimes$	22:ssh, 80:http, 3000:http
BSMS Laptop	10.111.200.200	$\boxtimes$		
DS Laptop	10.111.200.201		$\boxtimes$	



# 9. Simulator Software

The simulation software is built from a set of components which are described in this section.

# 9.1. Software Component Overview

The simulation software can be split up into three layers. [1] A web browser which provides the user interface, [2] a Test Controller which controls multiple components and [3] a set of Node Controllers of which each controls a single component (e.g. a DMB node or an IDB sender). These components perform the stimulation and check the system under test. The figure below illustrates a general setup with the connections between these parts.



Figure 29: General software architecture for BSMS and DS



#### **Test Controller**

The Test Controller provides the user interface on one side and controls a set of Node Controllers on the other. It has access to a collection of test sets. There is one Test Controller instance per simulator (BSMS and DS). The Test Controller runs on the Simulation Computer (VisionBox) and can be accessed via HTTP on port 80.

#### **Node Controller**

Each Node Controller is responsible for running one program for the simulation (e.g. bsm-sim). It unpacks needed files sent by the Test Controller, starts and monitors given programs and packages all results after a test run is finished. The Node Controller is controlled via a REST-API over HTTP on port 3000. For DMB and TTS simulation a Node Controller instance runs on every node. For IDB simulation a Node Controller instance runs on the Simulation Computer (VisionBox).

#### DMB/TTS Simulators (bsm-sim, device-sim)

This component allows the simulation of a single CDI2 BSM or a single CDI2 Device. It can be controlled via Lua scripts which are stored in the Test Set repository and provided via the Test - and Node Controller. These simulators run on the custom Node Controller Hardware.

#### IDB Sender/Receiver (idbfsender, idbfreceiver)

These components allow the simulation of IDB functionalities. The idbfsender sends images from stored image files to the IDB. It offers the possibility to insert controlled errors on the IDB to test the response of a BSM and Devices. The idbfreceiver receives and checks image streams from the IDB and stores the last 1,000 banknotes received to disk. The IDB tools are executed on the Simulation Computer (VisionBox) and are started by the Node Controller.

#### **SSH Server**

For service and maintenance all devices are accessible via SSH on port 22. To access all the Node Controller boards in a DS, the VisionBox offers a terminal multiplexer which can be started on the command line using the command "tmuxinator cdi2-dev".



the text that you want to appear here.

# 9.2. Graphical User Interface (GUI)

The CDI2 Simulator uses a web based GUI. Any state of the art web browser can be used, but the Edge Browser on Windows 10 is recommended.

The browser runs on the BSMS and DS GUI Laptop and it connects to the web server of the respective VisionBox, which provides proper content to get interactive access to the simulation.

BSMS URL = <u>http://10.111.200.70</u>

#### DS URL = <u>http://10.111.200.71</u>

The start page of the browser is set properly for BSMS and DS on the accompanying laptops, so that the connection to the simulator user interface is established automatically at start-up.

🖶 🖅 🌾 BSM Simulator X + V		-		×
$\leftarrow \rightarrow$ $\bigcirc$ $\bigtriangleup$ $\bigcirc$ 10.111.200.70/ $\square$	5≡	h	Ŀ	
BSM Simulator				
List of all Testcases:				
BSMS, BSM 20 State Transitions BSMS, BSM 20 Serverike Trons BSMS, BSM 20 Serverike Trons BSMS, BSM 20 Serverike Trons BSMS, BSM 20 Servering to Statem BSMS, BSM 20 Servering to Statem BSMS, BSM 20 Servering to Statem BSMS, DEPT 00 Servering to		~		
Status overview				
Response				
Version Information				

#### Figure 30: BSMS start page

🖻 🖷 🌾 Device Simulator	× + ~		B			-		×
$\leftarrow$ $\rightarrow$ O $rac{1}{2}$	0 10.111.200.71/			□ ☆	st≡	L	Ŕ	
	I	Device Simu	lator					
List of all Testcase 105,588/40217 05,588/40217 05,588/4022 Po 05,588/4028 Po 05,588/4020 Po 05,	e Tr'arar adolotrar services de Transitions werkink Erons Meare Update Sont States riting to Stackers dire Tel de Stackers Tip do Stackers TP and additional services					~		
Activate Star Test Case Der Test Case Par	t Continue Stop Abort Dor scription	wnload Results						
Status overview	,							
Version Infor	mation							

Figure 31: DS start page



# 9.2.1. Panels

The user interface provides a list of different panels.



Figure 32: Panels

(1) Header

Indicates to which instance this interface belongs to (either "BSM Simulator" or "Device Simulator"). The animation of the logo indicates a successful update of the test status while a test case is running.

(2) List of Testcases

Lists all available test cases. Test cases can be selected by clicking the test case name.

(3) Buttons

[see 9.2.3]

(4) Test Case Description

The steps that are performed by the test case are described in this panel. It can be shown or hidden by clicking on "Test Case Descriptions".

(5) Test Case Parameters

The parameters offer a way to control the execution of the test case. Parameters must be entered before the test case is activated. Hovering over the name of a parameter will show a short description of the parameter. For detailed descriptions of the parameters refer to the test case description. The panel can be shown or hidden by clicking on "Test Case Parameters" [see 9.2.5]

(6) Status Overview

This panel provides an overview of all the running components in the test case [see 9.2.6].



#### (7) Response

This panel provides detailed responses from the simulation devices. The data is formatted as JSON and parts of it can be collapsed by clicking "-" or expanded by clicking "+". While a test case is running, the data is refreshed every second which resets the view of this data. To select and analyse this field, it is recommended to let the simulation finish or to stop it first.

The panel can be shown or hidden by clicking on "Response".

### 9.2.2. Test Case Description

BSM Simulator
List of all Testcases:
BSMS_BSM-014 Softing Or test citats BSMS_BSM-020 HTTP and additional services BSMS_BSM-020 HTTP and additional services BSMS_BSM-021 State Transitions BSMS_BSM-023 Software Updates BSMS_BSM-024 Non-TTS Operation BSMS_BSM-024 Non-TTS Operation BSMS_BSM-031 Sorting to Stackers BSMS_BSM-031 Sorting to Stackers BSMS_BSM-030 IDB Error BSMS_BSM-031 Sorting to Stackers BSMS_BSM-030 IDB Error
Activate Start Continue Stop Abort Download Results
Test Case Description
BSMS_BSM-G01 Sorting This test case provides the BSM configuration for a SS-BSM Standard Setup with 16 devices and sorts 1000 bank notes. It is set up to broadcast the Powerlink NetTime and RelativeTime in each SoC frame, and it fulfills all TTS requirements.
Functionality
Initially the test brings all devices to the FEED_OFF state. After all devices reached the FEED_OFF state it goes to the SORTING state, via the READY_TO_SORT state, and sorts 1000 bank notes. Then it shuts itself and the devices down and checks if it has received all of the 1000 BNRESULTs for all of the bank notes from all devices.
Triggering
This test case supports two trigger sources, which can be selected with a test case parameter:
<ol> <li>Internal: Generates internal bank note trigger at a rate of 50 bank notes per second, as well as an internal transport clock with a resolution of 0.1 mm.</li> <li>External; Configures the PLL and the interrupts to work with an external transport clock and trigger signal. The external clock is expected to have a resolution of 0.1 mm.</li> </ol>
IDB Receiver
This test case contains an IDB receiver module, which stores all images received on the IDB and checks the IDB network quality. This module generates a message that indicates the number of images it has received as well as the number of errors they contained.

Figure 33: Test case description

When selecting a testcase (1), a description of the test set is shown (2). The "Activate" button (3) is enabled with which the test sets can be loaded to the simulator nodes on activation.



# 9.2.3. Buttons

BSMS_BSM-G01 Sorting										
BSMS CS-007 Sorting to Stackers										
BSMS DET-003 Sorting to Stackers										
BSMS DEV-003 HTTP and additional services										
BSMS_DEV-005_State Transitions										
BSMS_DEV-006 Powerlink Errors										
Antimates Church Constitutes Church Albert Download Devultes										
Activate Start Continue Stop Abort Download Results										
Test Case Description										
Test Case Description										
Test Case Description										



# • Activate

Clicking this button transfers all necessary files, scripts and the test case parameters to the nodes being part of the test case. When finished, the Start button becomes available.

• Start

Clicking this button starts the test cases on the nodes and enables the monitoring in the Status Overview and Response panels.

Continue

If one of the nodes is in the waiting state, this button becomes active. The reaction to pressing this button is dependent on the executed test case. Usually information on the needed interaction is presented in the Instructions panel.

• Stop

This button causes a graceful shutdown of all the test components. Afterwards, logs and status reports will be available.

# • Abort

This button causes all components to immediately abort the operation. No logs or reports will be saved.

# Download Results

After the test case is finished, either because the test case finished or the Stop button was pressed, clicking this button will download an archive containing all logs, status reports and images recorded by the test case. The filename of the downloaded file consists of the test case name and the current date and time. See 9.2.8 for further details.

# 9.2.4. Instructions

If a test case needs user interaction it will display instructions in this blue panel. The content is dependent on the test case.

# 9.2.5. Test Case Parameters

The parameters offer a way to control the execution of the test case. Parameters must be entered before the test case is activated. Hovering over the name of a parameter will show a short description of the parameter.



#### the text that you want to appear here.

Test Case Parameters		
Number of Banknotes:	1000	
Manual Mode:	False	•
Trigger source:	Internal	•
Trigger distance (ms):	20	
Internal TC Clock Rate (Hz):	125000	
BSM Command Line:		
No Camera System:	False	٣

#### Figure 35: Test case parameters example

In the following, commonly used parameters are explained.

#### Common

#### Number of Banknotes

The number of banknotes to sort (for the BSMS), or the number of banknotes to expect (for the DS).

#### BSM

#### Manual Mode

When true the BSMS stops during start up at BS\_FEED\_OFF and waits for the user to press Continue.

#### Trigger source

Either use the TS (External) or the internal (Internal) trigger and clock generation.

#### Trigger distance (ms)

When Trigger source is Internal: This value specifies the time between the leading edges of successive simulated banknotes (e.g. use 20 ms to set a sorting rate of 50 banknotes per second). When the trigger source is external this parameter is ignored.

#### Internal TC Clock Rate (Hz)

Clock rate of the transport clock when in Internal trigger mode. The TC is counting tenths of millimetres so a value of 125000 results in a transport speed of 12.5 m/s. When the trigger source is external the value is ignored.

#### No Camera System

When set to true the BSMS will ignore the note recognition information sent by the camera system and instead provides simulated BNINFO packets.

#### BSM Command Line

Additional command line parameters are given to the BSM simulator. Relevant arguments are:

#### --device-selection

A comma separated list of node IDs which the BSMS should use.

#### --mechanical-slots

A comma separated list of distances from the photo barrier for each mechanical slot in mm.



--mech-slot-assign

A comma separated list of slot assignments per device. E. g. "--mech-slot-assign 1,2,0" means device 1 and 2 are placed in mechanical slots 1 and 2 respectively and device 3 is an IEU without a mechanical slot.

--ignore-bn-recognition

If given the BSMS will ignore the BN recognition of the CS and will instead send its own recognition data.

-v, --verbosity

Sets the level for messages in the log files, where -v-2 leads to the minimal number of messages, -v0 includes only errors, warnings and info messages and -v9 leads to the highest number of messages. For long time tests a value of -v5 is recommended. For detailed tests -v9 can be used.

The usage of parameters is described in the acceptance protocol if needed for a test case.

# Device

# Run Forever

When set true the device does not abort when DS\_ERROR is reached. Instead it accepts a new startup sequence of the BSM and continues normal operation. This option is useful when the BSM has to be restarted repeatedly. *Run Forever* is most useful with a general testcase like *DS\_BSM-G01*.

# Fitness Results

A comma separated list of values (FIT, UNFIT, REJECT, SPECIAL1, SPECIAL2, SPECIAL3, SPECIAL4 or SPECIAL5) that is returned as result code for each banknote. When the end of the list is reached the next result will start again with the first entry.

### Device Command Line

Additional command line parameters given to the device simulator. Relevant arguments are:

--number-of-segments

The number of segments this device will send in its results.

--bp-offset

The BP offset the device will need in mm.

--tc-resolution

The TTS TC resolution of the device in mm/clock.

--tts-support

If 0 the device will not use TTS, if 1 the device will use TTS.

-v, --verbosity

Sets the level for messages in the log files, where -v-2 leads to the minimal number of messages, -v0 includes only errors, warnings and info messages and -v9 leads to the highest number of messages. For long time tests a value of -v5 is recommended. For detailed tests -v9 can be used.

The usage of parameters is described in the acceptance protocol if needed for a test case.



#### 9.2.6. Status Overview

This panel provides an overview of all the running components in the test case. It lists the Powerlink node id, the role of the device (e.g. BSM, Camera System or IEU), the current CDI2 state of the simulated device and a small textual description of the test state. The test state includes one of five icons to indicate the general state:

- the test is running
- the test is waiting for the user to interact with the simulation or to press Continue
- $\checkmark$  the test is finished and passed
- X the test is finished and failed

### 9.2.7. Response

This panel provides detailed responses from the simulation devices. The data is formatted as JSON and parts of it can be collapsed by clicking "-" or expanded by clicking "+". While a test case is running, the data is refreshed every second which resets the view of this data. To select and analyse this field it is recommended to let the simulation finish or to stop it first.

The panel can be shown or hidden by clicking on "Response".

Common fields in the Response are:

- bsm\_cdi2\_states: A list of all states the BSM has been in during the test case run.
- o cdi2\_states: A list of all states this simulated device has been in during the test case.
- o errors: A list of errors recorded by the device.
- history\_errors: A list of Powerlink errors recorded by the device.
- node id: The Powerlink node id of the device.
- powerlink\_states: A list of all Powerlink states the device has been in.
- o role: The role of the device in the test case (e.g. BSM, Camera System or IEU).
- status: One of RUNNING, WAITING, PASSED and ERROR indicating the test case status.

The BSMS provides these additional fields:

- nodes: A list with all Powerlink nodes that were detected by the BSM, with all recorded state transitions and errors recorded for each of them.
- $\circ$  system\_states: A list of all combined states the CDI2 system has been in.





#### User Manual

Status ove	erview		
Node ID	Role	CDI2 Status	Test Status
240	BSM	BS_FEED_OFF	<ul> <li>Received 0 BNRESULTS from all devices</li> </ul>
	IDB Receiver		<ul> <li>Ready to receive (single threaded)</li> </ul>
Respons	se		
-( -( ), -( ) )	'cdi2_stat 'hostname' 'message'': 'node_id''''' 'nole'''''''''''''''''''''''''''''''''''	te": "BS_FEED : "BS_FEED is "Bc.lil.200 Sorting Test", "Received 0 SSN", : 20077, "RUNNING", "RUNNING", "RUNNING",	_OFF", .66" BNRESULTS from all devices", , 9.70" aceive (single threaded)",

#### Figure 36: Response example - while test is running



#### Figure 37: Response example - when test has finished



# 9.2.8. Download Results (download results archive)

After the test case is finished, either because the test case has finished or the Stop button was pressed, clicking the Download button will download an archive containing all logs, status reports and images recorded by the test case. The filename of the downloaded file consists of the test case name and the current date and time.

Example of a result archive file:

BSMS\_BSM-G01\_2018-08-01\_06-55-52.tar.xz

To open the result archive, the 7-Zip program is recommended.

22 D:\tmp\BSMS_BSM-GO	01_2018-08-01_06-55-5	2.tar.xz\BSMS_BSI	1-G01_2018-08-0	1_06-55-52.tar\			- 🗆 🗵
File Edit View Favorites	Tools Help						
🗘 🖿 🗸 🗤	🔶 🔿 🗙 i						
Add Extract Test Co	py Move Delete Info						
D:\tmp\BSMS_BSM	-G01_2018-08-01_06-55-52	.tar.xz\BSMS_BSM-G0	1_2018-08-01_06-55	-52.tar\			•
Name	Size	Packed Size	Modified	Mode	User	Group	Symbolic Li
₽.	C	) 0	2018-08-01 08:47	0rwxr-xr-x			
IDB_BSM	3 571 629 413	3 571 714 560	2018-07-31 23:24	0rwxr-xr-x			
BSM_SIM_response.json	7 866	5 8 192	2018-08-01 08:47	0rw-rr			
BSM_SIM_results.tgz	172 967 504	172 967 936	2018-08-01 08:49	0rw-rr			
IDB_BSM_move.json	88	3 512	2018-08-01 08:47	0rw-rr			
IDB_BSM_response.json	596	5 1024	2018-08-01 08:47	0rw-rr			
					1		
							<u> </u>
0 object(s) selected		J					

Figure 38: 7-Zip example

In the following the content of the result archive is described.

For every used component the result archive contains one file and one archive (<node\_name>\_response.json and <node\_name>\_result.tgz). The JSON file contains a quick overview of the test result while the tgz-archive contains all logs and reports that were created during the test run.

For the BSM the tgz-archive contains the CDI2 data store as a compressed XML file, a compressed log file with detailed information on what happened during the test run and a folder for each device containing the received *device\_info.xml* and the written *device\_config.xml*.

For Devices the tgz-archive contains the *device\_config.xml* written by the BSM, the *machine\_info.xml* written by the BSM and a compressed log file containing detailed information about the test run.

For the IDB receiver a folder exists containing the images received correctly (*pictures*) and images received containing error (*pictures\_ERR*).

For the IDB sender the tgz-archive contains the images sent during the test.

When the version information test case is run the archive contains a file called *versions.log* which contains information about the installed software versions.

CDI2SIM: Error! Use the Home tab to apply Titel to the text that you want to appear here. User Manual



♣ ━ ▽ ゅ	→ × 1					
Add Extract Test Copy I	Move Delete Into			i and i i inc		
D: \tmp \BSMS_BSM-G01_2	018-08-01_06-55-52.tar xzv	BSMS_BSM-G01_2018-08-01	_06-55-52.tar\BSI	M_SIM_results.tgz/BS	M_SIM_results.tar	
Vame		Size	Packed Size	Modified	Mode User	Group
a de la companya de l		0	0	2018-07-31 17:50	Urwxr-xr-x	
device_1		/ 508	8 192	2018-07-31 17:50	Urwxr-xr-x	
device_10		4 197	5 120	2018-07-31 17:50	Urwxr-xr-x	
device_11		4 197	5 120	2018-07-31 17:50	0rwxr-xr-x	
device_12		4 197	5 120	2018-07-31 17:50	Orwxr-xr-x	
evice_13		4 197	5 120	2018-07-31 17:50	Orwxr-xr-x	
evice_14		4 197	5 120	2018-07-31 17:50	Orwxr-xr-x	
evice_15	2	4 197	5 120	2018-07-31 17:50	0rwxr-xr-x	
evice_16		3 770	4 096	2018-07-31 17:50	Orwxr-xr-x	
evice_2	/-	3 759	4 096	2018-07-31 17:50	0rwxr-xr-x	
device_3		3 761	4 096	2018-07-31 17:50	Orwxr-xr-x	
device_4		3 761	4 096	2018-07-31 17:50	Orwxr-xr-x	
device_5		3 761	4 096	2018-07-31 17:50	Orwxr-xr-x	
device_6		3 758	4 096	2018-07-31 17:50	Orwxr-xr-x	
device_7		3 761	4 096	2018-07-31 17:50	0rwxr-xr-x	
device_8		3 758	4 096	2018-07-31 17:50	Orwxr-xr-x	
device_9		3 762	4 096	2018-07-31 17:50	Orwxr-xr-x	
gitignore 🧉 🧉		0	0	2018-05-28 10:25	Orw-rr	
2018-07-31_15-50-59_1_Austri	a-OeBS.xml.gz	39 908 278	39 908 352	2018-07-31 23:25	0rw-rr	
everything.log.gz		287 615 001	287 615 488	2018-07-31 23:25	Orw-rr	
		3				

Figure 39: Result archive

- (1) path to BSM\_SIM\_results
- (2) Data-Storage file

The BSMs stores the received banknote results in this file. The file format complies with the XML storage file format as specified in [Ref 1.] 9.1.1 Aggregated Data.

(3) everything.log.gz

A gzip compressed logfile generated by the simulator with all events during a simulation run. Mainly used for debugging when the simulation returned an unexpected result (see examples in Figure 40, Figure 41 and Figure 42).

📄 every	/thing.log 🔀								
1	arguments:	bsm-simrt-c	cpu-affinit;	y 1tc-correction	n 0cdi	-version-switchover 2.5 -	ba	atch-modeconfig config bsm.xml -v9log-dir 1	Logres 🔺
	Current di	r: /var/tmp/BSM	MS BSM-G01						
(1)	File verbo:	sity level: 9	-						
	date	time	(uptime )	[ thread name/id		file:line	٧I		
5	2020-01-24	09:01:02.629	( 0.009s)	[bsm-sim		log.cc:208	01	Logging to 'log/everything.log.gz', mode: 'a', v	verbosity
6	2020-01-24	09:01:02.629	( 0.010s)	[bsm-sim		main.cc:203	91	Registering signal handlers	
7	2020-01-24	09:01:02.629	( 0.010s)	[bsm-sim	(3)	main.cc:47	01	CDI2 Simulator v1.1.0.0	
	2020-01-24	09:01:02.629	( 0.010s)	[bsm-sim		main.cc:48	21	Git-Commit: 1163323 (rohner/playground)	5
2	2020-01-24	09:01:02.629	( 0.010s)	[bsm-sim		main.cc:49	21	Build-System: Linux-4.4.0-altera (mn)	
10	2020-01-24	09:01:02.629	( 0.010s)	[bsm-sim		main.cc:50	21	Build-Time: 2020-01-21T19:36:50Z	-
11	2020-01-24	09:01:02.629	( 0.010s)	[bsm-sim		main.cc:51	3	Compiler: GNU-7.3.0	
12	2020-01-24	09:01:02.629	( 0.010s)	[bsm-sim	4	main.cc:52	91	Compiler-Flags: /usr/bin/c++ -DCONFIG_INCLUDE_IN	P -DCONFI
13	2020-01-24	09:01:02.647	( 0.028s)	[cdi2-main		test_case.cc:94	01	Loading LUA test script: sorting_test.lua	
14	2020-01-24	09:01:02.689	( 0.070s)	[cdi2-main 🥑	•	state_machine.h:126	01	Transition from BS_INVALID to BS_START_UP	
15	2020-01-24	09:01:02.689	( 0.070s)	[cdi2-main		stack.cc:180	01	Starting Powerlink Stack	
16	2020-01-24	09:01:02.689	( 0.070s)	[cdi2-main		stack.cc:181	01	Node ID: 240, CycleLen: 1000	
17	2020-01-24	09:01:05.123	( 2.504s)	[cdi2-main		node.cc:180	61	Initializing process image	
18	2020-01-24	09:01:05.123	( 2.504s)	[cdi2-main		node.cc:182	61	Size of process image: Send = 208 Recv = 22912	
19	2020-01-24	09:01:05.124	( 2.504s)	[cdi2-main		node.cc:220	61	Linking process image vars	
20	2020-01-24	09:01:05.124	( 2.504s)	[cdi2-main	-	binding.cc:78	01	Getting the system to state `SYS_FEED_OFF`	
21	2020-01-24	09:01:05.124	( 2.505s)	[cdi2-main	6	binding.cc:78	01	Waiting for `SYS_START_UP`	
22	2020-01-24	09:01:05.125	( 2.505s)	[cdi2-main		loop.cc:133	91	Iteration-Stats: Min: 420.13 us, Max 420.13 us,	Avg: 1.6
2.3	2020-01-24	09:01:05.125	( 2.506s)	[on]k-eventur	-	stack.cc:619	71	Stack entered state: NmtGsTnitializing	× *

Figure 40: BSMS everything.log example 1 (start)

The example in Figure 40 shows initial messages at startup of the simulator.

- (1) Simulator calling string with actual parameters
- (2) Date/time
- (3) Thread name/id
- (4) File:line
- (5) Log message
- (6) Log level of messages

User-Manual-CDI2SIM-v1r10-tracked.docx



📄 eve	ything.log 🗵			
355	2020-01-24 09:01:21.319 ( 18	8.699s) [cdi2-main ]	banknote scheduler.cc:65	Schedule BNID 1 TC 15225
356	2020-01-24 09:01:21.339 ( 18	8.719s) [cdi2-main ]	banknote schidtler.cc:65 9	Schedule BNID 2 TC 17725
357	2020-01-24 09:01:21.359 ( 18	8.739s) [cdi2-main ]	banknote_scheduler.cc:65 9	Schedule BNID 3 TC 20225
358	2020-01-24 09:01:21.363 ( 18	8.744s) [cdi2-main ]	bsm_loop.cc:1608	Received BnRecognition: Device 1, BNID 1
359	2020-01-24 09:01:21.379 ( 18	8.759s) [cdi2-main ]	banknote_scheduler.cc.65 9	Schedule BNID 4 TC 22725
360	2020-01-24 09:01:21.383 ( 18	8.764s) [cdi2-main ]	hszlpop.cc:160 8	Received BnRecognition: Device 1, BNID 2
361	2020-01-24 09:01:21.399 ( 18	8.779s) [cdi2-main ]	banknote_scheduler.cc:65 9	Schedule BNID 5 TC 25225
362	2020-01-24 09:01:21.403 ( 18	8.784s) [cdi2-main ]	bsm_loop.cc:160 8	Received BnRecognition: Device 1, BNID 3
363	2020-01-24 09:01:21.419 ( 18	8.799s) [cdi2-main ]	banknote_scheduler.cc:65 9	Schedule BNID 6 TC 27725
364	2020-01-24 09:01:21.423 ( 18	8.804s) [cdi2-main ]	bsm_loop.cc:160 8	Received BnRecognition: Device 1, BNID 4
365	2020-01-24 09:01:21.439 ( 18	8.819s) [cdi2-main ]	banknote_scheduler.cc:65 9	Schedule BNID 7 TC 30225
366	2020-01-24 09:01:21.443 ( 18	8.824s) [cdi2-main ]	bsm 300p cc:160 8	Received BnRecognition: Device 1, BNID 5
367	2020-01-24 09:01:21.459 ( 18	8.839s) [cdi2-main ]	banknote_scheduler.cc:65 9	Schedule BNID 8 TC 32725
368	2020-01-24 09:01:21.462 ( 18	8.842s) [cdi2-main ]	bsm_loop.cc:193	Final Judgement (BNID 1, Serial: PA3530953214): FIT
369	2020-01-24 09:01:21.463 ( 18	8.844s) [cdi2-main ]	bsm_loop.cc:160 8	Received BnRecognition: Device 1, BNID 6
370	2020-01-24 09:01:21.479 ( 18	8.859s) [cdi2-main ]	banknote_scheduler.cc:65 9	Schedule BNID 9 TC 35225
371	2020-01-24 09:01:21.482 ( 18	8.862s) [cdi2-main ]	bsm_loop.cc:193 0	Final Judgement (BNID 2, Serial: PA3530953215): FIT
372	2020-01-24 09:01:21.483 ( 18	8.864s) [cdi2-main ]	bsm_loop.cc:160 8	Received BnRecognition: Device 1, BNID 7
373	2020-01-24 09:01:21.499 ( 18	8.879s) [cdi2-main ]	banknote_scheduler.cc:65 9	Schedule BNID 10 TC 37725
374	2020-01-24 09:01:21.502 ( 18	8.882s) [cdi2-main ]	bsm_loop.cc:193 0	Final Judgement (BNID 3, Serial: PA3530953216): FIT
375	2020-01-24 09:01:21.503 ( 18	8.884s) [cdi2-main ]	bsm_loop.cc:160 8	Received BnRecognition: Device 1, BNID 8
376	2020-01-24 09:01:21.519 ( 18	8.899s) [cdi2-main ]	banknote_scheduler.cc:65 9	Schedule BNID 11 TC 40225
377	2020-01-24 09:01:21.522 ( 18	8.902s) [cdi2-main 1	bsm loop.cc:193 01	Final Judgement (BNTD 4. Serial: PA3530953217): FTT
1.5				>

Figure 41: BSM everything.log example 2 (sorting)

The example in Figure 41 shows log messages during normal sorting.

- (1) Banknote with BNID=1 is scheduled.
- (2) BnRecognition for BNID=1 received from Device 1 (which is the CS).
- (3) Final Judgment for BNID=1. Message is issued when BnResults for BNID=1 has been received from all devices.

ſ	948	3.035s)	[cdi2-main	]	banknote_scheduler.cc:65	91	Schedule BNID 198 TC 507728	^
	949	3.041s)	[cdi2-main	1	bsm loop.cc:160	81	Received BnRecognition: Device 1, BNID 196	
	950	3.055s)	[cdi2-main	1	bsm loop.cc:193	01	Final Judgement (BNID 192, Serial: PA3530953405): FIT	
	951	3.055s)	[cdi2-main	1	baningte scheduler.cc:65	91	Schedule BNID 199 TC 510228	
	952	3.061s)	[cdi2-main	1	bsm loop.cc:160	81	Received BnRecognition: Device 1, BNID 197	
	953	3.075s)	[cdi2-main	i	bam loop.cc:193	01	Final Judgement (BNID 193, Serial: PA3530953406): FIT	
	954	3.075s)	[cdi2-main	i	banknote scheduler.cc:65	91	Schedule BNID 200 TC 512728	
	955	3.081s)	[cdi2-main	i	bsm loop.cs:160	81	Received BnRecognition: Device 1, BNID 198	
	956	3.093s)	[oplk-eventup	i	Stack.cc:540	WARN	[ 3][ 8] HistoryEntry: E DLL LOSS PRES TH(0x8243) Additional Info: 083a000800000	ก
	957	3.093s)	[op1k-eventup	i	stack.cc:510	6	NodeEvent: Id 8. State NmtCsNotActive	2
	958	3.094s)	[cdi2-main	i	bsm state.cc:50	ERRI	[ 3][ 8] Device 8 is unresponsive on the Powerlink laver	
	959	3.094s)	[cdi2-main	i	state machine.h:126	01	Transition from BS SORTING to BS ERROR	
	960	3.094s)	[cdi2-main	i	binding.cc:78	81	Start downloading error log.xml from device 1	
	961	3.094s)	[cdi2-main	i	binding.cc:78	81	Start downloading error log.xml from device 2	
	962	3.0955)	[cdi2-main	i	binding.cc:78	81	Start downloading error log.xml from device 3	
	963	3.095s)	[cdi2-main	í	binding.cc:78	81	Start downloading error log.xml from device 4	
	964	3,0955)	[cdi2-main	i	binding.cc:78	81	Start downloading error log.xml from device 5	
	965	3.095s)	[cdi2-main	- í	binding.cc:78	81	Start downloading error log.xml from device 6	
	966	3,0968)	[cdi2-main	- í	binding.cc:78	81	Start downloading error log.xml from device 7	
	967	3,0965)	[cdi2-main	í	binding.cc:78	81	Start downloading error log.xml from device 8	
	968	3,0963)	[cdi2-main	- 1	hinding cc:78	81	Start downloading error log xml from device 9	
	969	3.0968)	[cdi2-main	- 1	binding.cc:78	81	Start downloading error log.xml from device 10	
	970	3 0968)	[cdi2-main	1	binding cc:78	81	Start downloading error log will from device 1	$\checkmark$
I	<						3	

Figure 42: BSM everything.log example 3 (error)

The example in Figure 42 shows a typical warning and error when a Device stops operation during sorting.

- (1) Warning, E\_DLL\_LOSS\_PRES\_TH, Node 8 did not respond with PRes on Powerlink layer
- (2) Error, Device 8 does not respond on the Powerlink layer

#### 9.2.9. Example Procedure

To illustrate the execution of a test case, this section shows a step by step example of the process for the general sorting test (BSM-G01).

- (1) Select a test set
- (2) Click activate, and wait until Start becomes available
- (3) Click start

CDI2SIM: Error! Use the Home tab to apply Titel to the text that you want to appear here.



User Manual

BSM Simulator
ist of all Testcases: DSMS_DSMS-017 Powerlink and Nettime BSMS_BSM-020 HTTP and additional services BSMS_BSM-021 State Transitions BSMS_BSM-021 State Transitions BSMS_BSM-022 Powerlink Errors BSMS_BSM-031 Non-TTS Operation BSMS_BSM-031 Sorting to Stackers BSMS_BSM-031 Sorting BSMS_BSM-031 Sorting ESMS_BSM-031 Sorting ESMS_BSM-031 Sorting ESMS_BSMS_BSM-031 Sorting ESMS_BSMS_BSM-031 Sorting ESMS_BSMS_BSM_031 Sorting ESMS_BSMS_BSMS_BSM_031 Sorting ESMS_BSMS_BSMS_BSMS_BSM_031 Sorting ESMS_BSMS_BSMS_031 Sorting ESMS_BSMS_BSM_031 Sorting ESMS
Test Case Parameters
Status overview

The test set will now have been copied to all used components and have been started.

BSM Simulator
List of all Testcases: D3M32_D3M-019 Sorting Of test Charles BSM5_BSM-017 Powerlink and Nettime BSM5_BSM-021 Fitter Transitions BSM5_BSM-021 State Transitions BSM5_BSM-022 Powerlink Errors BSM5_BSM-023 Software Updates BSM5_BSM-030 IDB Error BSM5_BSM-031 Orbig to Stackers BSM5_BSM-031 Sorting to Stackers BSM5_BSM-032 Reset Devices BSM5_BSM-031 Continue Start Continue Stop Abort Download Results
Test Case Description
Test Case Parameters
Status overview
Node ID Role CDI2 Status Test Status
240 BSM BS_START_UP ►
IDB Ready to receive (single threaded)

The started components now report their status in the status overview. The logo is animated to indicate that the information is updated. The stop and abort buttons are active to indicate that the simulation can be stopped.



BSM Simulator						
ist of all Testcases: Domo_Commerce Optimes BSMS_BSM-024 Non-TTS Operation BSMS_BSM-030 IOB Error BSMS_BSM-030 IOB Error BSMS_BSM-031 Sorting to Stackers BSMS_BSM-032 Reset Devices BSMS_DSM-003 Sorting to Stackers BSMS_DET-003 Sorting to Stackers BSMS_DEV-003 State Transitions BSMS_DEV-005 State Transitions BSMS_DEV-006 Powerlink Errors Activate Stat Continue Stop Abort Download Results						
Click the "Continue" button above in order to transition to SYS_SORTING Test Case Description Test Case Parameters						
Status overview						
Node ID Role CDI2 Status Test Status						
240 BSM BS_FEED_OFF 🗌 🖸 Waiting						
IDB Ready to receive (single threaded)						
Response						

By default, if the sorting test reaches BS\_FEED\_OFF it waits for the user to click Continue before it transitions to the sorting state. The instructions are now shown in the blue box. At the same time the status overview of the BSMS reports that it is waiting for user interaction. Clicking continue, which became available, will cause the simulation to proceed.

Usually waiting is needed to allow the user to prepare parts of the simulation e.g. start the TS.
CDI2SIM: Error! Use the Home tab to apply Titel to the text that you want to appear here.



User Manual

BSM Simulator
st of all Testcases: Dama_Commoc_3 Jontware opportes BSMS_BSM-024 Non-TTS Operation BSMS_BSM-030 IDB Error BSMS_BSM-030 IDB Error
BSMS_pSM-031_Sorting to Stackers BSMS_pSM-032 Reset Devices BSMS_pSM-0601 Sorting BSMS_C5-007 Sorting to Stackers BSMS_DET-003 Sorting to Stackers BSMS_DET-003 Sorting to Stackers BSMS_DET-003_SOTING to Stackers BSMS_DET-0
BSMS_DEV-005 FIT P and additional services BSMS_DEV-005 State Transitions BSMS_DEV-006 Powerlink Errors Activate Start Continue Stop Abort Download Results
Test Case Description
Test Case Parameters
Status overview
Node ID Role CDI2 Status Test Status
240 BSM BS_SORTING ► Received 259 BNRESULTS from all devices
ID8 E 200 images received with 0 errors
Response

The simulator now starts to sort 1,000 banknotes and the IDB receiver component receives images sent on the IDB.

BSM Simulator				
List of all Ter	stcases:			
BSMS_BSM BSMS_BSM BSMS_BSM BSMS_BSM BSMS_BSM	A-023 Sort A-030 IDB A-031 Sort A-032 Rese A-001 Sort	-TTS Operation Error ing to Stackers et Devices		
BSMS_CS- BSMS_DET BSMS_DEV BSMS_DEV BSMS_DEV	007 Sortin [-003 Sorti /-003 HTTF /-005 State /-006 Powe	g to Stackers ng to Stackers and additiona Transitions erlink Errors	services	
Activate	Start	Continue St	op Abort	Download Results
Test Ca	se Descript	ion		
Test Ca	se Paramet	ers		
Status ov	Status overview			
Node ID	Role	CDI2 Status	Test Status	
240	BSM		✓ PASSED	Test was successful!
	IDB		✓ PASSED	
	FReceive			



After 1,000 banknotes were sorted and the simulator did not detect any errors the test set is marked as PASSED.

Now the Download Results button becomes available and allows to download all log and result files.

## 9.2.10. Extra BSMS Parameters

The following BSMS parameters and features are available since version SW\_CDI2SIM\_V27C\_20220315.

Parameter	Description
Sorting Timeout	GUI parameter "SORTING Timeout (ms)"
	Wait this many milliseconds for expected BNRESULT messages before aborting the running test. Set to 0 to wait forever
	Allow specifying the timeout (in ms) for when the machine would error out after it enters a sorting state and stops receiving results during sorting.
	Set to 0 to disable the timeout (wait forever). Of course, the testcase can be stopped or aborted still.
BN ID Start	GUI parameter "First BNID"
	Starting point of banknote identifications allocated during this test run
Repeat Note/Trigger Counter	A GUI button "Continue N" (additionally to "Continue") provides a means to repeat a sorting sequence without the need to reload the testcase. This is useful in manual mode, e.g. when tests with the transport simulator are done. The test case starts and waits for operator input before doing the sort run. The operator can prepare the transport simulator and presses either "Continue" or "Continue N" when the transport simulator has spun up.
	"Continue" works unchanged and will do a single sorting run and terminates. Whereas the new "Continue N" sorts the desired number of banknotes ("Number of Banknotes" parameter) and returns to the waiting state again. The operator may repeat the test run many times. For termination the "Finish" Button is pressed.
Denom/Series/Orientation	GUI parameters for denom/series/orientation *)
	Parameters are taken for BNINFO when "No Camera System" is set true. "BN Series"
	BN series sent out in BNINFO
	"BN Denomination"
	BN denomination sent out in BNINFO
	"BN Orientation"
	BN orientation sent out in BNINFO
Short Self-Test Cycle (BN)	Sort this many BNs between short self-tests. Set to 0 for no short self- tests. The BSMS transitions from BS_SORTING to BS_REQUEST_TO_SORT



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	to allow detectors to run a short self-test.
Intensive Self-Test Cycle (BN)	Sort this many BNs between intensive self-tests. Set to 0 for no intensive self-tests. The BSMS transitions from BS_SORTING to BS_FEED_OFF to allow detectors to run an intensive self-test. The Intensive Self-Test Cycle interval shall be longer than the Short Self-Test Cycle interval.
Test Tag	GUI parameter "Test Tag"
	Operator-specified textual metadata that is stored along with the BSM results package.
	The tag is added to the filename of the download package, to the filename of the BSM_SIM_results.tgz and is added to META.json.
	e.g. tag = "AIT-new-parameters"
	BSMS_BSM-G01_AIT-new-parameters_2020-12-17_09-30-30.tar.xz
	BSM_SIM_results_AIT-new-parameters.tgz
	META.json: "test_tag": "AIT-new-parameters"

Table 5: Extra BSMS parameters

See 17.16.2 for a complete list of parameters or see description of BSMS\_BSM-G01 Sorting in the GUI.



The following screenshots show the GUI with new parameters and an example how a test can be repeated with "Continue N". For below example DS\_BSM-G01 Sorting was used at the Device Simulator side.

	BSM Simulator
List of all Testcases:	
BSMS_BSM-023 Software Upp BSMS_BSM-024 Non-TTS Opp BSMS_BSM-030 IDB Error BSMS_BSM-031 Sorting to Sta BSMS_BSM-032 Reset Device: BSMS_BSM-033 XML Error BSMS_BSM-G01 Sorting BSMS_BSM-G03 Flexible Gene BSMS_CS-007 Sorting to Stac BSMS_DET-003 Sorting to Stac BSMS_DET-003 HTTP and add	dates eration ackers s eral Purpose Test kers ickers ditional cenvices
Activate Start Continue	e Continue N Stop Abort Download Results
Test Case Description	
Test Case Parameters	
Number of Banknotes:	10
Manual Mode:	True
Trigger source:	Internal use "external" for Transport Simulator
Trigger distance (ms):	20
Internal TC Clock Rate (Hz):	125000
BSM Command Line:	
No Camera System:	False
First BNID:	1
BN Series:	SER_US3 ~
BN Denomination:	DEN_US100 ~
BN Orientation:	ORI_FF 🗸 🗸
BNINFO Delay (ms):	2
SORTING Timeout (ms):	0
Test Tag:	AIT-new-parameters

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### Note:

Use "Mouse-Over" to get additional parameter info.

First B	INID: 1
	Starting point of banknote identifications allocated during this test run
BN Series:	SER_US3
BN series	sent out in BNINFO (Only relevant for "No Camera System"-Mode)
BN Deno	mination: DEN_US100
	BN denomination sent out in BNINFO (Only relevant for "No Camera System"-Mode)
BN Orient	ation: ORI_FF
BN orient	ation sent out in BNINFO (Only relevant for "No Camera System"-Mode)
SORTING	Timeout (ms):       40000         Wait this many milliseconds for expected BNRESULT messages before aborting the running test. Set to 0 to wait forever       Image:
Test Tag:	Operator-specified textual metadata that is stored along with tor-specified textual metadata that is stored along with the BSM results package



BSM Simulator
ist of all Testcases:
BSMS_BSM-002 Distance BSMS_BSM-006 Flutter BSMS_BSM-014 Sorting of test charts BSMS_BSM-017 Powerlink and Nettime BSMS_BSM-020 HTTP and additional services BSMS_BSM-021 State Transitions BSMS_BSM-021 State Transitions BSMS_BSM-022 Powerlink Errors BSMS_BSM-023 Software Updates BSMS_BSM-024 Non-TTS Operation BSMS_BSM-030 IDB Error BSMS_BSM-031 Sorting to Stackers
Activate     Start     Continue     Continue     Stop     Abort     Download Results       Click "Continue" above in order to transition to SYS_SORTING
Test Case Description
Test Case Parameters
Status overview
Node ID Role CDI2 Status Test Status
1 BSM BS_FEED_OFF Waiting
IDB Ready to receive (single threaded)
Response

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BSM Simulator				
List of all Testcases: BSMS_BSM-002 Distance BSMS_BSM-014 Sorting of test charts BSMS_BSM-014 Sorting of test charts BSMS_BSM-014 Sorting of test charts BSMS_BSM-020 HTTP and additional services BSMS_BSM-021 State Transitions BSMS_BSM-021 State Transitions BSMS_BSM-022 Powerlink Errors BSMS_BSM-023 Software Updates BSMS_BSM-024 Non-TTS Operation BSMS_BSM-030 IDB Error BSMS_BSM-031 Sorting to Stackers				
Activate       Start       Finish       Continue N       Stop       Abort       Download Results         Click "Continue" above in order to transition to SYS_SORTING       Test Case Description       Test Case Description				
Test Case Parameters				
Status overview				
Node ID Role CDI2 Status Test Status				
1 BSM BS_FEED_OFF Test substep sorting 10 notes (10 total) was successful!				
IDB FReceiver PASSED				
Response				



BSM Simulator				
ist of all Testcases:				
BSMS_BSM-002 Distance BSMS_BSM-004 Flutter BSMS_BSM-014 Sorting of test charts BSMS_BSM-017 Powerlink and Nettime BSMS_BSM-020 HTTP and additional services BSMS_BSM-021 State Transitions BSMS_BSM-021 State Transitions BSMS_BSM-022 Powerlink Errors BSMS_BSM-023 Software Updates BSMS_BSM-024 Non-TTS Operation BSMS_BSM-024 Non-TTS Operation BSMS_BSM-030 IDB Error BSMS_BSM-031 Sorting to Stackers				
Activate     Start     Finish     Continue N     Stop     Abort     Download Results       Click "Continue" above in order to transition to SYS_SORTING				
Test Case Description				
Test Case Parameters				
Status overview				
Node ID Role CDI2 Status Test Status				
BSM         BS_FEED_OFF         Test substep sorting 10 notes (20 total) was successful!				
IDB FReceiver PASSED				
Response				

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t of all Test	cases:						
SINIS_BSIN SIMS_BSIN SIMS_BSIN SIMS_BSIN SIMS_BSIN SIMS_BSIN SIMS_BSIN SIMS_BSIN SIMS_BSIN SIMS_BSIN	-002 Distail -006 Flutte -014 Sortir -017 Powe -020 HTTP -021 State -022 Powe -023 Softw -024 Non- -030 IDB E	r g of test charts rlink and Nettime and additional servic Transitions rlink Errors are Updates ITS Operation rror	es				
SMS_BSM	-031 Sortir	ig to Stackers					
Activate Test Case	-031 Sortir Start F e Descriptio	inish Continue N	Stop	Abort	Download Re	sults	
Activate Test Case	-031 Sortir Start F e Descriptio e Paramete	ig to Stackers Continue N on	Stop	Abort	Download Re	sults	
Interference Status over	-031 Sortir Start F e Descriptic e Paramete rview	ig to Stackers	Stop	Abort	Download Re:	sults	
ictivate Test Cas Test Cas Status ove	-031 Sortir Start F e Description e Paramete rview Role	inish Continue N	Stop	Abort I	Download Re:	sults	
ctivate Test Cas Test Cas Status ove Node ID	-031 Sortir Start F e Descriptic e Paramete rview Role BSM	inish Continue N Continue N Con CDI2 Status BS_REQUEST_TO_SH	Stop	Abort I	Download Re s	utts	

## 9.2.11. Extra DS Parameters

The following DS parameters and features are available since version SW\_CDI2SIM\_V27C\_20220315.

Parameter	Description
Short Self-Test Duration (ms)	Time in milliseconds the devices will need to perform a short self-test, including system state transition times (10ms). If specified as min:max, a random value between min and max is chosen.
Intensive Self-Test Duration (ms)	Time in milliseconds the devices will need to perform an intensive self- test, including system state transition times (10ms). If specified as min:max, a random value between min and max is chosen.
Stall Short Self-Test (duration:cycle)	Let a Short Self-Test take a certain duration (ms) at a specific self-test cycle (cycle counting starts at 0). This is done once and overrides the Short Self-Test Duration parameter.



the text that you want to appear here.

Stall Intensive Self-Test (duration:cycle)	Let an Intensive Self-Test take a certain duration (ms) at a specific self-test cycle (cycle counting starts at 0). This is done once and overrides the Intensive Self-Test Duration parameter.
Set Maintenance State at Short Self-Test (state@cycle)	Set maintenance status flags at a specific Short Self-Test cycle (cycle counting starts at 0). The state code may range from 0 to 15. The maintenance status flags are reset to 0 at the next, either short or intensive self-test.
Set Maintenance State at Intensive Self-Test (state@cycle)	Set maintenance status flags at a specific Intensive Self-Test cycle (cycle counting starts at 0). The state code may range from 0 to 15. The maintenance status flags are reset to 0 at the next, either short or intensive self-test.
Test Tag	GUI parameter "Test Tag" Operator-specified textual metadata that is stored along with the BSM results package. The tag is added to the filename of the download package, to the filename of the BSM_SIM_results.tgz and is added to META.json.

#### Table 6: Extra DS parameters

See 16.17.3 for a complete list of parameters or see description of DS\_BSM-G01 Sorting in the GUI.

## 9.2.12. Common Interface Protocol

The device simulator nodes support the common interface protocol, as it was introduced with the "CDI2 Device - PC Implementation" [Ref 6.]. It allows an external computer to inject banknote results over the TCP/IP network connection and override the internal BnResults generated by the testcase.

The network interface of each device node provides a TCP port at 4000. At this port following commands and messages are available:

- messages originated by the CDI2 BSM (banknote announcement, banknote info and banknote trigger)
- messages to be transferred to the CDI2 BSM (banknote result)
- configuration commands for CDI2 Device
- error messages of the CDI2 Device

TCP/IP is used as the communication protocol. Basically, the communication uses a simple text-oriented bidirectional Lua shell, which can be accessed on TCP port 4000 of the CDI2 Device Interface Box.

Refer to the appropriate chapters in [Ref 6.] for protocol details and how to use it.



# **10.** Service and Maintenance Screen (DS)

The device simulator provides a Service and Maintenance screen for each simulated node. It provides live status information about the simulated node. The presented information is updated in a regular manner and can be used for supervision and debugging purposes.

On the device simulator this screen is always available, as long as the simulation instance is active. Actually, the same screen is provided via the Powerlink network also, which makes it accessible via the BSM laptop as well.

Refer to chapter 8.2 for the list of IP addresses. For convenience, the device simulator GUI provides direct links on the Status Overview panel for each of the simulated nodes [Figure 43]. Clicking the link opens a new browser window with the Service and Maintenance Screen of the desired node [Figure 44].

	Status ove	rview				
	Node ID	Role	CDI2 Status	Tes	t Status	
•	1	Camera System	DS_SORTING		Received 366 trigger	
•	2	Detector	DS_SORTING		Received 360 trigger	
	3	Detector	DS_SORTING		Received 364 trigger	
	4	Detector	DS_SORTING		Received 363 trigger	
	5	Detector	DS_SORTING		Received 363 trigger	
	6	Detector	DS_SORTING		Received 363 trigger	
	7	Detector	DS_SORTING		Received 362 trigger	
	8	Detector	DS_SORTING		Received 362 trigger	
	9	Detector	DS_SORTING		Received 361 trigger	
	10	IEU	DS_SORTING		Received 365 trigger	

#### Figure 43: Status overview with links to Service and Maintenance screens

- (1) Link to open a new window with Service and Maintenance screen of Node 1
- (2) Link to open a new window with Service and Maintenance screen of Node 2

### 10.1 Main and Status Dag

the text that you want to appear here.



#### Figure 44: Service and Maintenance screen

The start page provides menu tabs for Status, Commands, Statistics, Device Information and Logs. The default screen opens the Status tab, which displays an overview about the operational status of the Device, with data about the received signals from the DMB and the TTS port. The components of the screen have the following meaning:

- (1) The device Powerlink ID
- (2) View Status page
- (3) View Commands page
- (4) View Statistics page
- (5) View Device Information page
- (6) View Logs page
- (7) CDI2 state of the simulated device
- (8) CDI2 state of the BSM
- (9) Current transport speed as measured from DMB messages
- (10) Current transport speed as measured from TTS
- (11) Length of the TTS BP pulse
- (12) Sampled distance between two banknotes
- (13) Graph displaying the banknote rate on the TTS compared to the DMB
- (14) Graph displaying the transport speed according to the DMB over time
- (15) Graph displaying the transport speed according to TTS over time



# **10.2.** Device Information Page

Ģ	0 <u>12</u>		\$	Servio	ce a	nd N	Mair	nten	ance	•		
Device	#1:	Status	Commands	Statistics	Device	e Informat	ion Lo	ogs				
Gener	al				Conne	ections	1	Image	e Evalua	tion		
Node Id			1		IDB Sup	oport	true	Suppor	t	true		
Camera	Syst	em	true		TTS Su	pport	true	Fitness		true		
Manufac	cture	r	CamT	ech	TC Res	olution	1	Numbe	r Reading	true		
Descript	tion		CS12	3	BP Offs	et	13	DOL				
Softwar	e Ver	sion	4.54a	а				BSW	Info			
Serial N	umbe	er	12345	6				Result	Timeout	1200		
Device (	Class		4					Mechai	nical Slot	1		
Softwar	e Upo	date Supp	ported true					Mounti	ng Position	left		
Original	XML		device	e_info.xml								
Image	S											
_	0											
Туре		Resolu	ition Interna	Resolution	Width	Height	Payloa	ad Type	IDB Stream	m Nr		
R_left		0.2	0.2		500	1016	4		1			
B loft		0.2	0.2		508	1016	1		2			
		0.2	0.2		508	1016	1		3			
R right		0.2	0.2		508	1016	1		Л			
G right		0.2	0.1		508	1016	1		5			
B right		0.2	0.2		508	1016	1		6			
IR right		0.2	0.1		508	1016	1		7			
transmis	sion	0.2	0.2		508	1016	32768		8			
num		0.1	0.1		250	800	32768		9			
UV		0.5	0.5		180	360	1		10			
Supple	eme	ental D	ata	ç	Service	Files						
ld Tv	pe	Offset	Name	Unit	Descriptio	on		Name			Type	Mode
4 2		0	judgement		Configurati	ion		myparam	.cfg		bin	ΓW
5 2		1	result		DeviceStat	tus		dev_stat.)	<u>kml</u>		text	r
6 2		2	quality		Diagnosis	Data		logfile.txt			text	rw
7 13		3	serialnumber		Last100			allscans.b	<u>bin</u>		bin	r
8 2		19	orientation		LastMeasu	urement		lastscan.t	bin		bin	r
9 2		20	denomination		SpecialRea	adService	Bin	SpecialRe	eadService_I	<u>Bin.bin</u>	bin	r
10 2		21	series		SpecialRea	adService	Text	SpecialRe	adService	Text.txt	text	г
11 6		22	bnlength		SpecialWri	iteService	_Bin	SpecialW	riteService E	Bin.bin	bin	rw
12 6		26	bnwidth		SpecialWri	iteService	_Text	SpecialW	riteService	Text.txt	text	ΓW
13 6		30	soil		Statistics			stat.txt			text	r

#### Figure 45: Device Info page

The device information screen provides an overview of the contents of the *device\_info.xml* of this device. The service files displayed on the screen can be used to access the additional services, however it is recommended to use WinSCP instead, since it also allows writing of files.



## 10.3. Logs Page

	Service and Maintenance
Device #1: Sta	tus Commands Statistics Device Information Logs
Logs	
2018-08-01T16:05:00 2018-08-01T16:09:0 2018-08-01T16:09:0 2018-08-01T16:09:00 2018-08-01T16:09:00 2018-08-01T16:09:00 2018-08-01T16:09:00 2018-08-01T16:09:00 2018-08-01T16:09:00 2018-08-01T16:09:00	8 [warning] Node 240: 3 Packets lost 9 [warning] Iteration-Stats: Min: 29.74 us, Max 896.11 us, Avg: 51.83 us 4 [warning] BNID announcement without corresponding BP signal: BNID 8763, TC-Trig 27398829 9 [warning] BNID announcement without corresponding BP signal: BNID 8931, TC-Trig 27923829 9 [warning] BNID announcement without corresponding BP signal: BNID 8931, TC-Trig 27923829 9 [warning] BNID announcement without corresponding BP signal: BNID 8931, TC-Trig 27923829 9 [warning] BNID announcement without corresponding BP signal: BNID 8931, TC-Trig 27923829 9 [warning] BNID announcement without corresponding BP signal: BNID 8931, TC-Trig 27923829 9 [warning] BNID announcement without corresponding BP signal: BNID 8931, TC-Trig 27923829 9 [warning] BNID announcement without corresponding BP signal: BNID 8931, TC-Trig 27923829 9 [warning] BNID announcement without corresponding BP signal: BNID 8931, TC-Trig 27923829 9 [warning] BNID announcement without corresponding BP signal: BNID 8931, TC-Trig 27923829 9 [warning] BNID announcement without corresponding BP signal: BNID 8931, TC-Trig 27923829 9 [warning] BNID announcement without corresponding BP signal: BNID 8931, TC-Trig 27923829 9 [warning] BNID announcement without corresponding BP signal: BNID 8931, TC-Trig 27923829 9 [warning] BNID announcement without corresponding BP signal: BNID 8931, TC-Trig 27923829 9 [warning] BNID announcement without corresponding BP signal: BNID 8931, TC-Trig 27923829 9 [warning] BNID announcement without corresponding BP signal: BNID 8931, TC-Trig 27923829 9 [warning] BNID announcement without corresponding BP signal: BNID 8931, TC-Trig 27923829 9 [warning] BNID announcement without corresponding BP signal: BNID 8931, and BNID 8932)
	© 2018 Austrian Institute of Technology (AIT)

Figure 46: Logs page

The logs screen presents all error and warning messages generated by the simulator instance. Warnings are displayed in yellow and errors in red.



# 11. Testsets

In order to support testing of CDI2 compliance of a specific BSM or Device, a number of test cases are pre-installed on the Simulation Computer. Further, the user may modify existing test sets or create his own as well.

Alternatively, a convenient tool to generate new sorting tests for the DS is provided by means of the test case generator [11.3].

## 11.1. Files and Testset Layout

All testsets are stored at the BSM simulator or Device Simulator VisionBox at a pre-defined location. The GUI webserver is configured to retrieve the list of testcases from here.

For the BSM simulator

/usr/share/cdi2/cdi2-testcases/bsm-simulator

For the Device Simulator

/usr/share/cdi2/cdi2-testcases/device-simulator

## 11.1.1. Files

### description.md

Contains a description of the test case. It describes the function, parameters and actions of the testcase. The text is written using the Markdown formatting syntax.

### testcaseinfo.json

Describes the test case components to the Test Controller. It contains the list and parameters for all components and nodes taking part in the test case, the description of the parameters that can be used with the test case and default values for these parameters. A testcase can inherit information from another test case using the field *InheritFrom* which points to one or more folders of other testcases.

### Meta files

Each component is supplied with a MetaFile which is named in the *testcaseinfo.json*. It contains information on which program to run, which parameters to run the program with and paths to specify where logs and results are to be stored.

### Lua Script

Usually DMB nodes are supplied with a Lua script which describes how the simulated node will behave.

## pictures/ folder and idbImgDirList.txt

When an IDB sender is part of the setup, one or more folders with images are supplied along the testcase. The folder is usually called *pictures/*, but the list of folders is specified in the file *idbImgDirList.txt*. The images are stored in pgm format with one channel being stored in one file.



## 11.1.2. Activation and Start

When Activate is pressed, the following steps are performed:

- The parameters are written to a file called *ui\_parameters.lua* which is needed later.
- For every component:
  - All files listed in *testcaseinfo.json* for this node are added to a .tar.xz archive.
  - The previously generated *ui\_parameters.lua* is added to the archive.
  - The MetaFile listed in *testcaseinfo.json* is added as *META.json* to the archive.
  - The archive is uploaded to the component and stored on there in the /var/tmp/<TestCaseName> folder.
  - The Node Controller running on the component unpacks and checks the archive contents.

When Start is pressed, the Node Controller on the component starts the program listed in META.json. The working directory of the program is within the */var/tmp/<TestCaseName>* folder.

## 11.1.3. Stop, Abort and Download

At the end of a test run, either when it finishes by itself or when Stop is pressed, all results are gathered and moved to this location.

### /root/cdi2/Results

Upon Download Results the content of the *Results* folder is packed into a single file, the result archive. The file is then downloaded to the computer where the browser GUI is located. The filename is generated automatically using the testcase name and the actual date/time string. Note that upon Abort no result archive is generated.

Example of a result archive file:

BSMS\_BSM-G01\_2018-08-01\_06-55-52.tar.xz

To open the result archive the 7-Zip program is recommended.

## 11.2. How to install a new testcase

All testcases are stored on the Simulation Computer in the folder /usr/share/cdi2/cdi2-testcases.

New testcases can be added in the corresponding sub folders (BSMS or DS) via WinSCP. After a new testcase has been added the Test Controller needs to be restarted. Either by rebooting the Simulation Computer or by running the following shell command:

# systemctl restart testcontroller

For convenience, above command can be issued on the GUI-PC using this batch script as well:

On the BSMS

C:\CDI2\20\_RestartTestController\_BSMS.bat

On the DS

C:\CDI2\20\_RestartTestController\_DS.bat



## 11.3. Test Case Generator for the DS

An alternate way to generate a new sorting test case for the DS is to use a test case generator.

The generator is based on an OpenDocument spreadsheet located in

C:\CDI2\05-LibreOffice-Tools\TestCaseGenerator\_V1\_2.ods.

It provides an interface to configure each of the 16 device simulator nodes as a CS, Detector or an IEU, and whether the node should use TTS. For nodes with TTS the transport clock resolution and the BP offset can be configured.

Once the testcase has been generated by the tool it can be installed on the DS. For this purpose, the output folder must be copied to the VisionBox into folder [see 11.2]

/usr/share/cdi2/cdi2-testcases/device-simulator.

	TestCaseGenerato	or_V1_2.ods	- LibreOffice Cal	c							×
<u>F</u> ile	<u>E</u> dit <u>V</u> iew	Insert Fo	rmat St <u>y</u> les	<u>S</u> heet <u>D</u> ata <u>T</u> ools	<u>W</u> indow <u>H</u> e	lp N					×
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3	DIZ		Version 1.2								- T
4					C Thom as Kern 2018						
6		Тур	TTS mode	TTS Resolution	BPOffset						
7	Device #01	NONE	TTS	0.1	20						
8	Device #02	DET	TTS	1	15						0
9	Device #03	DET	TTS	0.2	0						ha
10	Device #04	DET	Non-TTS	0.2	1						
11	Device #05	NONE		0.2	2						
12	Device #06	NONE		0.2	3						
13	Device #07	NONE		0.2	4						
14	Device #08	NONE		0.2	23						
15	Device #09	NONE		0.2	6						
16	Device #10	IEU	Non-TTS	0.2	7						
17	Device #11	IEU	Non-TTS	0.2	8						
18	Device #12	NONE		0.2	9						
19	Device #13	NONE		0.2	10						
20	Device #14	NONE		0.2	11						
21	Device #15	NONE		0.2	12						
22	Device #16	NONE		0.2	13						
23											
24											
25											
26	TESTCAS	SE NAI	ME:		b3						
27											
28	TestCase	Direc	torv		C:\Lib	reOfficeTod	ols				
20	TUSICASC	DIEC	iory.								
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Figure 47: Test Case Generator

## 11.4. IDB Sender Setup

## 11.4.1. Testcase Settings

The IDB Sender is used for simulating a CS in the device simulator. It is an extra simulation instance (refer 9.1 also) and has to be listed in the testcaseinfo.json of the testcase. Most testcases inherit from the general testcase DS\_BSM-G01. Thus, DS\_BSM-G01 contains an IDB Sender setup, as shown in the example below. Its metafile points to idb\_sender\_run\_config.json with parameters for the IDB Sender executable.

```
root@dev-sim-visionbox:/usr/share/cdi2/cdi2-testcases/device-simulator/DS BSM-
G01# cat testcaseinfo.json
{
  "Name": "DS BSM-G01 Sorting",
  "LogDir": "log",
  "Data": [
    { "RemoteDir": "DS BSM-G01",
      "MetaFile" : "cn1 run config.json",
      "TestFiles": ["device infos",
                    "log",
                    "device sorting test.lua",
                    "cs sorting test.lua",
                    "config device.xml"],
      "DeviceID" : "DMB DEVICE 01" },
. .
    { "RemoteDir": "DS BSM-G01",
      "MetaFile" : "idb sender run config.json",
      "TestFiles": ["log",
                    "pictures",
                    "idbImgDirList.txt"],
      "DeviceID" : "IDB DEV" }
root@dev-sim-visionbox:/usr/share/cdi2/cdi2-testcases/device-simulator/DS BSM-
G01# cat idb sender run config.json
{
    "name"
                  : "DS BSM-G01 Sorting",
    "description" : "Integration Test",
    "script"
                  : null,
                                        "./idbImgDirList.txt",
                  : [ "--imglist",
    "args"
                      "--imgfirst, "512x1024",
                      "--multicastip", "239.205.18.1",
                      "--count",
                                        "-1",
                      "--triggermode", "MC.224.0.0.100:5000"],
                  : "/usr/bin/idbfsender"
    "simulator"
}
root@dev-sim-visionbox:/usr/share/cdi2/cdi2-testcases/device-simulator/DS BSM-
```

```
G01#
```



## 11.4.2. Image List Format and Stream Data Files

The *idbfsender* scans all directories listed in the image list file for stream data files. The stream data file must be PGM formated, 8-bit monochrome, images with following filename naming convention.

<stream\_number>\_<tag>.pgm

### stream\_number

This number is the stream number. The number may use leading zeros and denotes the stream number which shall be used for the image. Image streams must include 0, 1, 2, 3, 4, 5, 6 and 7 for mandatory streams. Optional streams continue with 8 and above.

### tag

Unique text to mark all files belonging to the same banknote. e.g. images with tag=BN0001 belong to one banknote, whereas images with tag=BN0002 belong to another banknote.

### Example *idbImgDirList.txt*:

# comment line
#
# image set 1
./pictures-set1
# image set 2
./pictures-set2

### Example file names:

pictures-set1/00\_BN001.pgm pictures-set1/01\_BN001.pgm pictures-set1/02\_BN001.pgm pictures-set1/03\_BN001.pgm pictures-set1/04\_BN001.pgm pictures-set1/06\_BN001.pgm pictures-set1/06\_BN002.pgm pictures-set1/01\_BN002.pgm pictures-set1/02\_BN002.pgm

pictures-set1/03\_BN002.pgm pictures-set1/04\_BN002.pgm pictures-set1/05\_BN002.pgm pictures-set1/06\_BN002.pgm

Note that the tag field needs to be unique within the same folder only. Thus, it is permitted to reuse the same tag within other directories.

### Example reusing tag=BN001 in pictures-set2

pictures-set2/00\_BN001.pgm
pictures-set2/01\_BN001.pgm



```
pictures-set3/02_BN001.pgm
pictures-set2/03_BN001.pgm
pictures-set2/04_BN001.pgm
pictures-set2/05_BN001.pgm
pictures-set2/06_BN001.pgm
```

### 11.4.3. How to run Optional Images

A testset for sending optional streams requires a proper image set with a matching *device\_info.xml* file. Testcases "BSMS\_BSM-G01-HR Sorting" and "DS\_BSM-G01-HR Sorting" are provided as reference examples for using optional streams. Please refer to 11.6 for details.

### 11.4.4. Debugging Hints

For debug purposes the *idbfsender* writes rotating log files, named *idb\_<n>.log*, starting with *idb\_0.log*. The files are created at the working directory of the *idbfsender* (e.g. /var/tmp/<testcase\_name> during test and are included in the download package. Please note that the /var/tmp/<testcase\_name> is moved to /root/Results/CurrentTestRun after completion of the testcase and /var/tmp/<testcase\_name> might not exist after a successful test.

If a testcase has not completed for unknown reasons, see files in /var/tmp/<testcase\_name> or /root/Results/CurrentTestRun.

#### Example of an idbfsender *idb\_0.log*:

2021-07-06T07:17:16.617348Z [I]	NFO]: {"me	sage":"Par	sing option	s","role	":"IDB
Sender", "status": "RUNNING", "ve	rsion":"Ju	2 2021,	18:20:13"}		
2021-07-06T07:17:16.617599Z [I]	NFO]: {"me	sage":"Sca	nning image	e directo	ries","role":"IDE
Sender","status":"RUNNING"}					
2021-07-06T07:17:16.617653Z [I]	NFO]: read	.ngimgli	st ./idbImg	DirList.	txt
2021-07-06T07:17:16.617772Z [I]	NFO]: scan	ing image	directory .	/picture	s/BN00001
2021-07-06T07:17:16.618374Z [I]	NFO]: scan	ing image	directory .	/picture	s/BN00002
2021-07-06T07:17:16.618643Z [I]	NFO]: scan	ing image	directory .	/picture	s/BN00003
2021-07-06T07:17:16.618904Z [I]	NFO]: scan	ing image	directory .	/picture	s/BN00004
2021-07-06T07:17:16.619183Z [I]	NFO]: scan	ing image	directory .	/picture	s/BN00005
2021-07-06T07:17:16.619452Z [I]	NFO]: scan	ing image	directory .	/picture	s/BN00006
2021-07-06T07:17:16.619720Z [I]	NFO]: scan	ing image	directory .	/picture	s/BN00007
2021-07-06T07:17:16.619989Z [I]	NFO]: scan	ing image	directory .	/picture	s/BN00008
2021-07-06T07:17:16.620262Z [I]	NFO]: scan	ing image	directory .	/picture	s/BN00009
2021-07-06T07:17:16.620530Z [I]	NFO]: scan	ing image	directory .	/picture	s/BN00010
2021-07-06T07:17:16.620788Z [I]	NFO]: 10 t	ansmit ima	ige sets fou	ınd	
2021-07-06T07:17:16.620806Z [I	NFO]: 200	ransmit ch	hannel image	s found	
2021-07-06T07:17:16.620820Z [I]	NFO]: {"me	sage":"Mma	ap(2)ing ima	ige sets"	,"role":"IDB
Sender","status":"RUNNING"}					
2021-07-06T07:17:16.621048Z [I]	NFO]: ./pi	tures/BN00	001/00 BN00	01.pgm:	488x920
2021-07-06T07:17:16.621225Z [I	NF0]: ./pi	tures/BN00	001/01_BN00	01.pgm:	488x920
2021-07-06T07:17:16.621387Z [I	NFO]: ./pi	tures/BN00	001/02_BN00	01.pgm:	488x920
2021-07-06T07:17:16.621558Z [I]	NFO]: ./pi	tures/BN00	001/03_BN00	01.pgm:	488x920
2021-07-06T07:17:16.621721Z [I	NFO]: ./pi	tures/BN00	001/04_BN00	01.pgm:	488x920
2021-07-06T07:17:16.621883Z [I]	NFO]: ./pi	tures/BN00	001/05_BN00	01.pgm:	488x920
2021-07-06T07:17:16.622047Z [I]	NFO]: ./pi	tures/BN00	001/06_BN00	01.pgm:	488x920
2021-07-06T07:17:16.622208Z [I]	NFO]: ./pi	tures/BN00	001/07_BN00	01.pgm:	488x920
2021-07-06T07:17:16.622369Z [I]	NFO]: ./pi	tures/BN00	001/08_BN00	01.pgm:	488x920
2021-07-06T07:17:16.622530Z [I]	NFO]: ./pi	tures/BN00	001/09_BN00	01.pgm:	488x920
2021-07-06T07:17:16.622700Z [I	NFO]: ./pi	tures/BN00	001/10_BN00	01.pgm:	488x920
2021-07-06T07:17:16.622862Z [I	NFO]: ./pi	tures/BN00	001/11_BN00	01.pgm:	488x920
2021-07-06T07:17:16.623018Z [I	NFO]: ./pi	tures/BN00	001/12_BN00	01.pgm:	488x920
2021-07-06T07:17:16.623177Z [I	NFO]: ./pi	tures/BN00	001/13_BN00	01.pgm:	488x920
2021-07-06T07:17:16.623335Z [I]	NFO]: ./pi	tures/BN00	001/14_BN00	01.pgm:	488x920
2021-07-06T07:17:16.623843Z [I]	NFO]: ./pi	tures/BN00	001/15_BN00	01.pgm:	976x1840
2021-07-06T07:17:16.624347Z [I	NFO]: ./pi	tures/BN00	001/16_BN00	01.pgm:	976x1840
2021-07-06T07:17:16.624855Z [I]	NFO]: ./pi	tures/BN00	001/17_BN00	01.pgm:	976x1840
2021-07-06T07:17:16.624901Z [I	NFO]: ./pi	tures/BN00	001/18_BN0C	01.pgm:	976x16
2021-07-06T07:17:16.624946Z [I	NFO]: ./pi	tures/BN00	001/19_BN00	01.pgm:	976x16

Version 1.10 / 23.01.2025

User-Manual-CDI2SIM-v1r10-tracked.docx

CDI2SIM: Error! Use the Home tab to apply Titel to the text that you want to appear here. User Manual



2021-07-06T07:17:16.625108Z [INFO]: ./pictures/BN00002/00 BN0002.pgm: 488x920 2021-07-06T07:17:16.625263Z [INFO]: ./pictures/BN00002/01\_BN0002.pgm: 488x920 2021-07-06T07:17:16.625423Z [INFO]: ./pictures/BN00002/02\_BN0002.pgm: 488x920 2021-07-06T07:17:16.625585Z [INFO]: ./pictures/BN00002/03 BN0002.pgm: 488x920 2021-07-06T07:17:16.625745Z [INFO]: ./pictures/BN00002/04 BN0002.pgm: 488x920 2021-07-06T07:17:16.625906Z [INFO]: ./pictures/BN00002/05 BN0002.pgm: 488x920 2021-07-06T07:17:16.661109Z [INFO]: ./pictures/BN00010/18\_BN0010.pgm: 976x16 2021-07-06T07:17:16.661153Z [INFO]: ./pictures/BN00010/19\_BN0010.pgm: 976x16 2021-07-06T07:17:16.661174Z [INFO]: {"message":"Setup thread pool, trigger, and TX tasks", "role": "IDB Sender", "status": "RUNNING"} 2021-07-06T07:17:16.661349Z [INFO]: TX thread pool configured, 1+2 TX threads 2021-07-06T07:17:16.666133Z [INFO]: {"message":"Setup TX paket mmap ring","role":"IDB Sender", "status": "RUNNING" } 2021-07-06T07:17:16.717681Z [INFO]: TX packet ring: frame size 12288, block size 12288, blocks 128, frames 128 2021-07-06T07:17:16.777886Z [INFO]: configured TX packet ring on ni4, MTU 9000, slots 128 2021-07-06T07:17:16.777925Z [INFO]: {"message":"Ready to send","role":"IDB Sender", "status": "RUNNING" } 2021-07-06T07:17:16.7786442 [INFO]: starting --triggermode MC, TID ffff977a91e0 2021-07-06T07:17:27.779437Z [INFO]: {"failures":0,"message":"100 BNs sent with 0 errors", "role":"IDB Sender", "sentBNs":107, "sentBlocks":2135, "status": "RUNNING"} 2021-07-06T07:17:29.779708Z [INFO]: {"failures":0,"message":"200 BNs sent with 0 errors", "role": "IDB Sender", "sentBNs": 207, "sentBlocks": 4140, "status": "RUNNING"} 2021-07-06T07:17:31.779971Z [INFO]: {"failures":0,"message":"300 BNs sent with 0 errors","role":"IDB Sender","sentBNs":307,"sentBlocks":6140,"status":"RUNNING"} 2021-07-06T07:17:33.7802222 [INFO]: {"failures":0,"message":"400 BNs sent with 0 errors", "role": "IDB Sender", "sentBNs": 407, "sentBlocks": 8140, "status": "RUNNING"} 2021-07-06T07:17:35.780445Z [INFO]: {"failures":0,"message":"500 BNs sent with 0 errors", "role":"IDB Sender", "sentBNs":507, "sentBlocks":10136, "status":"RUNNING"} 2021-07-06T07:17:37.780697Z [INFO]: {"failures":0,"message":"600 BNs sent with 0 errors", "role": "IDB Sender", "sentBNs": 608, "sentBlocks": 12136, "status": "RUNNING" } 2021-07-06T07:17:39.780949Z [INFO]: {"failures":0,"message":"700 BNs sent with 0 errors","role":"IDB Sender","sentBNs":708,"sentBlocks":14136,"status":"RUNNING"} 2021-07-06T07:17:41.781209Z [INFO]: {"failures":0,"message":"800 BNs sent with 0 errors", "role":"IDB Sender", "sentBNs":808, "sentBlocks":16142, "status": "RUNNING"} 2021-07-06T07:17:43.781439Z [INFO]: {"failures":0,"message":"900 BNs sent with 0 errors", "role":"IDB Sender", "sentBNs":908, "sentBlocks":18141, "status":"RUNNING"} 2021-07-06T07:17:45.720892Z [INFO]: GVSP LEADER 20000, PAYLOAD 1399000, TRAILER 20000, blocks 20000, bytes 12243250000 2021-07-06T07:17:45.720934Z [INFO]: shutting down...



### idbfsender parameter list

Parameter	Description
-h [help ]	produce help message
-v [verbose ]	verbose logging
-l [imglist ] arg	text document listing all image directories to scan for stream data
-f [imgformat ] arg	expected image format: This parameter is obsolete and is ignored. The idbfsender takes the images size from the stream data files instead. By this means each stream may use its own size.
-i [multicastip ] arg	multicast IP address of image streams use 239.205.18.1 for CDI2 IDB
-c [count ] arg	-1: send BNs until termination, 0: send BNs of imglist once, n: send n BNs
-t [triggermode ] arg (=FREE)	one of MC.:, DIG., or FREE
-r [rate ] arg (=0)	sendrate BN per seconds, 0 for best effort
-b [bnidstart ] arg (=1)	start with BNIDbnidstart
seq	check BNID sequence
log-dir arg (=./LOG/idbfsender)	set logging directory
result-dir arg (=./RESULT/idbfsender)	set directory for RESULTS.json file
errRATE arg (=0)	inject errors everyerrRATE BN, 0: no error injection
errNUMBER arg (=0)	stop error injection aftererrNUMBER errors, 0: never stop error injection
errCHANNEL	drop a complete image channel
errLEADER	drop a LEADER packet
errPAYLOAD	drop a PAYLOAD packet
errTRAILER	drop a TRAILER packet
errORDER	wrong sequence number (GVSP packet_id)
-u [mtu ] arg (=9000)	MTU to use for TX interface
-s [txSlots ] arg (=128)	number of TX slots in packet ring
-x [xmtthreads ] arg (=2)	number of TX threads
maxthroughput arg (=0)	egress traffic shaping max. throughput [Mbps]
maxburst arg (=0)	egress traffic shaping max. burst size
-p [rtPrio ] arg (=10)	real-time priority

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maxStall	arg	(=10)
----------	-----	-------

maximum stall time [ms] avoiding overlapping	
BNs	

Table 7: IDB sender parameters

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## **11.5. IDB Receiver Setup**

## 11.5.1. Testcase Settings

The IDB Receiver is used in the BSM simulator to receive image data coming from a CS. It is an extra simulation instance (refer 9.1 also) and has to be listed in the testcaseinfo.json of the testcase. Most testcases inherit from the general testcase BSMS\_BSM-G01. Thus, BSMS\_BSM-G01 contains an IDB Receiver setup, as shown in the example below. Its metafile points to

idb receiver run config.json with parameters for the IDB Receiver executable idbfreceiver.

```
root@bsm-sim-visionbox:/usr/share/cdi2/cdi2-testcases/bsm-simulator/BSMS BSM-
G01# cat testcaseinfo.json
  "Name": "BSMS BSM-G01 Sorting",
  "LogDir": "log",
  "Data": [
    { "RemoteDir": "BSMS BSM-G01",
      "MetaFile" : "mn run config.json",
      "TestFiles": ["config bsm.xml",
                    "mn run config.json",
                    "sorting test.lua",
                    "log"],
      "DeviceID" : "BSM SIM" },
    { "RemoteDir": "BSMS BSM-G01",
      "MetaFile" : "idb_receiver_run_config.json",
      "TestFiles": ["log",
                    "idb_receiver_run_config.json"],
      "DeviceID" : "IDB BSM" }
  ],
root@bsm-sim-visionbox:/usr/share/cdi2/cdi2-testcases/bsm-simulator/BSMS BSM-
G01# cat idb receiver run config.json
{
    "name"
                  : "BSMS BSM-G01 Sorting",
    "description" : "Integration Test",
    "script"
                  : null,
                  : [ "-f", "10",
    "args"
                      "/usr/bin/idbfreceiver",
                      "--destination", "./pictures",
                      "--multicastip", "239.205.18.1" ],
    "simulator"
                  : "chrt"
}
```

## 11.5.2. Received Image File Format

The received stream images are stored in the ./pictures folder. The image files are PGM formatted, 8-bit monochrome, with following filename naming convention.

```
<stream_number>_BN<bnid>.pgm
```



*stream\_number* This number is the stream number

### bnid

This field is the left zero-padded banknote id of the received banknote. Images received with detected errors are saved as *<stream\_number* >\_BN<bnid>\_ERR.pgm files, the PGM header comment shows detailed information.

### Example:

02\_BN000000036.pgm received image from stream 02 with BNID=36

### Important note:

In contrast to the previous version, the IDB receiver stores all images in the same folder and does not use extra folders for each banknote. Having all images files in one folder makes file handling easier, e.g. receive files can be used by the IDB sender directly.

## 11.5.3. How to run Optional Images

The IDB receiver allocates receive buffers in main memory in advance. As the main memory is a limited resource, the parameters <code>-streams</code>, <code>-depth</code> and <code>-hr</code> are used to control the amount of required memory. <code>-streams</code> sets the number of streams to be received, <code>-depth</code> sets the maximum number of banknotes kept in the ring buffer and <code>-hr</code> sets the maximum image size (see Table 9 for complete parameter list).

Parameter	Mandatory streams only (default)	Mandatory and 12 optional streams
streams	8	20
depth	1000	100
hr	not set	set
	(allocate size 512x1024)	(allocate size 1024x2048)

		<i>c</i>	
Table 8: IDB red	ceiver paramet	ers for optio	onal streams

Examples of idb\_receiver\_run\_config.json:

### Mandatory streams only (default)

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the text that you want to appear here.

```
"--depth", "1000",
"--streams", "8",
"--multicastip", "239.205.18.1" ],
"simulator" : "chrt"
```

Mandatory and optional streams

```
{
    "name"
                  : "BSMS BSM-G01 Sorting",
    "description" : "Integration Test",
    "script"
                 : null,
    "args"
                  : [ "-f", "10",
                       "/usr/bin/idbfreceiver",
                       "--destination", "./pictures",
                       "--depth", "100",
                       "--streams", "20",
                       "--hr",
                       "--multicastip", "239.205.18.1" ],
    "simulator"
                  : "chrt"
}
```

Testcases "BSMS\_BSM-G01-HR Sorting" and "DS\_BSM-G01-HR Sorting" are provided as reference examples for using optional streams. Please refer to 11.6 for more details.

### 11.5.4. Debugging Hints

For debug purposes the *idbfreceiver* writes rotating log files *idb\_<n>.log, staring with idb\_0.log*. The file is created at the working directory of the *idbfreceiver* (e.g. */var/tmp/<testcase\_name>* during test and it is included in the download package. Please note that the */var/tmp/<testcase\_name>* is moved to */root/Results/CurrentTestRun* after completion of the testcase and */var/tmp/<testcase\_name>* does not exist after a successful test.

If a testcase has not completed for unknown reasons, see files in /var/tmp/<testcase\_name> or /root/Results/CurrentTestRun.

#### Example of an *idbfreceiver idb\_0.log:*

```
2021-07-06T11:02:28.891173Z [INFO]: {"message":"Parsing options","role":"IDB
Receiver", "status": "RUNNING", "version": "Jul 2 2021, 18:22:17"}
2021-07-06T11:02:30.658184Z [INFO]: {"message":"Image stream reassembly buffer configured for 20
image streams/BN, 100 BN save depth", "role": "IDB Receiver", "status": "RUNNING"}
2021-07-06T11:02:30.658290Z [INFO]: {"message":"Setup RX paket mmap ring","role":"IDB
Receiver", "status": "RUNNING" }
2021-07-06T11:02:30.704064Z [INFO]: RX packet ring: frame size 12288, block size 12288, blocks
2048, frames 2048
2021-07-06T11:02:30.745652Z [INFO]: configured RX packet ring on ni4, MTU 9000, slots 2048
2021-07-06T11:02:30.745701Z [INFO]: {"message":"Ready to receive","role":"IDB
Receiver", "status": "RUNNING" }
2021-07-06T11:02:30.745759Z [INFO]: RX packet ring: ring processing thread tied to CPU 7
2021-07-06T11:02:44.746847Z [INFO]: {"Gbps MAC":"0.803249","failed":0,"message":"100 BNs received
with 0 errors", "rcvdBNIDs":114, "role": "IDB Receiver", "status": "RUNNING" }
2021-07-06T11:02:46.747181Z [INFO]: {"Gbps_MAC":"4.868041","failed":0,"message":"200 BNs received with 0 errors","rcvdBNIDs":214,"role":"IDB Receiver","status":"RUNNING"}
2021-07-06T11:02:48.748089Z [INFO]: {"Gbps_MAC":"4.918769","failed":0,"message":"300 BNs received
with 0 errors", "rcvdBNIDs": 314, "role": "IDB Receiver", "status": "RUNNING"}
2021-07-06T11:02:50.748415Z [INFO]: {"Gbps MAC":"4.871095","failed":0,"message":"400 BNs received
with 0 errors", "rcvdBNIDs":414, "role": "IDB Receiver", "status": "RUNNING"}
```

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2021-07-06T11:02:52.748874Z [INFO]: {"Gbps MAC":"4.922154","failed":0,"message":"500 BNs received with 0 errors", "rcvdBNIDs":514, "role": "IDB Receiver", "status": "RUNNING"} 2021-07-06T11:02:54.749482Z [INFO]: {"Gbps\_MAC":"4.874641","failed":0,"message":"600 BNs received with 0 errors", "rcvdBNIDs":614, "role": "IDB Receiver", "status": "RUNNING"} 2021-07-06T11:02:56.750383Z [INFO]: {"Gbps MAC":"4.929154","failed":0,"message":"700 BNs received with 0 errors", "rcvdBNIDs": 715, "role": "IDB Receiver", "status": "RUNNING"} 2021-07-06T11:02:58.750679Z [INFO]: {"Gbps\_MAC":"4.896574","failed":0,"message":"800 BNs received with 0 errors", "rcvdBNIDs":815, "role": "IDB Receiver", "status": "RUNNING"} 2021-07-06T11:03:00.750966Z [INFO]: {"Gbps\_MAC":"4.896598","failed":0,"message":"900 BNs received with 0 errors", "rcvdBNIDs":915, "role": "IDB Receiver", "status": "RUNNING"} 2021-07-06T11:03:02.476114Z [INFO]: shutting down... 2021-07-06T11:03:02.476348Z [INFO]: GVSP LEADER 20000, PAYLOAD 1399000, TRAILER 20000, blocks 20000, bytes 12243250909 2021-07-06T11:03:02.476374Z [INFO]: saving reassembled images... 2021-07-06T11:03:02.476404Z [INFO]: create directory for reassembled images: "./pictures"

Parameter	Description
-h [help ]	produce help message
-v [verbose ]	verbose logging
-d [destination ] arg	destination directory collecting received images
-i [multicastip ] arg	multicast IP address of image streams use 239.205.18.1 for CDI2 IDB
-c [count ] arg	0: receive BN until termination N: terminate after receiving N BNs
-s [streams ] arg (=8)	number of streams/images per BN
depth arg (=1000)	max. number of BN to save at termination
hr	allocate standard (512x1024) or HR (1024x2048) image buffers
cks	calculate naive per-image checksum to detect single bit errors
seq	check BNID sequence
log-dir arg (=./LOG/idbfreceiver)	set logging directory
result-dir arg (=./RESULT/idbreceiver)	set directory for RESULTS.json file
-u [mtu ] arg (=9000)	MTU to use for RX interface
-f [rxSlots ] arg (=2048)	number of RX slots in packet ring
-x [rcvthreads ] arg (=2)	number of RX threads

#### idbfreceiver parameter list

**Table 9: IDB receiver parameters** 



# 11.6. IDB Reference Testcase for Optional Streams

A reference test showing the use of optional streams is provided. It consists of

"BSMS\_BSM-G01-HR Sorting" and "DS\_BSM-G01-HR Sorting" for BSMS and DS respectively. The testcases are extended versions of the generic testcases "BSMS\_BSM-G01-HR Sorting" and "DS\_BSM-G01 Sorting".

## 11.6.1. DS\_BSM-G01-HR Sorting

the text that you want to appear here.

"DS\_BSM-G01-HR Sorting" implements an IDB sender, as described in 11.4.

The testcase files are located at this folder /usr/share/cdi2/cdi2-testcases/device-simulator/DS\_BSM-G01-HR.

Hint: Testcase files can be extracted from the Debian package (cdi2-testcases-xxx.deb) also (with e.g. 7-zip)

pictures-hr/ contains an image set for 20 streams

pictures-hr/00_	_BN0001.pgm	:	488x920
pictures-hr/01_	BN0001.pgm	:	488x920
pictures-hr/02_	BN0001.pgm	:	488x920
pictures-hr/03_	BN0001.pgm	:	488x920
pictures-hr/04_	BN0001.pgm	:	488x920
pictures-hr/05_	BN0001.pgm	:	488x920
pictures-hr/06_	BN0001.pgm	:	488x920
pictures-hr/07_	BN0001.pgm	:	488x920
pictures-hr/08_	_BN0001.pgm	:	488x920
pictures-hr/09_	BN0001.pgm	:	488x920
pictures-hr/10_	BN0001.pgm	:	488x920
pictures-hr/11_	_BN0001.pgm	:	488x920
pictures-hr/12_	_BN0001.pgm	:	488x920
pictures-hr/13_	BN0001.pgm	:	488x920
pictures-hr/14_	BN0001.pgm	:	488x920
pictures-hr/15_	_BN0001.pgm	:	976x1840
pictures-hr/16_	_BN0001.pgm	:	976x1840
pictures-hr/17_	_BN0001.pgm	:	976x1840
pictures-hr/18_	BN0001.pgm	:	976x16
pictures-hr/19_	BN0001.pgm	:	976x16

Please note that images have different images size. Also note the mandatory image size of the mandatory streams 0-7 is 488x920 in this example, in contrast to DS\_BSM-G01 having 512x1024.

pictures-hr-10/ contains an annotated image set for 10 banknotes. The images contain an imprinted string with banknote number and stream number.

Device description should match and shall list 20 streams.

Example of device infos/device info camera hr.xml

<Images>
 <!--mandatory streams -->

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<Image type="R\_left" resolution="0.2" internalResolution="0.2"</pre> height="920" width="488" idbStreamNr="0" gvspPayloadType="1" /> <Image type="G left" resolution="0.2" internalResolution="0.2" height="920" width="488" idbStreamNr="1" gvspPayloadType="1" /> <Image type="B\_left" resolution="0.2" internalResolution="0.2"</pre> height="920" width="488" idbStreamNr="2" gvspPayloadType="1" /> <Image type="IR left" resolution="0.2" internalResolution="0.2" height="920" width="488" idbStreamNr="3" gvspPayloadType="1" /> <Image type="R right" resolution="0.2" internalResolution="0.1"</pre> height="920" width="488" idbStreamNr="4" gvspPayloadType="1" /> <Image type="G right" resolution="0.2" internalResolution="0.2" height="920" width="488" idbStreamNr="5" gvspPayloadType="1" /> <Image type="B\_right" resolution="0.2" internalResolution="0.2"</pre> height="920" width="488" idbStreamNr="6" gvspPayloadType="1" /> <Image type="IR right" resolution="0.2" internalResolution="0.1"</pre> height="920" width="488" idbStreamNr="7" gvspPayloadType="1" /> <!--optional streams --> <Image type="TR right" resolution="0.2" internalResolution="0.1"</pre> height="920" width="488" idbStreamNr="8" gvspPayloadType="1" /> <Image type="GR R left" resolution="0.2" internalResolution="0.2"</pre> height="920" width="488" idbStreamNr="9" gvspPayloadType="1" /> <Image type="GR G left" resolution="0.2" internalResolution="0.2"</pre> height="920" width="488" idbStreamNr="10" gvspPayloadType="1" /> <Image type="GR\_B\_left" resolution="0.2" internalResolution="0.2" height="920" width="488" idbStreamNr="11" gvspPayloadType="1" /> <Image type="GR\_R\_right" resolution="0.2" internalResolution="0.1"</pre> height="920" width="488" idbStreamNr="12" gvspPayloadType="1" /> <Image type="GR G right" resolution="0.2" internalResolution="0.2"</pre> height="920" width="488" idbStreamNr="13" gvspPayloadType="1" /> <Image type="GR\_B\_right" resolution="0.2" internalResolution="0.2"</pre> height="920" width="488" idbStreamNr="14" gvspPayloadType="1" /> <Image type="HR left" resolution="0.1" internalResolution="0.1"</pre> height="1840" width="976" idbStreamNr="15" gvspPayloadType="1" /> <Image type="HR\_right" resolution="0.1" internalResolution="0.1" height="1840" width="976" idbStreamNr="16" gvspPayloadType="1" /> <Image type="HR\_TR\_left" resolution="0.1" internalResolution="0.1" height="1840" width="976" idbStreamNr="17" gvspPayloadType="1" /> <Image type="BADPIX left" resolution="0.1" internalResolution="0.1" height="16" width="976" idbStreamNr="18" gvspPayloadType="1" /> <Image type="BADPIX\_right" resolution="0.1" internalResolution="0.1"</pre> height="16" width="976" idbStreamNr="19" gvspPayloadType="1" /> </Images>

### **Important Note:**

All required files and directories of the testcase must be listed as "TestFiles" in *testcaseinfo.json*. Otherwise the files are not transferred to the testcase working directory, e.g. "pictures-hr-10" must be listed for above example.

### testcaseinfo.json:

```
{ "RemoteDir": "DS_BSM-G01-HR",
 "MetaFile" : "idb_sender_run_config.json",
 "TestFiles": ["log",
 "pictures-hr-10",
 "idbImgDirList.txt"],
 "DeviceID" : "IDB_DEV" }
```

#### idbImgDirList.txt:

```
# banknote with mandatory and hr streams
#./pictures
# 10 annotated banknotes with mandatory and hr streams
./pictures-hr-10
```

#### idbsender\_run\_config.json:

{



```
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```

```
"name" : "DS_BSM-G01-HR Sorting",
"description" : "Integration Test",
"script" : null,
"args" : [ "--imglist", "./idbImgDirList.txt",
        "--multicastip", "239.205.18.1",
        "--count", "-1",
        "--triggermode", "MC.224.0.0.100:5000"],
"simulator" : "/usr/bin/idbfsender"
```

### 11.6.2. BSMS\_BSM-G01-HR Sorting

"BSMS\_BSM-G01-HR Sorting" implements an IDB receiver, as described in 11.5.

The testcase files are located at this folder /usr/share/cdi2/cdi2-testcases/bsm-simulator/BSMS\_BSM-G01-HR

Hint: Testcase files can be extracted from the Debian package (cdi2-testcases-xxx.deb) also (with e.g. 7-zip).

testcaseinfo.json:

```
{ "RemoteDir": "BSMS_BSM-G01-HR",
 "MetaFile" : "idb_receiver_run_config.json",
 "TestFiles": ["log",
 "idb_receiver_run_config.json"],
 "DeviceID" : "IDB BSM" }
```

idb\_receiver\_run\_config.json:

```
{
    "name"
                  : "BSMS BSM-G01-HR Sorting",
    "description" : "Integration Test",
    "script"
                  : null,
                  : [ "-f", "10",
    "args"
                       "/usr/bin/idbfreceiver",
                       "--destination", "./pictures",
                       "--depth", "100",
                       "--streams", "20",
                       "--hr",
                       "--multicastip", "239.205.18.1" ],
                  : "chrt"
    "simulator"
}
```



# 12. Tools

The simulator setup is delivered with some hardware and software tools. Their basic usage is described in this section. For detailed information and manuals refer to the referenced sources.

## 12.1. Wireshark

Wireshark is a network analyser which is used in the testcases to view and inspect the messages on the DMB. For this task it is equipped with some custom tools which are already installed on the GUI PC and can be found in the *CDI2-Installation* folder in *"03-CDI2-Wireshark-Plugins"*.

Detailed documentation and manuals can be found at: <a href="https://www.wireshark.org/">https://www.wireshark.org/</a>

For capturing the Powerlink network traffic with the required time resolution, the BSMS and the DS are equipped with a dedicated network logger, a ProfiShark 100M device. It is connected via USB to the GUI-PC (Sniffer Connector on the rear panel). The ProfiShark device installs as a network interface and Wireshark can use it as capture device. ProfiShark is capable to timestamp the captured network packets with a resolution < 100 ns. This feature is required to analyse and judge the quality of the Powerlink communication.

Note that the *profishark.dll* plugin, provided with the ProfiShark device, has to be installed when Wireshark logs originating from ProfiShark have to be analysed.

Refer to the manufacturer for further details

ProfiShark 100M, C1AP-100 http://www.profitap.com

For manual Wireshark installation or upgrade to a newer version refer to chapter 12.1.8.

## 12.1.1. General Usage and Capture

Apply a display filter <chr></chr> Welcome to Wireshark     Capture	e Ed	it View G	erwork Analyzer 30. Capture Analyze Statistics Telephony Wireless Tools Help		- 0	
Apply a display filter <cht></cht> Welcome to Wireshark  Capture sing this filter: Enter a capture filter Profilia Bluetooth Network No addresses Ethere Wi-Fi  User's Guide : Wild : Questions and Answers : Mailing Lets You are running Wireshark.2.4.5 (v2.4.5-0-g1328667eff). You receive automatic updates.		1 🔘 📘				
Welcome to Wireshark         Capture        using this filter:         Profiliap         Buetooth Network         No addresses         Ethernet         No capture filte         Wi-Fil    Eternet Buetooth Network in the state of	Apply a	display filter .			Expression	+ 0
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			You are running Wireshark 2.4.5 (v2.4.5-0-g153e867ef1). You receive automatic updates.			
			g			
Ready to load or capture No Packets Profil	Rea	dy to load or c	capture	No Packets	Profile	: Defa

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#### Figure 48: Select Profishark network card at startup

To start a capture open Wireshark and double click the ProfiTap interface (1).

	Capturing from ProfiTap										-		>
Fi	ile Edit View Go Capt	ure Analyze Statistics Te	elephony Wireless Tools	Help									
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	85809 7 730356	AitAustr_9f:c5:1d	AitAustr 9f.c5.24	POWER 72.2	10-> 1	PReg [	61 01	F · RD-1	v.a a	-0.0	c	.5_01 E10	A
	85810 7 730365	AitAustr 9f:c5:24	FPLv2 PRes	CDT2 1464	4->255	PRes [	14281	F·RD-1 R	S-0 PR-0	V-0 0	NMT C	S OPER	ΔТ
	85811 7 730506	AitAustr 9f:c5:1d	EPLV2_SoA	POWER 72.2	10->255	SoA (I	NO SERV	TCE)->	0 NMT M	S OPERAT		.5_01 E14	
	85812 7 730870	AitAustr 9f:c5:1d	EPLV2_Soft	POWER 72 2	10->255	500		102) /	·		1010112		
	85813 7.730882	AitAustr 9f:c5:1d	EPLV2_DRes	CDT2 244.2	10->255	PRes [	2081	F:RD=1.R	S=0.PR=0	V=0.0	NMT N	IS OPER	AT.
	85814 7.730902	AitAustr 9f:c5:1d	AitAustr 9f:c5:25	POWER 72.2	40-> 5	PReg [	01	F:RD=1	V:0.0				
	85815 7 730910	AitAustr 9f:c5:25	FPLv2 PRes	CDT2 1464	5->255	PRes [	14281	F-RD=1 R	S=0 PR=0	V=0 0	NMT C	S OPER	АТ
	85816 7.731056	AitAustr 9f:c5:1d	AitAustr 9f:c5:26	POWER	10-> 6	PReg [	01	F:RD=1	V:0.0				
	85817 7.731064	AitAustr 9f:c5:26	FPLv2 PRes	CDT2 1464	6->255	PRes [	14281	F:RD=1.R	S=0.PR=0	V=0.0	NMT C	S OPER	AT.
	85818 7.731206	AitAustr 9f:c5:1d	AitAustr 9f:c5:27	POWER 72.24	40-> 7	PReg [	01	F:RD=1	V:0.0				
	85819 7.731215	AitAustr 9f:c5:27	EPLv2 PRes	CDI2 1464	7->255	PRes [	1428]	F:RD=1,R	S=0,PR=0	V=0.0	NMT C	S OPER	AT.
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Figure 49: Wireshark main screen

A running capture can be stopped using the stop button (2). A new capture can then be started by clicking Start (1).

The captured packets are shown in overview (3) and the selected packet is shown in detail (4) and (5). (4) Shows the dissected package with all parsed protocol layers, including CDI2 fields. (5) shows the raw bytes of the packet.

### 12.1.2. Powerlink Timing

/ \*DrofiTan

Another tool provided for CDI2 is the "Powerlink Timing" statistics. It can be started by clicking "Statistics" (1) -> "Powerlink Timing..." (2).

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User-Manual-CDI2SIM-v1r10-tracked.docx



### Figure 50: Open Powerlink timing window

The Powerlink Timing statistics provides a statistical summary of time delays involved in the Powerlink communication.

Total Powerlink packet count:       307206         - SoC - time delta between SoC Count, Min, max, avg, sd [ms]:       27676,       0.999915,       1.0000800,       0.999988,       0.000026         - PReq - time delta since SoC Count:       110705       0.999915,       1.0000800,       0.999988,       0.000040         Dest.node 1, count, min, max, avg, sd [ms]:       6919,       0.032235,       0.032225,       0.032279,       0.000040         Dest.node 2, count, min, max, avg, sd [ms]:       6919,       0.036075,       0.336166,       0.186118,       0.000040         Dest.node 4, count, min, max, avg, sd [ms]:       6919,       0.032275,       0.032270,       0.0000400         Dest.node 5, count, min, max, avg, sd [ms]:       6919,       0.0326075,       0.032166,       0.080040         Dest.node 7, count, min, max, avg, sd [ms]:       6919,       0.032675,       0.032280,       0.000040         Dest.node 1, count, min, max, avg, sd [ms]:       6919,       0.032675,       0.032166,       0.080040         Dest.node 11, count, min, max, avg, sd [ms]:       6919,       0.032675,       0.032280,       0.000040         Dest.node 11, count, min, max, avg, sd [ms]:       6919,       0.032675,       0.032166,       0.031616,       0.000040         Dest.node 12, count, min, max, avg, sd [ms]:	Wireshark - Powerlink Timing Statistics		4 3 2	? ×
<ul> <li>SoC - time delta between soC Court, Min, max, avg, sd [ms]:</li> <li>27676, 0.999915, 1.000080, 0.999980, 0.000026</li> <li>PReq - time delta since SoC Court:</li> <li>110705</li> <li>Dest.node 1, count, min, max, avg, sd [ms]:</li> <li>6919, 0.03225, 0.032279, 0.000040</li> <li>Dest.node 2, count, min, max, avg, sd [ms]:</li> <li>6919, 0.03265, 0.032250, 0.032279, 0.000040</li> <li>Dest.node 3, count, min, max, avg, sd [ms]:</li> <li>6919, 0.03265, 0.032650, 0.03216, 0.000040</li> <li>Dest.node 4, count, min, max, avg, sd [ms]:</li> <li>6919, 0.032657, 0.036160, 0.036116, 0.000040</li> <li>Dest.node 5, count, min, max, avg, sd [ms]:</li> <li>6919, 0.032657, 0.032616, 0.036216, 0.000040</li> <li>Dest.node 7, count, min, max, avg, sd [ms]:</li> <li>6919, 0.032657, 0.032616, 0.032280, 0.000040</li> <li>Dest.node 7, count, min, max, avg, sd [ms]:</li> <li>6919, 0.032657, 0.032616, 0.036116, 0.000040</li> <li>Dest.node 7, count, min, max, avg, sd [ms]:</li> <li>6919, 0.032675, 0.032610, 0.036116, 0.000040</li> <li>Dest.node 10, count, min, max, avg, sd [ms]:</li> <li>6919, 0.0480675, 0.0486075, 0.048110, 0.000040</li> <li>Dest.node 11, count, min, max, avg, sd [ms]:</li> <li>6919, 0.0480675, 0.048160, 0.0486114, 0.000040</li> <li>Dest.node 12, count, min, max, avg, sd [ms]:</li> <li>6919, 0.048075, 0.048160, 0.0486114, 0.000040</li> <li>Dest.node 14, count, min, max, avg, sd [ms]:</li> <li>6919, 0.048075, 0.0486106, 0.0486114, 0.000040</li> <li>Dest.node 14, count, min, max, avg, sd [ms]:</li> <li>6919, 0.048075, 0.0486106, 0.0486114, 0.000040</li> <li>Dest.node 14, count, min, max, avg, sd [ms]:</li> <li>6919, 0.048075, 0.0480160, 0.0486114, 0.000040</li> <li>Dest.node 14, count, min, max, avg, sd [ms]:</li> <li>6919, 0.048075, 0.0480160, 0.0486114, 0.000040</li> <li>Src. mode 14, count, min, max, avg, sd [ms]:</li> <li>6919, 0.0480715, 0.0480165, 0.0486127, 0.048</li></ul>	Total Powerlink packet count:	307206		^
<ul> <li>SoC - time delta between SoC Court, Min, max, avg, sg [ms]:</li> <li>PReq - time delta since SoC (court, min, max, avg, sd [ms]:</li> <li>Preq - time delta since SoC (court, min, max, avg, sd [ms]:</li> <li>Preq - time delta since SoC (court, min, max, avg, sd [ms]:</li> <li>Preq - time delta since SoC (court, min, max, avg, sd [ms]:</li> <li>Preq - time delta since SoC (court, min, max, avg, sd [ms]:</li> <li>Preq - time delta since SoC (court, min, max, avg, sd [ms]:</li> <li>Preq - time delta since SoC (court, min, max, avg, sd [ms]:</li> <li>Preq - time delta since SoC (court, min, max, avg, sd [ms]:</li> <li>Preq - time delta since SoC (court, min, max, avg, sd [ms]:</li> <li>Preq - time delta since SoC (court, min, max, avg, sd [ms]:</li> <li>Preq - time delta since SoC (court, min, max, avg, sd [ms]:</li> <li>Preq - time delta since SoC (court, min, max, avg, sd [ms]:</li> <li>Preq - time delta since SoC (court, min, max, avg, sd [ms]:</li> <li>Preq - time delta since SoC (ms]:</li> <li>Preq - time delta since</li></ul>				
Count, Min, Max, avg, so [ms]:       27676,       0.399915,       1.0000808,       0.399988,       0.000020         - PReq - time delta since SoC       110705       0.032225,       0.032225,       0.032279,       0.000040         Dest.node 1, count, min, max, avg, sd [ms]:       6919,       0.032235,       0.032225,       0.032279,       0.000040         Dest.node 2, count, min, max, avg, sd [ms]:       6919,       0.036075,       0.361660,       0.166118,       0.000040         Dest.node 4, count, min, max, avg, sd [ms]:       6919,       0.032235,       0.032228,       0.000040         Dest.node 5, count, min, max, avg, sd [ms]:       6919,       0.036075,       0.336160,       0.186118,       0.000040         Dest.node 6, count, min, max, avg, sd [ms]:       6919,       0.336075,       0.336166,       0.486116,       0.000040         Dest.node 1, count, min, max, avg, sd [ms]:       6919,       0.336075,       0.336166,       0.486116,       0.000040         Dest.node 11, count, min, max, avg, sd [ms]:       6919,       0.336075,       0.336166,       0.486116,       0.000040         Dest.node 11, count, min, max, avg, sd [ms]:       6919,       0.336075,       0.336166,       0.486116,       0.000040         Dest.node 12, count, min, max, avg, sd [ms]:       6919,       0	- SoC - time delta between SoC	27676 0 0000	1 000000 0 000000	0.000000
<ul> <li>PRe - time delta since SoC</li> <li>110705</li> <li>Det:node 1, count, min, max, avg, sd [ms]: 6013, 0.082225, 0.082279, 0.000040</li> <li>Det:node 2, count, min, max, avg, sd [ms]: 6013, 0.080275, 0.08126, 0.080240</li> <li>Det:node 4, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08126, 0.08114, 0.000040</li> <li>Det:node 5, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08116, 0.080040</li> <li>Det:node 5, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08116, 0.080040</li> <li>Det:node 5, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08116, 0.080040</li> <li>Det:node 5, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08116, 0.080040</li> <li>Det:node 7, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08116, 0.080040</li> <li>Det:node 7, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08116, 0.080040</li> <li>Det:node 10, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08116, 0.080040</li> <li>Det:node 10, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08116, 0.080040</li> <li>Det:node 11, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08116, 0.080040</li> <li>Det:node 11, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08116, 0.080040</li> <li>Det:node 11, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08116, 0.080040</li> <li>Det:node 11, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08116, 0.080040</li> <li>Det:node 11, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08116, 0.080040</li> <li>Det:node 11, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08116, 0.080040</li> <li>Det:node 11, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08116, 0.080040</li> <li>Det:node 11, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08116, 0.080040</li> <li>Det:node 11, count, min, max, avg, sd [ms]: 6013, 0.080075, 0.08016, 0.03116, 0.080040</li> <li>Frex - time delta since SoC for NN or PReq(note)</li> <li>Manging node ecount, min, max, avg, sd [ms]: 6013, 0.080715, 0.080735, 0.080214,</li></ul>	Count, Min, max, avg, so [ms]:	2/6/6, 0.99991	5, 1.000080, 0.999988,	0.000026
Count:       110705         Dest.node 1, count, min, max, avg, sd [ms]:       6913, 0.032235, 0.032235, 0.032275, 0.000040         Dest.node 2, count, min, max, avg, sd [ms]:       6913, 0.136075, 0.136166, 0.336116, 0.000040         Dest.node 3, count, min, max, avg, sd [ms]:       6913, 0.136075, 0.136166, 0.336116, 0.000040         Dest.node 4, count, min, max, avg, sd [ms]:       6913, 0.436075, 0.436166, 0.436114, 0.000040         Dest.node 5, count, min, max, avg, sd [ms]:       6913, 0.136075, 0.136160, 0.136116, 0.000040         Dest.node 6, count, min, max, avg, sd [ms]:       6913, 0.136075, 0.136160, 0.136116, 0.000040         Dest.node 7, count, min, max, avg, sd [ms]:       6919, 0.136075, 0.136160, 0.136116, 0.000040         Dest.node 8, count, min, max, avg, sd [ms]:       6919, 0.436075, 0.306160, 0.486114, 0.000040         Dest.node 1, count, min, max, avg, sd [ms]:       6919, 0.436075, 0.306160, 0.366116, 0.000040         Dest.node 11, count, min, max, avg, sd [ms]:       6919, 0.436075, 0.336160, 0.336116, 0.000040         Dest.node 11, count, min, max, avg, sd [ms]:       6919, 0.436075, 0.336160, 0.336116, 0.000040         Dest.node 12, count, min, max, avg, sd [ms]:       6919, 0.436075, 0.336160, 0.336116, 0.000040         Dest.node 12, count, min, max, avg, sd [ms]:       6919, 0.432675, 0.436160, 0.486114, 0.000040         Dest.node 14, count, min, max, avg, sd [ms]:       6919, 0.432675, 0.436160, 0.486116, 0.4000040         Dest.node 15,	- PReg - time delta since SoC			
Dest.node 1, count, min, max, avg, sd [ms]:       6919, 0.032253, 0.032279, 0.0022279, 0.000040         Dest.node 2, count, min, max, avg, sd [ms]:       6919, 0.1366075, 0.136616, 0.1366116, 0.000040         Dest.node 3, count, min, max, avg, sd [ms]:       6919, 0.336075, 0.336166, 0.4365116, 0.000040         Dest.node 4, count, min, max, avg, sd [ms]:       6919, 0.4366075, 0.436616, 0.4365116, 0.000040         Dest.node 5, count, min, max, avg, sd [ms]:       6919, 0.4366075, 0.336166, 0.4365116, 0.000040         Dest.node 6, count, min, max, avg, sd [ms]:       6919, 0.4366075, 0.336616, 0.4365116, 0.000040         Dest.node 7, count, min, max, avg, sd [ms]:       6919, 0.4366075, 0.436616, 0.4365116, 0.000040         Dest.node 7, count, min, max, avg, sd [ms]:       6919, 0.4366075, 0.436616, 0.4365116, 0.000040         Dest.node 10, count, min, max, avg, sd [ms]:       6919, 0.4366075, 0.436616, 0.4365116, 0.000040         Dest.node 11, count, min, max, avg, sd [ms]:       6919, 0.432675, 0.4366075, 0.436516, 0.436516, 0.406040         Dest.node 12, count, min, max, avg, sd [ms]:       6919, 0.432675, 0.436516, 0.436516, 0.406040         Dest.node 13, count, min, max, avg, sd [ms]:       6919, 0.432675, 0.436516, 0	Count:	110705		
Dest.node 2, count, min, max, avg, sd [ms]: 6919, 0.186075, 0.186160, 0.386116, 0.000040 Dest.node 4, count, min, max, avg, sd [ms]: 6919, 0.486075, 0.486116, 0.000040 Dest.node 5, count, min, max, avg, sd [ms]: 6919, 0.486075, 0.486160, 0.336116, 0.000040 Dest.node 5, count, min, max, avg, sd [ms]: 6919, 0.136075, 0.136160, 0.336116, 0.000040 Dest.node 6, count, min, max, avg, sd [ms]: 6919, 0.136075, 0.136160, 0.336116, 0.000040 Dest.node 7, count, min, max, avg, sd [ms]: 6919, 0.136075, 0.136160, 0.336116, 0.000040 Dest.node 8, count, min, max, avg, sd [ms]: 6919, 0.336075, 0.486114, 0.000040 Dest.node 9, count, min, max, avg, sd [ms]: 6919, 0.336075, 0.486116, 0.000040 Dest.node 10, count, min, max, avg, sd [ms]: 6919, 0.336075, 0.436116, 0.000040 Dest.node 11, count, min, max, avg, sd [ms]: 6919, 0.436075, 0.436116, 0.000040 Dest.node 11, count, min, max, avg, sd [ms]: 6919, 0.436075, 0.436116, 0.000040 Dest.node 11, count, min, max, avg, sd [ms]: 6919, 0.436075, 0.436116, 0.000040 Dest.node 11, count, min, max, avg, sd [ms]: 6919, 0.436075, 0.436160, 0.336116, 0.000040 Dest.node 11, count, min, max, avg, sd [ms]: 6919, 0.436075, 0.436160, 0.436114, 0.000040 Dest.node 14, count, min, max, avg, sd [ms]: 6919, 0.436075, 0.336160, 0.336116, 0.000040 Dest.node 15, count, min, max, avg, sd [ms]: 6919, 0.436075, 0.436160, 0.436114, 0.000040 Dest.node 15, count, min, max, avg, sd [ms]: 6919, 0.032235, 0.032280, 0.000040 Dest.node 15, count, min, max, avg, sd [ms]: 6919, 0.00715, 0.007150, 0.0000040 Dest.node 16, count, min, max, avg, sd [ms]: 6919, 0.00715, 0.000030, 0.00726, 0.000040 Src.node 1, count, min, max, avg, sd [ms]: 6919, 0.00715, 0.000030, 0.00733, 0.000040 Src.node 2, count, min, max, avg, sd [ms]: 6919, 0.00715, 0.0000805, 0.00733, 0.0000033 Src.node 5, count, min, max, avg, sd [ms]: 6919, 0.00715, 0.0008080, 0.00733, 0.0000033 Src.node 7, count, min, max, avg, sd [ms]: 6919, 0.009195, 0.009225, 0.0009225, 0.000033 Src.node 7, count, min, max, avg, sd [ms]: 6919, 0.009715, 0.0	Dest.node 1, count, min, max, avg, sd [ms]:	6919, 0.03223	5, 0.032325, 0.032279,	0.000040
Dest.node 3, count, min, max, avg, sd [ms]:       6919, 0.366075, 0.36616, 0.486160, 0.366116, 0.000040         Dest.node 4, count, min, max, avg, sd [ms]:       6919, 0.486075, 0.486160, 0.486116, 0.000040         Dest.node 5, count, min, max, avg, sd [ms]:       6919, 0.486075, 0.486160, 0.486116, 0.000040         Dest.node 5, count, min, max, avg, sd [ms]:       6919, 0.486075, 0.336166, 0.486116, 0.000040         Dest.node 7, count, min, max, avg, sd [ms]:       6919, 0.436075, 0.336166, 0.486160, 0.486114, 0.000040         Dest.node 9, count, min, max, avg, sd [ms]:       6919, 0.436075, 0.336166, 0.486116, 0.000040         Dest.node 10, count, min, max, avg, sd [ms]:       6919, 0.436075, 0.336166, 0.486160, 0.486116, 0.000040         Dest.node 11, count, min, max, avg, sd [ms]:       6919, 0.432275, 0.332616, 0.406040         Dest.node 11, count, min, max, avg, sd [ms]:       6919, 0.432675, 0.336166, 0.436116, 0.000040         Dest.node 12, count, min, max, avg, sd [ms]:       6919, 0.432675, 0.436160, 0.486161, 0.600040         Dest.node 13, count, min, max, avg, sd [ms]:       6919, 0.43275, 0.336166, 0.436116, 0.6000040         Dest.node 14, count, min, max, avg, sd [ms]:       6919, 0.43275, 0.436160, 0.486114, 0.600040         Dest.node 15, count, min, max, avg, sd [ms]:       6919, 0.60775, 0.336166, 0.436114, 0.600040         Dest.node 16, count, min, max, avg, sd [ms]:       6919, 0.60775, 0.436160, 0.486114, 0.600040         Count:       138381	Dest.node 2, count, min, max, avg, sd [ms]:	6919, 0.18607	5, 0.186160, 0.186118,	0.000040
Dest.node 4, count, min, max, avg, sd [ms]: 6919, 0.486075, 0.486160, 0.486114, 0.600040 Dest.node 5, count, min, max, avg, sd [ms]: 6919, 0.032235, 0.032228, 0.000040 Dest.node 6, count, min, max, avg, sd [ms]: 6919, 0.136075, 0.136160, 0.336116, 0.000040 Dest.node 7, count, min, max, avg, sd [ms]: 6919, 0.336075, 0.436116, 0.000040 Dest.node 8, count, min, max, avg, sd [ms]: 6919, 0.436075, 0.446116, 0.000040 Dest.node 9, count, min, max, avg, sd [ms]: 6919, 0.436075, 0.446116, 0.000040 Dest.node 11, count, min, max, avg, sd [ms]: 6919, 0.336075, 0.336160, 0.336116, 0.000040 Dest.node 11, count, min, max, avg, sd [ms]: 6919, 0.336075, 0.336160, 0.336116, 0.000040 Dest.node 11, count, min, max, avg, sd [ms]: 6919, 0.336075, 0.336160, 0.336116, 0.000040 Dest.node 12, count, min, max, avg, sd [ms]: 6919, 0.336075, 0.336160, 0.336116, 0.000040 Dest.node 13, count, min, max, avg, sd [ms]: 6919, 0.436075, 0.436160, 0.336116, 0.000040 Dest.node 14, count, min, max, avg, sd [ms]: 6919, 0.436075, 0.436160, 0.336116, 0.000040 Dest.node 14, count, min, max, avg, sd [ms]: 6919, 0.436075, 0.436160, 0.336116, 0.000040 Dest.node 14, count, min, max, avg, sd [ms]: 6919, 0.436075, 0.436160, 0.436118, 0.000040 Dest.node 14, count, min, max, avg, sd [ms]: 6919, 0.00715, 0.0486160, 0.436116, 0.000040 Dest.node 14, count, min, max, avg, sd [ms]: 6919, 0.00715, 0.000316, 0.000040 Dest.node 14, count, min, max, avg, sd [ms]: 6919, 0.00715, 0.000316, 0.000040 Dest.node 14, count, min, max, avg, sd [ms]: 6919, 0.00715, 0.000305, 0.000726, 0.000042 Src. node 2, count, min, max, avg, sd [ms]: 6919, 0.00715, 0.000305, 0.000730, 0.000040 Src. node 2, count, min, max, avg, sd [ms]: 6919, 0.00715, 0.0008065, 0.007730, 0.000040 Src. node 4, count, min, max, avg, sd [ms]: 6919, 0.00715, 0.0008065, 0.007730, 0.0000403 Src. node 4, count, min, max, avg, sd [ms]: 6919, 0.00715, 0.0008065, 0.00733, 0.000043 Src. node 5, count, min, max, avg, sd [ms]: 6919, 0.009715, 0.0080805, 0.00733, 0.000043 Src. node 4, count, min, max	Dest.node 3, count, min, max, avg, sd [ms]:	6919, 0.33607	5, 0.336160, 0.336116,	0.000040
Dest.node       5, court, min, max, avg, sd [ms]:       6919,       0.832235,       0.832236,       0.832280,       0.800040         Dest.node       6, court, min, max, avg, sd [ms]:       6919,       0.836075,       0.33616,       0.800040         Dest.node       7, count, min, max, avg, sd [ms]:       6919,       0.336075,       0.33616,       0.400040         Dest.node       8, count, min, max, avg, sd [ms]:       6919,       0.486075,       0.486160,       0.486114,       0.600040         Dest.node       9, count, min, max, avg, sd [ms]:       6919,       0.486075,       0.436166,       0.486116,       0.000040         Dest.node       10, count, min, max, avg, sd [ms]:       6919,       0.436075,       0.336166,       0.486114,       0.000040         Dest.node       12, count, min, max, avg, sd [ms]:       6919,       0.436075,       0.336166,       0.486114,       0.000040         Dest.node       14, count, min, max, avg, sd [ms]:       6919,       0.43275,       0.336166,       0.486114,       0.000040         Dest.node       15, count, min, max, avg, sd [ms]:       6919,       0.43275,       0.436166,       0.486114,       0.000040         Dest.node       16, count, min, max, avg, sd [ms]:       6919,       0.486075,       0.486160,       0.	Dest.node 4, count, min, max, avg, sd [ms]:	6919, 0.48607	5, 0.486160, 0.486114,	0.000040
Dest.node       6, count, min, max, avg, sd [ms]:       6919,       0.1366075,       0.136616,       0.000040         Dest.node       7, count, min, max, avg, sd [ms]:       6919,       0.336675,       0.4366116,       0.000040         Dest.node       9, count, min, max, avg, sd [ms]:       6919,       0.436675,       0.4366116,       0.000040         Dest.node       9, count, min, max, avg, sd [ms]:       6919,       0.336675,       0.436616,       0.336166,       0.000040         Dest.node       11, count, min, max, avg, sd [ms]:       6919,       0.336675,       0.336676,       0.336675,       0.436614,       0.000040         Dest.node       11, count, min, max, avg, sd [ms]:       6919,       0.436675,       0.336676,       0.336676,       0.336676,       0.336676,       0.336676,       0.336675,       0.436675,       0.436675,       0.436675,       0.436675,       0.436614,       0.000040         Dest.node       13, count, min, max, avg, sd [ms]:       6919,       0.126675,       0.336160,       0.33616,       0.000040         Dest.node       15, count, min, max, avg, sd [ms]:       6919,       0.126675,       0.436160,       0.436114,       0.000040         Dest.node       15, count, min, max, avg, sd [ms]:       6919,       0.436675,       0.436160	Dest.node 5, count, min, max, avg, sd [ms]:	6919, 0.03223	5, 0.032325, 0.032280,	0.000040
Dest.node 7, court, min, max, avg, sd [ms]: 6919, 0.360679, 0.366160, 0.366116, 0.000040 Dest.node 9, court, min, max, avg, sd [ms]: 6919, 0.436675, 0.436160, 0.436116, 0.000040 Dest.node 10, court, min, max, avg, sd [ms]: 6920, 0.136675, 0.336166, 0.136116, 0.000040 Dest.node 11, court, min, max, avg, sd [ms]: 6919, 0.436675, 0.336166, 0.436116, 0.000040 Dest.node 12, court, min, max, avg, sd [ms]: 6919, 0.436675, 0.336166, 0.436116, 0.000040 Dest.node 12, court, min, max, avg, sd [ms]: 6919, 0.436675, 0.336166, 0.436116, 0.000040 Dest.node 12, court, min, max, avg, sd [ms]: 6919, 0.436075, 0.336166, 0.436116, 0.000040 Dest.node 14, court, min, max, avg, sd [ms]: 6919, 0.436075, 0.336166, 0.436116, 0.000040 Dest.node 15, court, min, max, avg, sd [ms]: 6919, 0.436075, 0.436160, 0.436116, 0.000040 Dest.node 15, court, min, max, avg, sd [ms]: 6919, 0.436075, 0.436160, 0.436116, 0.000040 Dest.node 15, court, min, max, avg, sd [ms]: 6919, 0.436075, 0.436160, 0.436116, 0.000040 Dest.node 16, court, min, max, avg, sd [ms]: 6919, 0.007175, 0.011765, 0.011720, 0.000040 Court: 138381 Managing node, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.0008005, 0.007236, 0.000040 Src. node 1, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.0008005, 0.007236, 0.000040 Src. node 4, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.0008005, 0.007236, 0.000040 Src. node 4, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.0008005, 0.007236, 0.000043 Src. node 4, court, min, max, avg, sd [ms]: 6919, 0.009205, 0.0009226, 0.000032 Src. node 4, court, min, max, avg, sd [ms]: 6919, 0.009155, 0.009226, 0.000032 Src. node 5, court, min, max, avg, sd [ms]: 6919, 0.009155, 0.009226, 0.000032 Src. node 6, court, min, max, avg, sd [ms]: 6919, 0.009155, 0.009226, 0.0009035 Src. node 7, court, min, max, avg, sd [ms]: 6919, 0.009155, 0.009226, 0.000033 Src. node 8, court, min, max, avg, sd [ms]: 6919, 0.009155, 0.009226, 0.000033 Src. node 9, court, min, max, avg, sd [ms]: 6919, 0.009155, 0.009226, 0.000933 Src. node 19, c	Dest.node 6, count, min, max, avg, sd [ms]:	6919, 0.18607	5, 0.186160, 0.186118,	0.000040
Dest.node 8, court, min, max, avg, sd [ms]: 6919, 0.486075, 0.486104, 0.486114, 0.4960404 Dest.node 9, court, min, max, avg, sd [ms]: 6919, 0.32675, 0.336160, 0.336216, 0.090040 Dest.node 11, court, min, max, avg, sd [ms]: 6919, 0.336075, 0.336160, 0.336116, 0.090040 Dest.node 11, court, min, max, avg, sd [ms]: 6919, 0.336075, 0.336160, 0.336116, 0.090040 Dest.node 12, court, min, max, avg, sd [ms]: 6919, 0.32235, 0.032235, 0.032228, 0.000040 Dest.node 13, court, min, max, avg, sd [ms]: 6919, 0.336075, 0.336160, 0.336116, 0.090040 Dest.node 13, court, min, max, avg, sd [ms]: 6919, 0.336075, 0.336160, 0.336166, 0.336116, 0.000040 Dest.node 14, court, min, max, avg, sd [ms]: 6919, 0.336075, 0.486160, 0.336160, 0.306040 Dest.node 15, court, min, max, avg, sd [ms]: 6919, 0.436075, 0.486160, 0.336160, 0.306040 Dest.node 15, court, min, max, avg, sd [ms]: 6919, 0.436075, 0.486160, 0.436114, 0.000040 Dest.node 15, court, min, max, avg, sd [ms]: 6919, 0.436075, 0.486160, 0.436114, 0.000040 Dest.node 15, court, min, max, avg, sd [ms]: 6919, 0.436075, 0.486160, 0.436114, 0.000040 Dest.node 2, Court, min, max, avg, sd [ms]: 6919, 0.007135, 0.007135, 0.007246, 0.000040 Src. node 2, Court, min, max, avg, sd [ms]: 6919, 0.007135, 0.007315, 0.000226, 0.000042 Src. node 4, court, min, max, avg, sd [ms]: 6919, 0.009715, 0.009285, 0.009226, 0.000033 Src. node 4, court, min, max, avg, sd [ms]: 6919, 0.009195, 0.009226, 0.000034 Src. node 5, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.009285, 0.009226, 0.000034 Src. node 6, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.009285, 0.009226, 0.000033 Src. node 6, court, min, max, avg, sd [ms]: 6919, 0.009195, 0.009226, 0.000034 Src. node 7, court, min, max, avg, sd [ms]: 6919, 0.009195, 0.009226, 0.000034 Src. node 7, court, min, max, avg, sd [ms]: 6919, 0.009195, 0.009226, 0.000037 Src. node 7, court, min, max, avg, sd [ms]: 6919, 0.009195, 0.009225, 0.0009227, 0.0000034 Src. node 10, court, min, max, avg, sd [ms]: 6919, 0.009195, 0.009225, 0.0009227, 0.0000034 Src. node 10, co	Dest.node /, count, min, max, avg, sd [ms]:	6919, 0.33607	5, 0.336160, 0.336116,	0.000040
Dest.node 9, Count, min, max, avg, sd [ms]: 0919, 0.02223, 0.022240, 0.009040 Dest.node 10, Count, min, max, avg, sd [ms]: 0920, 0.02223, 0.022240, 0.009040 Dest.node 11, Count, min, max, avg, sd [ms]: 0919, 0.386075, 0.386160, 0.486116, 0.009040 Dest.node 12, Count, min, max, avg, sd [ms]: 0919, 0.486075, 0.386160, 0.486116, 0.009040 Dest.node 12, Count, min, max, avg, sd [ms]: 0919, 0.02237, 0.032280, 0.032280, 0.009040 Dest.node 14, Count, min, max, avg, sd [ms]: 0919, 0.032675, 0.386160, 0.486116, 0.009040 Dest.node 15, Count, min, max, avg, sd [ms]: 0919, 0.032675, 0.386160, 0.486116, 0.009040 Dest.node 15, Count, min, max, avg, sd [ms]: 0919, 0.032675, 0.386160, 0.486114, 0.009040 Dest.node 15, Count, min, max, avg, sd [ms]: 0919, 0.032675, 0.486160, 0.486114, 0.009040 Dest.node 15, Count, min, max, avg, sd [ms]: 0919, 0.047157, 0.047157, 0.04716, 0.011720, 0.009040 Count: 138381 Managing node, count, min, max, avg, sd [ms]: 0919, 0.007157, 0.008005, 0.007246, 0.009040 Src. node 1, Count, min, max, avg, sd [ms]: 0919, 0.007157, 0.008005, 0.007246, 0.009032 Src. node 1, Count, min, max, avg, sd [ms]: 0919, 0.009195, 0.009228, 0.009224, 0.000032 Src. node 4, Count, min, max, avg, sd [ms]: 0919, 0.009195, 0.009226, 0.009038 Src. node 4, Count, min, max, avg, sd [ms]: 0919, 0.009195, 0.009226, 0.009003 Src. node 5, Count, min, max, avg, sd [ms]: 0919, 0.009195, 0.009226, 0.009003 Src. node 6, Count, min, max, avg, sd [ms]: 0919, 0.009195, 0.009226, 0.009003 Src. node 7, Count, min, max, avg, sd [ms]: 0919, 0.009195, 0.009226, 0.009003 Src. node 8, Count, min, max, avg, sd [ms]: 0919, 0.009195, 0.009226, 0.009003 Src. node 9, Count, min, max, avg, sd [ms]: 0919, 0.009155, 0.009226, 0.009003 Src. node 9, Count, min, max, avg, sd [ms]: 0919, 0.009155, 0.009226, 0.009033 Src. node 9, Count, min, max, avg, sd [ms]: 0919, 0.009155, 0.009226, 0.009037 Src. node 9, Count, min, max, avg, sd [ms]: 0919, 0.009155, 0.009226, 0.009037 Src. node 9, Count, min, max, avg, sd [ms]: 0919, 0.009155, 0.009226, 0.009037 Src. nod	Dest.node 8, count, min, max, avg, sd [ms]:	6919, 0.4860/	5, 0.486160, 0.486114,	0.000040
Dest.node       16, count, min, max, avg, sd [ms]:       0520, 0:160073, 0:16016, 0:000040         Dest.node       11, count, min, max, avg, sd [ms]:       0519, 0:160075, 0:16016, 0:000040         Dest.node       12, count, min, max, avg, sd [ms]:       0519, 0:160075, 0:16016, 0:000040         Dest.node       12, count, min, max, avg, sd [ms]:       0519, 0:136075, 0:136675, 0:036666, 0:336166, 0:0306040         Dest.node       13, count, min, max, avg, sd [ms]:       0519, 0:136675, 0:136675, 0:136675, 0:036666, 0:136116, 0:000040         Dest.node       15, count, min, max, avg, sd [ms]:       0519, 0:136675, 0:13616, 0:000040         Dest.node       15, count, min, max, avg, sd [ms]:       0519, 0:436675, 0:486160, 0:486114, 0:000040         PRes - time delta since SoC for NN or PReq(node)       138381         Count:       138381         Managing node, count, min, max, avg, sd [ms]:       06919, 0:00715, 0:01726, 0:00736, 0:00032         Src. node       1, count, min, max, avg, sd [ms]:       6919, 0:00715, 0:00736, 0:00736, 0:00032         Src. node       1, count, min, max, avg, sd [ms]:       6919, 0:00715, 0:00726, 0:000032         Src. node       2, count, min, max, avg, sd [ms]:       6919, 0:007315, 0:009228, 0:009224, 0:000032         Src. node       4, count, min, max, avg, sd [ms]:       6919, 0:007315, 0:008065, 0:00733, 0:000029         Src. node       6, count, min, max, avg,	Dest.node 9, count, min, max, avg, sd [ms]:	6919, 0.03223	5, 0.032325, 0.032280,	0.000040
Dest.node 11, count, min, max, avg, sd [ms]:       0913, 00:38000, 00:38010, 0:3	Dest.node 10, count, min, max, avg, sd [ms]:	6920, 0.18007	5, 0.180100, 0.180118,	0.000040
Dest:node 15, count, min, max, yeg, sd [ms];       0:35, 0:400217, 0:4002235, 0:4002126, 0:400046         Dest:node 14, count, min, max, yeg, sd [ms];       0:31, 0:40046         Dest:node 15, count, min, max, yeg, sd [ms];       0:31, 0:40046         Dest:node 15, count, min, max, yeg, sd [ms];       0:31, 0:40046         Dest:node 15, count, min, max, yeg, sd [ms];       0:31, 0:400477, 0:40046         Dest:node 15, count, min, max, yeg, sd [ms];       0:31, 0:40077, 0:40046         Dest:node 15, count, min, max, yeg, sd [ms];       0:31, 0:40077, 0:40046         Dest:node 16, count, min, max, yeg, sd [ms];       0:40077, 0:400715, 0:401765, 0:401765, 0:400746, 0:400046         Count;       133811         Managing node, scunt, min, max, yeg, sd [ms];       27676, 0:401177, 0:407315, 0:407246, 0:400032         Src: node 1, count, min, max, yeg, sd [ms];       0:319, 0:407135, 0:400735, 0:407246, 0:400032         Src: node 1, count, min, max, yeg, sd [ms];       0:319, 0:407135, 0:400735, 0:400735, 0:400032         Src: node 2, Count, min, max, yeg, sd [ms];       0:319, 0:407135, 0:400735, 0:400032         Src: node 4, count, min, max, yeg, sd [ms];       0:319, 0:409135, 0:400226, 0:400033         Src: node 5, count, min, max, yeg, sd [ms];       0:319, 0:409135, 0:400226, 0:400033         Src: node 7, count, min, max, yeg, sd [ms];       0:319, 0:409135, 0:400226, 0:400037         Src: node 8, count, min, max, yeg, sd [ms];	Dest.node 11, count, min, max, avg, sd [ms]:	6010 0.0007	5, 0.330100, 0.330110,	0.000040
Dest.node 14, Count, min, max, avg, sd [ms]:       Os12, 0       Os12222, 0       Os100040         - PRes - time delta since SOC for MN or PReq(node)       138381       Nanaging node, count, min, max, avg, sd [ms]: C513, 0       Os1175, 0       Os1175, 0       Os11720, 0       Os00040         Src. node 1, count, min, max, avg, sd [ms]: C513, 0       Os0715, 0       Os02925, 0       Os00932, 0       Os0032       Src. node 4, count, min, max, avg, sd [ms]: C513, 0       Os09135, 0       Os09224, 0       Os0033       Src. node 5, count, min, max, avg, sd [ms]: C513, 0       Os09135, 0       Os09225, 0       Os00032       Src. node 6, count, min, max, avg, sd [ms]: C513, 0       Os09135, 0       Os09225, 0       Os00225, 0       Os00033       Src. node 7, count, min, max, avg,	Dest.node 12, count, min, max, avg, sd [ms]:	6010 0.48007	5, 0.480100, 0.480114,	0.000040
Dest.node 15, count, min, max, avg, sd [ms]:       C0336475, 0.336186, 0.336116, 0.000040         Dest.node 15, count, min, max, avg, sd [ms]:       C0336475, 0.436160, 0.336116, 0.000040         PRes - time delta since SoC for NN or PReq(node)       0.486075, 0.486160, 0.486176, 0.486114, 0.000040         Count:       manging node, exourt, min, max, avg, sd [ms]:       272766, 0.011675, 0.01175, 0.007315, 0.000732, 0.000032         Src. node 1, count, min, max, avg, sd [ms]:       C0319, 0.007715, 0.007735, 0.000735, 0.000032       Src. node 3, count, min, max, avg, sd [ms]:       C0319, 0.007735, 0.000735, 0.000032         Src. node 3, count, min, max, avg, sd [ms]:       C0319, 0.007715, 0.007735, 0.000735, 0.000032       Src. node 4, count, min, max, avg, sd [ms]:       C0319, 0.007735, 0.000032         Src. node 4, count, min, max, avg, sd [ms]:       C0319, 0.007715, 0.000735, 0.000032       Src. node 8, count, min, max, avg, sd [ms]:       C0319, 0.007735, 0.000032         Src. node 5, count, min, max, avg, sd [ms]:       C0319, 0.007735, 0.000033       Src. node 8, count, min, max, avg, sd [ms]:       C0319, 0.007735, 0.000032         Src. node 7, count, min, max, avg, sd [ms]:       C0319, 0.007735, 0.000032       Src. node 8, count, min, max, avg, sd [ms]:       C0319, 0.007735, 0.000032         Src. node 8, count, min, max, avg, sd [ms]:       C0319, 0.007735, 0.000032       Src. node 8, count, min, max, avg, sd [ms]:       C0319, 0.007735, 0.000032         Src. node 1, count, min, max, avg, sd [ms]:	Dest node 14 count min max, avg, su [ms].	6010 0.03223	5 0.196160 0.196119	0.000040
Dest.node 15, count, min, max, avg, sd [ms]: 6519, 0.486075, 0.200205, 0.200216, 0.000040 - PRes - time delta since SoC for NN or PReq(node) - Count: 138381 Managing node, count, min, max, avg, sd [ms]: 27676, 0.011675, 0.011765, 0.011720, 0.000040 Src. node 1, count, min, max, avg, sd [ms]: 6519, 0.007151, 0.000216, 0.000040 Src. node 2, count, min, max, avg, sd [ms]: 6519, 0.007151, 0.000205, 0.000736, 0.0000032 Src. node 2, count, min, max, avg, sd [ms]: 6519, 0.000155, 0.000226, 0.0000032 Src. node 4, count, min, max, avg, sd [ms]: 6519, 0.000155, 0.000226, 0.0000033 Src. node 5, count, min, max, avg, sd [ms]: 6519, 0.0007151, 0.000226, 0.0000033 Src. node 5, count, min, max, avg, sd [ms]: 6519, 0.0007151, 0.0080005, 0.007733, 0.0000034 Src. node 6, count, min, max, avg, sd [ms]: 6519, 0.000155, 0.000226, 0.0000037 Src. node 7, count, min, max, avg, sd [ms]: 6519, 0.000155, 0.000226, 0.0000037 Src. node 8, count, min, max, avg, sd [ms]: 6519, 0.000155, 0.000226, 0.0000037 Src. node 8, count, min, max, avg, sd [ms]: 6519, 0.000155, 0.000226, 0.000037 Src. node 9, count, min, max, avg, sd [ms]: 6519, 0.000155, 0.000226, 0.000037 Src. node 10, count, min, max, avg, sd [ms]: 6519, 0.000155, 0.000226, 0.000037 Src. node 10, count, min, max, avg, sd [ms]: 6519, 0.000155, 0.000226, 0.000037 Src. node 11, count, min, max, avg, sd [ms]: 6519, 0.000155, 0.000226, 0.000037 Src. node 11, count, min, max, avg, sd [ms]: 6519, 0.000155, 0.000226, 0.000037 Src. node 11, count, min, max, avg, sd [ms]: 6519, 0.000715, 0.008005, 0.007738, 0.000034 Src. node 11, count, min, max, avg, sd [ms]: 6519, 0.000715, 0.008005, 0.007338, 0.000034 Src. node 12, count, min, max, avg, sd [ms]: 6519, 0.000715, 0.008005, 0.000733, 0.000034 Src. node 12, count, min, max, avg, sd [ms]: 6519, 0.000715, 0.008005, 0.000733, 0.000034 Src. node 12, count, min, max, avg, sd [ms]: 6519, 0.000735, 0.0008034 Src. node 12, count, min, max, avg, sd [ms]: 6519, 0.000735, 0.0008034 Src. node 13, count, min, max, avg, sd [ms]: 6519,	Dest node 15 count min max, avg, sd [ms]:	6919 9 33697	5 0.336160 0.336116	0.000040
PRes - time delta since SoC for NN or PReq(nod) Court: 138381 Managing node, ecourt, min, max, avg, sd [ms]: 27676, 0.011675, 0.011765, 0.011720, 0.000040 Src. node 1, court, min, max, avg, sd [ms]: 6019, 0.007155, 0.007365, 0.000032 Src. node 2, court, min, max, avg, sd [ms]: 6019, 0.007155, 0.008005, 0.007366, 0.000032 Src. node 4, court, min, max, avg, sd [ms]: 6019, 0.009155, 0.000226, 0.000032 Src. node 4, court, min, max, avg, sd [ms]: 6019, 0.009155, 0.000226, 0.000032 Src. node 5, court, min, max, avg, sd [ms]: 6019, 0.009155, 0.000226, 0.000032 Src. node 5, court, min, max, avg, sd [ms]: 6019, 0.007155, 0.000226, 0.000032 Src. node 5, court, min, max, avg, sd [ms]: 6019, 0.009155, 0.000226, 0.000031 Src. node 5, court, min, max, avg, sd [ms]: 6019, 0.009155, 0.000226, 0.0000032 Src. node 7, court, min, max, avg, sd [ms]: 6019, 0.009155, 0.000226, 0.0000032 Src. node 7, court, min, max, avg, sd [ms]: 6019, 0.009155, 0.000226, 0.0000037 Src. node 1, court, min, max, avg, sd [ms]: 6019, 0.00715, 0.0008005, 0.007733, 0.000034 Src. node 1, court, min, max, avg, sd [ms]: 6019, 0.00715, 0.0008005, 0.007733, 0.000034 Src. node 1, court, min, max, avg, sd [ms]: 6019, 0.00715, 0.008005, 0.007733, 0.000034 Src. node 1, court, min, max, avg, sd [ms]: 6019, 0.00715, 0.008005, 0.007733, 0.000034 Src. node 1, court, min, max, avg, sd [ms]: 6019, 0.007915, 0.008005, 0.007733, 0.000034 Src. node 1, court, min, max, avg, sd [ms]: 6019, 0.007915, 0.008005, 0.007733, 0.000034 Src. node 1, court, min, max, avg, sd [ms]: 6019, 0.007915, 0.008005, 0.007733, 0.000034 Src. node 1, court, min, max, avg, sd [ms]: 6019, 0.007915, 0.008005, 0.007933, 0.000034 Src. node 1, court, min, max, avg, sd [ms]: 6019, 0.007915, 0.008005, 0.007933, 0.000034 Src. node 1, court, min, max, avg, sd [ms]: 6919, 0.007915, 0.008005, 0.007933, 0.000032	Dest.node 16, count, min, max, avg, sd [ms]:	6919, 0.48607	5. 0.486160. 0.486114.	0.000040
- PRes - time delta since SoC for NN or PReq(node) Court: Managing node, excurt, min, max, avg, sd [ms]: 27676, 0.011675, 0.011765, 0.011700, 0.000040 Src. node 1, court, min, max, avg, sd [ms]: 6919, 0.007135, 0.007315, 0.007246, 0.000032 Src. node 2, Court, min, max, avg, sd [ms]: 6919, 0.007135, 0.009285, 0.009224, 0.000033 Src. node 4, court, min, max, avg, sd [ms]: 6919, 0.009155, 0.009285, 0.009226, 0.000033 Src. node 5, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.008005, 0.00733, 0.000023 Src. node 5, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.008005, 0.00733, 0.000029 Src. node 6, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.008005, 0.00733, 0.000029 Src. node 7, court, min, max, avg, sd [ms]: 6919, 0.009155, 0.009225, 0.0000226, 0.000037 Src. node 8, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.008005, 0.00733, 0.000034 Src. node 9, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.008005, 0.00733, 0.000034 Src. node 9, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.008005, 0.00733, 0.000034 Src. node 10, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.008005, 0.00733, 0.000034 Src. node 11, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.008005, 0.00733, 0.000034 Src. node 11, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.008005, 0.00733, 0.000034 Src. node 11, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.008005, 0.00733, 0.000034 Src. node 11, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.008005, 0.00733, 0.000034 Src. node 12, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.008005, 0.00733, 0.000034 Src. node 12, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.008005, 0.00733, 0.000034 Src. node 13, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.008005, 0.00733, 0.000034 Src. node 13, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.008005, 0.00733, 0.000034 Src. node 13, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.008005, 0.00733, 0.000034 Src. node 13, court, min, max, avg, sd [ms]: 6919, 0.00715, 0.008005, 0.00733, 0.000034 Src. node 13, court, min			·, ·····, ·····,	
Count:       138381         Managing ande, acount, min, max, avg, sd [ms]:       276765, 0.011675, 0.011765, 0.01726, 0.000040         Src. node 1, count, min, max, avg, sd [ms]:       6019, 0.00715, 0.00715, 0.007246, 0.000032         Src. node 2, count, min, max, avg, sd [ms]:       6019, 0.00715, 0.008005, 0.007246, 0.000032         Src. node 3, count, min, max, avg, sd [ms]:       6019, 0.00715, 0.009285, 0.009226, 0.000032         Src. node 4, count, min, max, avg, sd [ms]:       6019, 0.009155, 0.009285, 0.009226, 0.000038         Src. node 5, count, min, max, avg, sd [ms]:       6019, 0.009155, 0.009285, 0.009226, 0.000038         Src. node 6, count, min, max, avg, sd [ms]:       6019, 0.009155, 0.009225, 0.009226, 0.000038         Src. node 7, count, min, max, avg, sd [ms]:       6019, 0.009155, 0.009225, 0.009226, 0.000037         Src. node 8, count, min, max, avg, sd [ms]:       6019, 0.009155, 0.009225, 0.0090226, 0.000037         Src. node 8, count, min, max, avg, sd [ms]:       6019, 0.009155, 0.009226, 0.000037         Src. node 10, count, min, max, avg, sd [ms]:       6019, 0.000915, 0.009226, 0.000037         Src. node 11, count, min, max, avg, sd [ms]:       6019, 0.00715, 0.008005, 0.00733, 0.000034         Src. node 11, count, min, max, avg, sd [ms]:       6019, 0.007915, 0.008005, 0.007939, 0.000034         Src. node 11, count, min, max, avg, sd [ms]:       6919, 0.007915, 0.008005, 0.007939, 0.000034         Src. node 11, count, min, max, avg, s	- PRes - time delta since SoC for MN or PReg(nor	de) 🔨		
Managing node, acount, min, max, avg, sd [ms]:       27676,       0.011757,       0.011757,       0.011726,       0.000040         Src. node 1, count, min, max, avg, sd [ms]:       6019,       0.007135,       0.007315,       0.007315,       0.007315,       0.000032         Src. node 2, count, min, max, avg, sd [ms]:       6019,       0.007155,       0.007366,       0.000032         Src. node 3, count, min, max, avg, sd [ms]:       6019,       0.007155,       0.000225,       0.000032         Src. node 4, count, min, max, avg, sd [ms]:       6019,       0.007155,       0.000225,       0.000032         Src. node 5, count, min, max, avg, sd [ms]:       6519,       0.007155,       0.000225,       0.000034         Src. node 6, count, min, max, avg, sd [ms]:       6519,       0.007155,       0.000225,       0.0000224,       0.000034         Src. node 6, count, min, max, avg, sd [ms]:       6519,       0.007155,       0.000225,       0.000033         Src. node 7, count, min, max, avg, sd [ms]:       6519,       0.009155,       0.009226,       0.000037         Src. node 8, count, min, max, avg, sd [ms]:       6519,       0.009155,       0.009226,       0.000037         Src. node 19, count, min, max, avg, sd [ms]:       6519,       0.009255,       0.009226,       0.000034         Src. n	Count:	138381		
Src. node 1, count; min, max, avg, sd [ms]:       6919, 0.00715, 0.008005, 0.007936, 0.000032         Src. node 2, count; min, max, avg, sd [ms]:       6919, 0.00715, 0.008005, 0.007936, 0.000032         Src. node 3, count; min, max, avg, sd [ms]:       6919, 0.00715, 0.008005, 0.007936, 0.000032         Src. node 4, count; min, max, avg, sd [ms]:       6919, 0.009195, 0.009285, 0.009226, 0.000038         Src. node 4, count; min, max, avg, sd [ms]:       6919, 0.009195, 0.009285, 0.009226, 0.000038         Src. node 5, count; min, max, avg, sd [ms]:       6919, 0.00715, 0.008005, 0.007333, 0.0000029         Src. node 6, count; min, max, avg, sd [ms]:       6919, 0.009155, 0.009225, 0.0090226, 0.0000037         Src. node 7, count; min, max, avg, sd [ms]:       6919, 0.009155, 0.009225, 0.0090226, 0.000037         Src. node 8, count; min, max, avg, sd [ms]:       6919, 0.009155, 0.009225, 0.0090226, 0.000037         Src. node 9, count, min, max, avg, sd [ms]:       6919, 0.009155, 0.009225, 0.009034         Src. node 10, count, min, max, avg, sd [ms]:       6919, 0.00715, 0.008005, 0.00733, 0.000034         Src. node 11, count, min, max, avg, sd [ms]:       6919, 0.007915, 0.0080925, 0.009227, 0.0080934         Src. node 11, count, min, max, avg, sd [ms]:       6919, 0.007915, 0.0080055, 0.007939, 0.000034         Src. node 13, count, min, max, avg, sd [ms]:       6919, 0.007915, 0.0080055, 0.007939, 0.000034         Src. node 14, count, min, max, avg, sd [ms]:       6919, 0.007915, 0.0080055,	Managing node, count, min, max, avg, sd [ms]:	27676, 0.01167	5, 0.011765, 0.011720,	0.000040
Src. node       2, court, min, max, avg, sd [ms]:       6919,       0.007915,       0.000936       0.000736,       0.000936         Src. node       3, court, min, max, avg, sd [ms]:       6919,       0.009195,       0.009285,       0.009226,       0.000936         Src. node       4, count, min, max, avg, sd [ms]:       6919,       0.009195,       0.009285,       0.009226,       0.000936         Src. node       5, count, min, max, avg, sd [ms]:       6919,       0.009195,       0.009285,       0.009238,       0.000938         Src. node       5, count, min, max, avg, sd [ms]:       6919,       0.009195,       0.009285,       0.00733,       0.000034         Src. node       6, count, min, max, avg, sd [ms]:       6919,       0.009195,       0.009226,       0.000037         Src. node       8, count, min, max, avg, sd [ms]:       6919,       0.009195,       0.009226,       0.000037         Src. node       9, count, min, max, avg, sd [ms]:       6919,       0.009195,       0.009226,       0.000031         Src. node       10, count, min, max, avg, sd [ms]:       6919,       0.00715,       0.008005,       0.00733,       0.000034         Src. node       12, count, min, max, avg, sd [ms]:       6919,       0.00715,       0.008005,       0.00733,       0.00003	Src. node 1, count, min, max, avg, sd [ms]:	6919, 0.00717	5, 0.007315, 0.007246,	0.000032
Src. node 3, count, min, max, avg, sd [ms]:       6919, 0.009155, 0.009285, 0.009226, 0.000938         Src. node 4, count, min, max, avg, sd [ms]:       6919, 0.009155, 0.009285, 0.009226, 0.000938         Src. node 5, count, min, max, avg, sd [ms]:       6919, 0.009155, 0.009285, 0.009226, 0.000038         Src. node 6, count, min, max, avg, sd [ms]:       6919, 0.00715, 0.008005, 0.007933, 0.0000029         Src. node 6, count, min, max, avg, sd [ms]:       6919, 0.009155, 0.009225, 0.0090226, 0.0000029         Src. node 7, count, min, max, avg, sd [ms]:       6919, 0.009155, 0.009225, 0.009226, 0.0000037         Src. node 8, count, min, max, avg, sd [ms]:       6919, 0.009155, 0.009225, 0.009226, 0.000037         Src. node 9, count, min, max, avg, sd [ms]:       6919, 0.009155, 0.009235, 0.009226, 0.000034         Src. node 10, count, min, max, avg, sd [ms]:       6919, 0.00715, 0.008005, 0.007938, 0.000034         Src. node 11, count, min, max, avg, sd [ms]:       6919, 0.007915, 0.008005, 0.007938, 0.000034         Src. node 11, count, min, max, avg, sd [ms]:       6919, 0.009155, 0.008025, 0.009227, 0.0080034         Src. node 11, count, min, max, avg, sd [ms]:       6919, 0.009155, 0.009227, 0.0080032         Src. node 11, count, min, max, avg, sd [ms]:       6919, 0.009155, 0.008025, 0.007937, 0.000032         Y       Holliopht       Immin max, avg, sd [ms]:         Holliopht       Immin max       Immin max         I       Stre. node	Src. node 2, count, min, max, avg, sd [ms]:	6919, 0.00791	5, 0.008005, 0.007936,	0.000032
Src. node       4, count, min, max, avg, sd [ms];       6019,       0.009215,       0.009226,       0.008003         Src. node       5, count, min, max, avg, sd [ms];       6019,       0.007240,       0.008005,       0.007033,       0.0080014         Src. node       5, count, min, max, avg, sd [ms];       6019,       0.007240,       0.008005,       0.007033,       0.0080015         Src. node       6, count, min, max, avg, sd [ms];       6019,       0.00715,       0.0080055,       0.009226,       0.0080037         Src. node       8, count, min, max, avg, sd [ms];       6019,       0.00715,       0.0080055,       0.009226,       0.0080037         Src. node       9, count, min, max, avg, sd [ms];       6019,       0.00715,       0.0080055,       0.009226,       0.0080037         Src. node       9, count, min, max, avg, sd [ms];       6919,       0.00715,       0.0080056,       0.007338,       0.000034         Src. node       10, count, min, max, avg, sd [ms];       6919,       0.00715,       0.0080056,       0.007339,       0.000034         Src. node       12, count, min, max, avg, sd [ms];       6919,       0.009155,       0.008227,       0.000034         Src. node       12, count, min, max, avg, sd [ms];       6919,       0.009155,       0.009227,	Src. node 3, count, min, max, avg, sd [ms]:	6919, 0.00919	5, 0.009285, 0.009224,	0.000036
Src. node       5, count, min, max, avg, sd [ms]:       6919,       0.007140,       0.008005,       0.007939,       0.0000034         Src. node       6, count, min, max, avg, sd [ms]:       6919,       0.00715,       0.008005,       0.007933,       0.0000029         Src. node       7, count, min, max, avg, sd [ms]:       6919,       0.00715,       0.008005,       0.007226,       0.000029         Src. node       8, count, min, max, avg, sd [ms]:       6919,       0.009195,       0.009226,       0.000037         Src. node       9, count, min, max, avg, sd [ms]:       6919,       0.009195,       0.009226,       0.000037         Src. node       10, count, min, max, avg, sd [ms]:       6919,       0.00715,       0.008005,       0.007939,       0.000034         Src. node       11, count, min, max, avg, sd [ms]:       6919,       0.00715,       0.008005,       0.007939,       0.000034         Src. node       12, count, min, max, avg, sd [ms]:       6919,       0.007915,       0.008005,       0.007939,       0.000034         Src. node       12, count, min, max, avg, sd [ms]:       6919,       0.009715,       0.008005,       0.007939,       0.000032       V         HoNight       Image       6919,       0.009715,       0.008005,       0.007937,	Src. node 4, count, min, max, avg, sd [ms]:	6919, 0.00919	5, 0.009285, 0.009226,	0.000038
Src. node       6, count, min, max, avg, sd [ms]:       6919,       0.007915,       0.0080057,       0.009226,       0.000037         Src. node       7, count, min, max, avg, sd [ms]:       6919,       0.009125,       0.009226,       0.000037         Src. node       8, count, min, max, avg, sd [ms]:       6919,       0.009125,       0.009226,       0.000037         Src. node       9, count, min, max, avg, sd [ms]:       6919,       0.009125,       0.009226,       0.000037         Src. node       10, count, min, max, avg, sd [ms]:       6919,       0.009125,       0.009285,       0.00733,       0.000031         Src. node       10, count, min, max, avg, sd [ms]:       6919,       0.00715,       0.0080805,       0.00733,       0.000034         Src. node       11, count, min, max, avg, sd [ms]:       6919,       0.009125,       0.009227,       0.000034         Src. node       12, count, min, max, avg, sd [ms]:       6919,       0.009125,       0.009227,       0.000033         Src. node       13, count, min, max, avg, sd [ms]:       6919,       0.009195,       0.009227,       0.000033         Src. node       13, count, min, max, avg, sd [ms]:       6919,       0.009195,       0.009227,       0.000033         Src. node       13, count, min, max, avg, sd [	Src. node 5, count, min, max, avg, sd [ms]:	🥑 6919, 0.00784	0, 0.008005, 0.007939,	0.000034
Src. node 7, count, min, max, avg, sd [ms]:       6919,       0.009195,       0.009285,       0.009226,       0.000037         Src. node 8, count, min, max, avg, sd [ms]:       6919,       0.009195,       0.009285,       0.009226,       0.000037         Src. node 9, count, min, max, avg, sd [ms]:       6919,       0.009195,       0.009285,       0.009236,       0.000037         Src. node 9, count, min, max, avg, sd [ms]:       6919,       0.00715,       0.008005,       0.007938,       0.000034         Src. node 10, count, min, max, avg, sd [ms]:       6919,       0.00715,       0.008005,       0.00739,       0.000034         Src. node 11, count, min, max, avg, sd [ms]:       6919,       0.00715,       0.008005,       0.00739,       0.000034         Src. node 11, count, min, max, avg, sd [ms]:       6919,       0.007915,       0.008005,       0.00739,       0.000034         Src. node 11, count, min, max, avg, sd [ms]:       6919,       0.009195,       0.009227,       0.000032       V         HoMight:	Src. node 6, count, min, max, avg, sd [ms]:	6919, 0.00791	5, 0.008005, 0.007933,	0.000029
Src. node 8, count, min, max, avg, sd [ms]:       6919,       0.009715,       0.008005,       0.009037         Src. node 9, count, min, max, avg, sd [ms]:       6920,       0.007915,       0.008005,       0.007938,       0.000034         Src. node 10, count, min, max, avg, sd [ms]:       6919,       0.007915,       0.008005,       0.007939,       0.000034         Src. node 11, count, min, max, avg, sd [ms]:       6919,       0.007915,       0.008005,       0.007939,       0.000034         Src. node 12, count, min, max, avg, sd [ms]:       6919,       0.009155,       0.009227,       0.000033         Src. node 13, count, min, max, avg, sd [ms]:       6919,       0.009155,       0.009227,       0.000033         Highlight:	Src. node 7, count, min, max, avg, sd [ms]:	6919, 0.00919	5, 0.009285, 0.009226,	0.000037
Src. node 9, count, min, max, avg, sd [ms]       6920, 0.007915, 0.008005, 0.007938, 0.000934         Src. node 10, count, min, max, avg, sd [ms]       6919, 0.007915, 0.008005, 0.007939, 0.000034         Src. node 11, count, min, max, avg, sd [ms]       6919, 0.007915, 0.008005, 0.007939, 0.000034         Src. node 11, count, min, max, avg, sd [ms]       6919, 0.009715, 0.008005, 0.007939, 0.000034         Src. node 12, count, min, max, avg, sd [ms]       6919, 0.009195, 0.008925, 0.009227, 0.000038         Src. node 13, count, min, max, avg, sd [ms]       6919, 0.007915, 0.008005, 0.007937, 0.000032         Hohlight:	Src. node 8, count, min, max, avg, sd [ms]:	6919, 0.00919	5, 0.009285, 0.009226,	0.000037
Src. node 10, count, min, max, avg, sd [ms]:       6919,       0.007915,       0.008005,       0.007939,       0.000034         Src. node 11, count, min, max, avg, sd [ms]:       6919,       0.007915,       0.008005,       0.007939,       0.000034         Src. node 11, count, min, max, avg, sd [ms]:       6919,       0.007915,       0.008005,       0.007939,       0.000034         Src. node 11, count, min, max, avg, sd [ms]:       6919,       0.007915,       0.008005,       0.007937,       0.000038         Src. node 13, count, min, max, avg, sd [ms]:       6919,       0.007915,       0.008005,       0.007937,       0.000032       v         Hyhlight:	Src. node 9, count, min, max, avg, sd [n	6920, 0.00791	5, 0.008005, 0.007938,	0.000034
Src. node 11, count, min, max, avg, sd [ms]:       6919,       0.007915,       0.008005,       0.007939,       0.000034         Src. node 12, count, min, max, avg, sd [ms]:       6919,       0.009195,       0.009285,       0.009227,       0.000038         Src. node 13, count, min, max, avg, sd [ms]:       6919,       0.009195,       0.009285,       0.00927,       0.000038         Hohlight:	Src. node 10, count, min, max, avg, sd [ms]:	6919, 0.00791	5, 0.008005, 0.007939,	0.000034
Src. node 12, count, min, max, avg, sd [ms]:         6919,         0.009195,         0.009285,         0.009227,         0.000038           Src. node 13, count, min, max, avg, sd [ms]:         6919,         0.007915,         0.008005,         0.007937,         0.000032           Highlight:	Src. node 11, count, min, max, avg, sd [ms]:	6919, 0.00791	5, 0.008005, 0.007939,	0.000034
Src. node 13, count, min, max, avg, sd [ms]: 6919, 0.007915, 0.008005, 0.007937, 0.000032	Src. node 12, count, min, max, avg, sd [ms]:	6919, 0.00919	5, 0.009285, 0.009227,	0.000038
Highlight Class	Src. node 13, count, min, max, avg, sd [ms]:	6919, 0.00791	5, 0.008005, 0.007937,	0.000032
Clara	Highlight:			
UBP				Close

Figure 51: Powerlink Timing Window

Wireshark - Powerlink Timing Statistics	R					?	>
Dest.node 5, count, min, max, avg, sd [m	s]: 6919,	0.032235,	0.032325,	0.032280,	0.000040		
Dest.node 6, count, min, max, avg, sd [m	s]: 6919,	0.186075,	0.186160,	0.186118,	0.000040		
Dest.node 7, count, min, max, avg, sd [m	s]: 6919,	0.336075,	0.336160,	0.336116,	0.000040		
Dest.node 8, count, min, max, avg, sd [m	s]: 6919,	0.486075,	0.486160,	0.486114,	0.000040		
Dest.node 9, count, min, max, avg, sd [m	s]: 6919,	0.032235,	0.032325,	0.032280,	0.000040		
Dest.node 10, count, min, max, avg, sd [m	s]: 6920,	0.186075,	0.186160,	0.186118,	0.000040		
Dest.node 11, count, min, max, avg, sd [m	s]: 6919,	0.336075,	0.336160,	0.336116,	0.000040		
Dest.node 12, count, min, max, avg, sd [m	s]: 6919,	0.486075,	0.486160,	0.486114,	0.000040		
Dest.node 13, count, min, max, avg, sd [m	s]: 6919,	0.032235,	0.032325,	0.032280,	0.000040		
Dest.node 14, count, min, max, 🕋, sd [m	s]: 6919,	0.186075,	0.186160,	0.186118,	0.000040		
Dest.node 15, count, min, max, avg, sd [m	s]: 6919,	0.336075,	0.336160,	0.336116,	0.000040		
Dest.node 16, count, min, max, avg, sd [m	s]: 6919,	0.486075,	0.486160,	0.486114,	0.000040		
PRes time delta since Sof for MN or PRes	(node)	-2					
Count:	138381						
Managing node, count, min, max, avg, sd [m	s]: 27676,	0.011675,	0.011765,	0.011720,	0.000040		
Src. node 1, count, min, max, avg, sd [m	s]: 6919.	0.007175	0.007315.	0.007246	0,000032		
Src. node 2, count min, max, avg, sd [m	s]: 6919.	0.007915.	0.008005.	0.007936	0.000032		
Src. node 3. count. min. max. avg. sd [m	s]: 6919.	0.009195.	0.009285.	0.009224.	0.000036		
Src. node 4. count, min, max avg. sd [m	s]: 6919.	0.009195.	0.009285.	0.009226.	0.000038		
Src. node 5, count, min, max, avg. sd [m	s]: 6919.	0.007840	0.008005.	0.007939.	0.000034		
Src. node 6, count, min, max, avg. sd [m	6919	0.007915.	0.008005.	0.007933.	0.000029		
Src. node 7, count, min, max, avg, sd [m	s]: 3 6919.	0.009195.	0.009285.	0.009226.	0.000037		
Src. node 8. count. min. max. avg. sd [m	s1: 6919.	0.009195	0.009285	0.009226	0.000037		
Src. node 9. count. min. max. avg. sd [m	s1: 6920.	0.007915	0.008005	0.007938	0.000034		
Src. node 10. count. min. max. avg. sd [m	s]: 6919.	0.007915	0.008005	0.007939	0.000034		
Src. node 11. count. min. max. avg. sd [m	s]: 6919.	0.007915	0.008005	0.007939	0.000034		
Src. node 12, count, min, max, avg. sd [m	s]: 6919	0.009195	0.009285	0.009227	0.000038		
Src node 13 count min max, avg, sd [m	c]· 6010	0.007915	0.003205,	0.007937	0.000030		
Src node 14 count min, max, avg, sd [m	s]. 6010	0.007915	0.000005,	0.007940	0.000032		
She node 15 count min max, avg, sd [m	s1. 6010	0.0079195	0.0000005,	0.0007340,	0.000033		
She hade 16 count min, max, avg, sd [m	6010	0.009195,	0.009285,	0.009229,	0.000038		
Site node 10, count, min, max, avg, su mi	isj. 0919,	0.009199,	0.009285,	0.005227,	0.000058		
SoA - time delta since SoC	5,7676	0 626075	0 636160	0 626112	0 000040		
councy min, max, avg, su [ms].	2/0/0,	0.030073,	0.050100,	0.050115,	0.000040		
ASnd - time delta since SoA 🛛 🖊							
Count:	2768						
Src. node 32, count, min, max, avg, sd [m	s]: 2768,	0.008075,	0.008165,	0.008126,	0.000039		
blight							_
iigina							
						Clo	ose

Figure 52: Powerlink timing window (cont.)



## 12.1.3. CDI2 Statistics

Similar to the Powerlink timing, a tool for timing statistics in the CDI2 protocol is provided. It can be started by clicking "Statistics" (1) -> "CDI2 Statistics..." (2).

	*Profila	р																	
File	Edit	View	Go	Capture	Analyze	Statisti	cs	Telephony	Wirele	ess Tools	Help								
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	nnlv a dis	nlav filte	r <0	 trl-/>	/	Re	sol	ved Addresses	;										_
Ne.	ppij a alo	Time				Pro	oto	col Hierarchy				1.00	- 41-	7-6-			_		
NO.	مدحدمح	11me			Source	Co	onve	ersations				Len		11110	255	00	<b>F</b> 4	4201	<b>F</b> . <b>D</b>
	303320	27.32	5084	- A	AltAustr_	En	dp	oints				14	+04 70	240	200	PRes	[14	428]	F:K
	202222	27.2	020	4	AILAUSTr_	- Pa	icke	t Lengths				ľ 1.	12	240-2	2	PReq	L [1]	נש בסבוי	F : K
	202222	27.52	5020	н 1	AltAustr_ AitAustr	1/0	) G	raph				14	72	240->	2))	DReg	[14	420] 01	F.N
	303322	27.32	5080		litAustr	Se	rvic	e Response Ti	me		,	ľ 1/	164	3-1	255	DRes	L [1,	1281	E · R
	303325	27.32	20		itAustr			te nesponse n	inc.			1	72	240-3	× 4	PRea	[1.	01	E:R
	303326	27.32	6139	, A	AitAustr	- CE	212	Statistics		↓ ♪		ľ 14	164	4->	255	PRes	[1/	4281	F:R
	303327	27.32	6280	F	AitAustr	DI	HCF	P (BOOTP) Stat	istics				72	240->	255	SoA	(N	0 SE	RVICE
	303328	27.32	6644	A	AitAustr	10	NC-	RPC Programs					72	240->	255	SoC		_	
	303329	27.32	6656	A	AitAustr	Po	wei	rlink Timing					244	240->	255	PRes	[ ]	208]	F:R
	303330	27.32	6676	A	AitAustr_	29	We	st			•	ŀ.	72	240->	> 5	PReq	[	0]	F:R
	303331	27.32	6684	A	AitAustr_	A	NCP	•				14	164	5->	255	PRes	[14	428]	F:R
	303332	27.32	6830	A	AitAustr_	BA	۱Cn	et			•	ŀ.	72	240->	<mark>⊳ 6</mark>	PReq	[	0]	F:R
	303333	27.32	6838	A	AitAustr_	Co	ollee	ctd				14	164	6->	255	PRes	[14	428]	F:R
	303334	27.32	6980	А	AitAustr_	DI	٧S					ŀ.	72	240->	> 7	PReq	[	0]	F:R
	303335	27.32	6989	A	AitAustr_	Flo	ow (	Graph				14	164	7->	255	PRes	[14	428]	F:R
	303336	27.32	7130	Α	AitAustr_	- н/	ART	-IP				ŀ.	72	240->	> 8	PReq	[	0]	F:R
	303337	27.32	7139	Α	AitAustr_	- HF	PFEI	EDS				14	164	8->	>255	PRes	[14	428]	F:R
>	Frame 1	1: 146	i4 by	tes or	n wire (1	н н	гтр				•	bit	5) (	on in	terf	ace 0		0	000
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>	Etherne	et POW	IERLI	NK		TC	PS	tream Graphs			•							0	030
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						IP۱	v6 S	Statistics			•							0	080
												_						0	090
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Figure 53: CDI2 Statistics window

## 12.1.4. Expert Info

Wireshark is able to detect errors in dissected packets. The CDI2 Wireshark plugins extend this capability also to the CDI2 protocol.

To see an overview of all messages that describe these errors, the "Expert Information" dialog is used. It can be opened by clicking "Analyse" (1) -> "Expert Information" (2). For large captures the loading time can be quite long, the status indictor (3) shows whether the loading is completed.



*D     *D     *D					
File Edit View Go Cap	ture Analyze Statistics Telephony Wireley	s Tools	Help		
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	Display Filter Macros	~			
Apply a display filter <ctrl< td=""><td></td><td></td><td></td><td></td><td></td></ctrl<>					
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303320 27.325684	Ai Apply as Filter 🕨		CDI2	1464	- 1
303322 27.325830	Ai Prepare a Filter 🕨	5:22	POWER	72	24(
303322 27.325838	Ai Conversation Filter		CDI2	1464	. 1
303323 27.325980	Ai	5:23	POWER	72	24(
303324 27.325989	Ai Enabled Protocols Ctrl+Shift+E		CDI2	1464	- 1
303325 27.326130	Ai Decode As	5:24	POWER	72	24(
303326 27.326139	Ai Reload Lua Plugins Ctrl+Shift+L		CDI2	1464	. 4
303327 27.326280	Ai SCTP		POWER	72	240
303328 27.326644	Ai Follow		POWER	72	24(
303329 27.326656	Ai		CDI2	244	24(
303330 27.326676	Ai Expert Information	5:25	POWER	72	24(
303331 27.326684	AitAustr_9f:c5:25 EPLv2_PRes		CDI2	1464	
303332 27.326830	AitAustr_9f:c5:1d AitAustr_9f:	c5:26	POWER	72	24(
303333 27.326838	AitAustr_9f:c5:26 EPLv2_PRes		CDI2	1464	. (
303334 27.326980	AitAustr_9f:c5:1d AitAustr_9f:	c5:27	POWER	72	24(
303335 27.326989	AitAustr_9f:c5:27 EPLv2_PRes		CDI2	1464	
303336 27.327130 3	AitAustr_9f:c5:1d AitAustr_9f:	c5:28	POWER	72	240
303337 27.327139	AitAustr_9f:c5:28 EPLv2_PRes		CDI2	1464	
> Frame 1: 1464 bytes	on wire (11712 bits), 1464 bytes o	aptured	(11712	oits)	on
> ProfiShark /					
> Ethernet II, Src: A	itAustr_9f:c5:29 (00:60:36:9f:c5:29	), Dst:	EPLv2_PI	Res (0	1:1
> Ethernet POWERLINK					
● Z wireshark_1D0BBEEC-E	85B-4783-98BE-303AE31D22C2_20180717101854_a08	504			

Figure 54: Expert Information

## 12.1.5. Apply filter expressions

Wireshark offers display filters to select specific packets and to exclude frames without interest. A standard filter equation for CDI2 is preinstalled and can be activated with the button "CDI2" (1). The filter selects active CDI2 packets with valid BNIDs (BNID not equal 0xFFFFFFF). It can be used to track banknote results in sorting mode. Furthermore, the colouring of frames is used to indicate the type and content of packets. An example screen is shown in Figure 56. Due to the applied CDI2 filter equation, only frames with a valid BNID are shown. The colouring of the frames indicates the type of frame.

BSMINFO frame with at least one trigger
BSMINFO frame with banknote recognition
frame with valid BNRESULT
frame with valid BNRECOGNITION (coming from CS usually)

User-Manual-CDI2SIM-v1r10-tracked.docx



the text that you want to appear here.

Help								×	
							Expression +	- CD	)12
Protocol	Length	Info							^
POWER	72	240->255	SoC						
CDI2	244	240->255	PRes	[ 208]	F:RD=1,RS=0,PR=0	V=0.0	NMT_MS_OPER		
POWER	72	240-> 13	PReq	[ 0]	F:RD=1 V:0.0				
CDI2	1464	13->255	PRes	[1428]	F:RD=1,RS=0,PR=0	V=0.0	NMT_CS_OPER		
POWER	72	240-> 14	PReq	[ 0]	F:RD=1 V:0.0				
CDI2	1464	14->255	PRes	[1428]	F:RD=1,RS=0,PR=0	V=0.0	NMT_CS_OPER		
POWER	72	240-> 15	PReq	[ 0]	F:RD=1 V:0.0				
CDI2	1464	15->255	PRes	[1428]	F:RD=1,RS=0,PR=0	V=0.0	NMT_CS_OPER		
POWER	72	240-> 16	PReq	[ 0]	F:RD=1 V:0.0				
CDI2	1464	16->255	PRes	[1428]	F:RD=1,RS=0,PR=0	V=0.0	NMT_CS_OPER		
POWER	72	240->255	SoA	(NO_SER	RVICE)-> 0 NMT_M	S_OPERAT	IONAL		
POWER	72	240->255	SoC						
CDI2	244	240->255	PRes	[ 208]	F:RD=1,RS=0,PR=0	V=0.0	NMT_MS_OPER		
DOLIED	70	240 . 1	DD	۲ n	F.DD 4 14.0 0				

Figure 55: CDI2 filter

BSM-002-Sorting-500E	N-16CNs.pcapng.gz							- C	× L
File Edit View Go Ca	apture Analyze Statistics	Telephony Wirel	ess Tools He	lp					
	र्षे 🖸 । 🤇 🗢 🏓 🚟 🛉 .	🛓 📃 📄 🔍 G	a, a, 🏦						
9 == 0xfffffff && cdi2.tctrig.	bnid10 == 0xffffffff && cdi2.tctrig	g.bnid11 == 0xffffffff &	& cdi2.tctrig.bnid1	2 == 0xfffffff && cdi2	tctrig.bnid13 == 0x	fffffff && cdi2.tctrig.bnid14 == 0xffffffff && co	di2.tctrig.bnid15 == 0xfffffff && cdi2.tctrig.bnid16	== 0xffffffff)) 🛛 🖃 💌 Expression	. + CD12
No. Time	Source	Destination	Protocol Le	ength Info					^
49277 4.438964	AitAustr_9f:c5:2d	EPLv2_PRes	CDI2	1464 13->255	PRes [1428]	F:RD=1,RS=0,PR=0 V=0.0 NMT	T_CS_OPERATIONAL, CDI2: BNRESULT	DS_SORTING RESULT(1, 2)	
49279 4.439119	AitAustr_9f:c5:2e	EPLv2_PRes	CDI2	1464 14->255	PRes [1428]	F:RD=1,RS=0,PR=0 V=0.0 NM1	T_CS_OPERATIONAL, CDI2: BNRESULT	DS_SORTING RESULT(1, 2)	
49281 4.439269	AitAustr_9f:c5:2f	EPLv2_PRes	CD12	1464 15->255	PRes [1428]	F:RD=1,RS=0,PR=0 V=0.0 NMI	I_CS_OPERATIONAL, CD12: BNRESULT	DS_SORTING RESULT(1, 2)	
49288 4.439965	AltAustr_9f:c5:21	EPLV2_PRes	CDI2	1464 1->255	PRes [1428]	F:RD=1,RS=0,PR=0 V=0.0 NM	T_CS_OPERATIONAL, CDI2: BNRESULT	DS_SORTING REC(2)	
49297 4.440954	AitAustr_9f.c5.1d	EPLV2_PRes	CDI2	244 240-2233	PRes [ 200]	E-PD-1 PS-0 DP-0 V-0 0 NM1	T_MS_OPERATIONAL, CD12. DSMINFO I	SS_SURTING TO TRIG.	
49308 4.441934	AitAustr_9f:c5:1d	EPLV2_PRes	CD12	244 240-2255	PRes [ 208]	E-RD-1 RS-0 PR-0 V-0 0 NMT	T_MS_OPERATIONAL_CD12: BSMINFO I	RS SORTING TC_TRIG:	
49333 4, 443965	AitAustr 9f:c5:21	EPLV2_PRes	CDT2	1464 1->255	PRes [1428]	E:RD=1,RS=0,PR=0, V=0,0, NMT	T CS OPERATIONAL, CDT2: BNRESULT	DS_SORTING_RESULT(2, 0)	
49342 4,444934	AitAustr 9f:c5:1d	EPLv2 PRes	CDI2	244 240->255	PRes [ 208]	F:RD=1,RS=0,PR=0 V=0.0 NMT	T MS OPERATIONAL, CDI2: BSMINFO I	BS SORTING TC TRIG:+	
49401 4.450117	AitAustr 9f:c5:2a	EPLv2 PRes	CDI2	1464 10->255	PRes [1428]	F:RD=1,RS=0,PR=0 V=0.0 NMT	T CS OPERATIONAL, CDI2: BNRESULT	DS SORTING RESULT(2, 0)	
49403 4.450269	AitAustr_9f:c5:2b	EPLv2_PRes	CDI2	1464 11->255	PRes [1428]	F:RD=1,RS=0,PR=0 V=0.0 NMT	T_CS_OPERATIONAL, CDI2: BNRESULT	DS_SORTING RESULT(2, 0)	
49405 4.450420	AitAustr_9f:c5:2c	EPLv2_PRes	CDI2	1464 12->255	PRes [1428]	F:RD=1,RS=0,PR=0 V=0.0 NMT	T_CS_OPERATIONAL, CDI2: BNRESULT	DS_SORTING RESULT(2, 0)	
49408 4.450934	AitAustr_9f:c5:1d	EPLv2_PRes	CDI2	244 240->255	PRes [ 208]	F:RD=1,RS=0,PR=0 V=0.0 NM1	T_MS_OPERATIONAL, CDI2: BSMINFO	BS_SORTING TC_TRIG:+-	
49410 4.450963	AitAustr_9f:c5:2d	EPLv2_PRes	CDI2	1464 13->255	PRes [1428]	F:RD=1,RS=0,PR=0 V=0.0 NMT	T_CS_OPERATIONAL, CDI2: BNRESULT	DS_SORTING RESULT(2, 0)	
49412 4.451119	AitAustr_9f:c5:2e	EPLv2_PRes	CDI2	1464 14->255	PRes [1428]	F:RD=1,RS=0,PR=0 V=0.0 NMT	T_CS_OPERATIONAL, CDI2: BNRESULT	DS_SORTING RESULT(2, 0)	
49414 4.451269	AitAustr_9f:c5:2f	EPLv2_PRes	CD12	1464 15->255	PRes [1428]	F:RD=1,RS=0,PR=0 V=0.0 NMT	T_CS_OPERATIONAL, CDI2: BNRESULT	DS_SORTING RESULT(2, 0)	
49446 4.454117	AitAustr_9f:c5:2a	EPLv2_PRes	CDI2	1464 10->255	PRes [1428]	F:RD=1,RS=0,PR=0 V=0.0 NM1	T_CS_OPERATIONAL, CDI2: BNRESULT	DS_SORTING RESULT(2, 1)	
49448 4.454268	AitAustr_9f:c5:2b	EPLv2_PRes	CD12	1464 11->255	PRes [1428]	F:RD=1,RS=0,PR=0 V=0.0 NMI	T_CS_OPERATIONAL, CD12: BNRESULT	DS_SORTING RESULT(2, 1)	
49450 4.454420	AitAustr_91:c5:2c	EPLV2_PRes	CD12	1464 12->255	PRes [1428]	F:RD=1,RS=0,PR=0 V=0.0 NMI	I_CS_OPERATIONAL, CDI2: BNRESULT	DS_SORTING RESULT(2, 1)	
49455 4.454963	AitAustr_9f:c5:20	EPLV2_PRes	CD12	1464 13->255	PRes [1428]	F:RD=1,RS=0,PR=0 V=0.0 NMI	T_CS_OPERATIONAL, CDI2: BNRESULT	DS_SURTING RESULT(2, 1)	
49457 4.455118	AILAUSUP_9T:C5:20	EPLVZ_PRes	CD12	1404 14->255	PRES [1428]	F:RD=1,RS=0,PR=0 V=0.0 NM	T_CS_OPERATIONAL, CDIZ: BNRESULT	DS_SURTING RESULT(2, 1)	×
Size: 1428						^ 0000 01 11 1e 00	00 02 00 60 36 9f c5 2e 88 ab	04 ff` 6	. ^
✓ CDI2 Powerlink	Protocol					0010 0e fd 21 00	00 00 94 05 41 2b 11 00 00 06 0	00 00! A+	•
Command ID:	BNRESULT (65)						00 00 01 00 01 00 00 00 00 00 00	31 00	•
Sequence Nr:	4395					0040 00 00 00 00		30 00	
Device State	: DS_SORTING (6)					0050 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00	0 00	
> Error State:	0×00					0060 00 00 00 00	00 00 00 00 00 00 00 00 00 00	00 00	
> Maintenance	State: 0x00					0070 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00	30 00	
<ul> <li>Recognition</li> </ul>	on RNTD: 4204067205 /	involid)				0080 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00 00	30 00	•
Recogniti	on Banknote Senjes: T	invaiiu) Get / Calibrat	ion (0)					00 00	·
Denominat	ion: undefined (0)	csc / cariorat	2011 (0)			00b0 00 00 00 00 00		30 00	:
Recogniti	on Orientation: Front	(1)				00c0 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00	30 00	:
Reserved		~-/				00 00 00 00 0b00 V	00 00 00 00 00 00 00 00 00 00	00 00	
BSM-002-Sorting-50	DBN-16CNs						Packets: 172754 · Displayed: 19495 (11.3%) ·	Load time: 0:9.25 Prof	file: Default

Figure 56: CDI2 filter and colouring of frames

## 12.1.6. CDI2 Protocol Settings

The CDI2 dissector plugin accepts parameters via the Wireshark protocol setting dialog,

*Edit->Preferences->Protocols->CDI2*. The same dialog can be opened alternatively by a right-click on a captured CDI2 frame and selecting *Protocol Preferences -> Open CDI2 Powerlink Protocol preferences*.

Essentially, this dialog gives user access to the limits used by the timing checker for the Expert Info [see 12.1.4]. Figure 57 shows a *CDI2 Powerlink Protocol preferences* dialog example.
CDI2SIM: Error! Use the Home tab to apply Titel to the text that you want to appear here. User Manual



Wireshark - Preferences BT MCAP BT RFCOMM BT SAP BT SDP BT VDP BT-DHT BT-UTP BTSNOOP Bundle BVLC C12.22 CAMEL CAN CAPWAP-CONTROL CAPWAP-CONTROL CAPWAP-DATA CAST CAT-TP CCSDS CDI2 CESoPSN basic (no RTP) CFDP CFLOW chargen CHDLC CIGI	1       3       4       5         CD2 Powerlink Protocol       Dissector version: 0.38       4       5         Maximum time for BNREC computation [ms]       5       6       6         Maximum time for BNREC to BNINFO [ms]       4       6       7         Maximum time for BNRESULT computation for detectors [ms]       42       7       7         Maximum time for BNRESULT computation for CS/IEUs [ms]       72       8         Camera system is computing results       9       9         Maximum BNRESULT computation time for node 1 [ms]       0       9         Maximum BNRESULT computation time for node 2 [ms]       0       7         Maximum BNRESULT computation time for node 4 [ms]       0       10         Maximum BNRESULT computation time for node 4 [ms]       0       10         Maximum BNRESULT computation time for node 4 [ms]       0       10         Maximum BNRESULT computation time for node 5 [ms]       0       10         Maximum BNRESULT computation time for node 8 [ms]       0       10         Maximum BNRESULT computation time for node 8 [ms]       0       10         Maximum BNRESULT computation time for node 9 [ms]       0       10         Maximum BNRESULT computation time for node 9 [ms]       0       10
CFDP CFLOW chargen CHDLC CIGI CIMD CIP CISC03 ERSPAN MARKEF CLDAP CLDP CLDP CMP CMP	Maximum BNRESULT computation time for node 9 [ms]       0         Maximum BNRESULT computation time for node 10 [ms]       0         Maximum BNRESULT computation time for node 11 [ms]       0         Maximum BNRESULT computation time for node 12 [ms]       0         Maximum BNRESULT computation time for node 13 [ms]       0         Maximum BNRESULT computation time for node 14 [ms]       0         Maximum BNRESULT computation time for node 15 [ms]       0         Maximum BNRESULT computation time for node 16 [ms]       0

Figure 57: CDI2 Powerlink Protocol settings

- (1) Wireshark Preferences dialog
- (2) Select CDI2 Protocol
- (3) Dissector version info [see 12.1.7 also]
- Maximum time for the CS to send the BNRECOGNITION packet (default: 25 ms) (4)
- (5) Maximum time for the BSM to send the received BNRECGNITION in the BSMINFO packet (default: 4 ms)
- (6) Maximum time for a Detector to send its BNRESULT after trigger (default: 42 ms)
- Maximum time for a CS or IEU to den its BNRESULT after trigger (default: 72 ms) (7)
- (8) When checked, the CS is expected to send BNSRESULT (default: checked)
- Expert mode: when checked, the maximum BNRESULT time can be set for each node (9) individually (default: unchecked)
- (10) Maximum BNRESULT time for each node. Use 42 ms for a Detector and 72 ms for a CS or IEU. A value of 0 ms disables the timing check for a node.

Due to a fundamental limitation of the Wireshark dissector implementation, the CDI2 dissector may fail to determine the CDI2 type (CS, IEU, DET) of a controlled node from the network packet log for the first few (up to 5) banknotes. This may lead to inadvertent warnings for those banknotes. To overcome this effect, the expert mode settings are provided. The user can set individual maximum BNRESULT time values for each of the nodes 1 to 16 and the automatic detection of the CDI2 type (CS, IEU, DET) is ignored in this case. As a default the user shall enter 42 ms for a Detector and 72 ms for a CS or IEU. A value of 0 ms disables the timing check for a node.



An example with expert mode enabled is shown in Figure 58. Assuming node 1 is a CS, nodes 2 to 9 being Detectors and nodes 10 to 16 being IEUs.

Figure 58: CDI2 Powerlink Protocol settings - Expert mode

- (1) Expert mode: when checked, the maximum BNRESULT time can be set for each node individually
- (2) Maximum BNRESULT computation time for node 1. Use 72 ms for a CS.
- (3) Maximum BNRESULT computation time for node 2. Use 42 ms for a Detector.
- (4) Maximum BNRESULT computation time for node 10. Use 72 ms for an IEU.

Note that the BNRECOGNITION and BNRESULT delays for the timing checks include the banknote capture time. Thus, the actual values depend on assumptions for the banknote length and the transport speed. Above examples assume 200 mm banknote length and 12.5 m/s banknote transport speed. Further it is assumed that the node does not request a none-zero trigger offset in its *device\_info.xml* (bpOffset=0).

Following calculations apply accordingly.

BNRECOGNITION time of a CS:

220mm capture length / 12.5m/s = 17.6ms + 3ms Recognition + 4ms Powerlink Transmission => 24.6ms

BNRESULT time of a CS or IEU:

220mm capture length / 12.5m/s = 17.6ms + 5ms image transmission + 45ms Calculation + 4ms Powerlink Transmission => 71.6ms



#### BNRESULT time of a Detector:

220mm capture length / 12.5m/s = 17.6ms + 20ms Calculation + 4ms Powerlink Transmission => 41.6ms

### 12.1.7. Version Information

The Wireshark version used for the GUI PC is Version 2.4.5 (v2.4.5-0-g153e867ef1) or later. It can be checked by going to Help -> About Wireshark.

Using the "About Wireshark" dialog also allows checking of the installed plugins via the "Plugins" tap. New dissectors or updates to existing ones can be installed to the "Personal Plugins" folder listed in the "Folders" tab.



Figure 59: About Wireshark

In the Folders Tab the Wireshark tool lists the actual folders for Plugins. An example is shown in Figure 60.



CDI2SIM: Error! Use the Home tab to apply Titel to

the text that you want to appear here.

About Wir	eshark			\$		?	×
Wireshark	Authors	Folders	Plugins	Keyboard Shortcuts	License		
Name		Location			Typical Files		
"File" dialog	s	C:\Acceptanc	e\201810t	ance TK\DS_BSM-017\	capture files		
Temp		C:\Users\CDI	2\AppData\L	ocal\Temp	untitled capture files		
Personal cor	nfiguration	C:\Users\CDI	2\AppData\R	toaming\Wireshark\	dfilters, preferences, ethers,		
Global config	guration	C:\Program F	iles\Wiresha	<u>ark</u>	dfilters, preferences, manuf,		
System		C:\Program F	iles\Wiresha	<u>ark</u>	ethers, ipxnets		
Program		C:\Program F	iles\Wiresha	ark_	program files		
Personal Plu	gins	C:\Users\CDI	2\AppData\	.ming\Wireshark\plugins	dissector plugins		
Global Plugir	าร	C:\Program F	iles\Wiresha	ark\plugins\2.4.5	dissector plugins		
Extcap path		C:\Program F	iles\Wiresha	ark\extcap	Extcap Plugins search path		
						0	K

#### Figure 60: About Folders

In the Plugins Tab the Wireshark tool lists the installed plugins and their versions. The versions of the CDI2 plugins can be checked here. An example is shown in Figure 61.

Wireshark A	Authors F	olders	Plugins Keyboard Shortcuts License	
Name	Version	Туре	Path	 
docsis.dll	0.0.5	dissector	C:\Program Files\Wireshark\plugins\2.4.5\docsis.dll	
ethercat.dll	0.1.1	dissector	C:\Program Files\Wireshark\plugins\2.4.5\ethercat.dll	
gryphon.dll	0.0.4	dissector	C:\Program Files\Wireshark\plugins\2.4.5\gryphon.dll	
irda.dll	0.0.6	dissector	C:\Program Files\Wireshark\plugins\2.4.5\irda.dll	
m2m.dll	1.1.0	dissector	C:\Program Files\Wireshark\plugins\2.4.5\m2m.dll	
mate.dll	1.0.0a	dissector	C:\Program Files\Wireshark\plugins\2.4.5\mate.dll	
opcua.dll	1.1.0	dissector	C:\Program Files\Wireshark\plugins\2.4.5\opcua.dll	
profinet.dll	0.2.4	dissector	C:\Program Files\Wireshark\plugins\2.4.5\profinet.dll	
stats_tree.dll	0.0.1	tap	C:\Program Files\Wireshark\plugins\2.4.5\stats_tree.dll	
transum.dll	2.0.2	dissector	C:\Program Files\Wireshark\plugins\2.4.5\transum.dll	
unistim.dll	0.0.2	dissector	C:\Program Files\Wireshark\plugins\2.4.5\unistim.dll	
wimax.dll	1.1.0	dissector	C:\Program Files\Wireshark\plugins\2.4.5\wimax.dll	
wimaxasncp.dl	l 0.0.1	dissector	C:\Program Files\Wireshark\plugins\2.4.5\wimaxasncp.dll	
wimaxmacphy.	dl 0.8.1	dissector	$C:\Program Files\Wireshark\plugins\2.4.5\wimaxmacphy.dll$	
profishark.dll	0.0.8	dissector	$\label{eq:c:UsersCDI2AppDataRoaminsharkpluginsprofishark.dll} C:\label{eq:c:UsersCDI2AppDataRoaminsharkpluginsprofishark.dll}$	
cdi2pl.lua	0.38	luascript	$\label{eq:c:UsersCDI2AppDataRoamiireshark\plugins\cdi2pl.lua} C:\Users\CDI2\AppDataRoamiireshark\plugins\cdi2pl.lua$	
cdi2plperf.lua	0.10	lua script	$\label{eq:c:UsersCDI2AppDataRoamiharkpluginscdi2plperf.lua} C:\Users\CDI2\AppDataRoamiharkplugins\AppDataRoamiharkplugins\AppDataRoam$	
plperf.lua	0.12	lua script	$\label{eq:c:UsersCDI2AppDataRoamiireshark\plugins\plperf.lua} C:\Users\CDI2\AppData\Roamiireshark\plugins\plperf.lua$	
	/			

Figure 61: About Plugins

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### 12.1.8. Wireshark Installation/Upgrade Hints

Wireshark installation or upgrading it to a newer version than the installed 2.4.5 requires some precautions.

- The CDI2 LUA plugins *cdi2pl.lua*, *cdi2perf.lua* and *perf.lua* can be used on newer Wireshark versions as well, e.g. for Wireshark 3.2.1.
- The ProfiShark binary plugin (*profishark.dll*) must match to desired Wireshark version and computer platform.
- The plugin folder structure of Wireshark has been changed slightly since version 2.4.5. LUA plugins folder *%APPDATA%\Wireshark\plugins*:

cdi2pl.lua, cdi2perf.lua and perf.lua

Binary plugins folder %APPDATA%\Wireshark\plugins\3.2\epan

profishark.dll

File locations

CDI2 LUA plugins

C:\CDI2-Installation\Windows\03-CDI2-Wireshark-Plugins

ProfiShark vendor binary plugins for windows platforms

*C:\ CDI2-Installation\Windows\03-CDI2-Wireshark-Plugins\Dissector Wireshark\dist e.g.* .*\wireshark\_3.2\amd64\profishark.dll* for Wireshark 3.2 on 64-bit platform.

ProfiShark vendor driver package for all platforms

C:\CDI2-Installation\Windows\03-CDI2-Wireshark-Plugins\PROFISHARK\_USBKEY\_89.zip

#### Important note:

Following Wireshark protocol settings are required for proper handling of the ProfiShark nstimestamps. Otherwise CDI2 plugins will show imprecise values.

🥖 Wireshark · Prefer	ences
PN-RT PN532 PN532_HCI PNIO PNRP POP Port Control PPI PPP MP PPPoED PPTP PPTES ProfiShark ProteBuf PTP PTP PTP PTP PULSE PVFS O 021	ProfiShark     Decode timestamps for Profishark-100 (black)

Figure 62: ProfiShark Protocol Settings



the text that you want to appear here.

Wireshark - Preferences	
	ireshark · Preference
	eCPRI EDONKEY EGD EHS Elasticsearch ELCOM ELF ENIP ENIP ENIP ENIP ENIP ENIP ENIP ENIP

Figure 63: Ethernet Protocol Settings

#### Installation of coloring rules

View->Coloring Rules->Import...

*C:\CDI2-Installation\Windows\03-CDI2-Wireshark-Plugins\CDI2\_alt.col\_rules* Uncheck Broadcast and System Event (Figure 64).

🚄 Wireshark · Coloring Rules Default	×
Name	Eiltar
	ten analusia (lana 909) Itan analusia usia datu un data
	tcp.analysis.nags o.o. itcp.analysis.window_update
Constant Change	nsrp.state := 6 ccc nsrp.state := 10
Spanning free topology Change	stp.type == 0x80
✓ OSPF State Change	ospt.msg != I
✓ ICMP errors	icmp.type eq 3    icmp.type eq 4    icmp.type eq 5    icmp.type eq 11    icmpvo.type
M ARP	arp
	tcp.nags.reset eq 1
SCTP ABORT	sctp.chunk_type eq ABORT
✓ ITL low or unexpected	(!  ip.dst == 224.0.0.0/4  & dcl ip.ttl < 5  & dcl !pim & dcl !ospf)    (ip.dst == 224.0.0.0/24)
Checksum Errors	eth.fcs.status=="Bad"    ip.checksum.status=="Bad"    tcp.checksum.status== "Bad
M 2MB	smb    nbss    nbns    netbios
	http    tcp.port == 80    http2
M DCERPC	dcerpc
✓ Routing	hsrp    eigrp    ospf    bgp    cdp    vrrp    carp    gvrp    igmp    ismp
ICP SYN/FIN	tcp.flags & 0x02    tcp.flags.fin == 1
I TCP	tcp
	udp
Broadcast	eth[0] & 1
System Event	systemd_journal    sysdig
CDI2 BNRESULT + Result	cdi2 && cdi2.cmd == 0x41 && !(cdi2.bnid == 4294967295)
CDI2 BNRESULT + Recognition	cdi2 && cdi2.cmd == 0x41 && !(cdi2.rbnid == 4294967295)
CDI2 BNRESULT	cdi2 && cdi2.cmd == 0x41
CDI2 BSMINFO + BNINFO	cdi2 && cdi2.cmd == 0x81 && !(cdi2.bnid == 4294967295)
CDI2 BSMINFO + Trigger	cdi2 && cdi2.cmd == 0x81 && !(cdi2.tctrig.bnid01 == 4294967295 && cdi2.tctrig.
CDI2 BSMINFO	cdi2 && cdi2.cmd == 0x81
CDI2	cdi2
EPL SoA	epl && epl.mtyp == 5
EPL ASnd	epl && epl.mtyp == 6
EPL SoC	epl && epl.mtyp == 1
EPL PReq	epl && epl.mtyp == 3
EPL PResM	epl && epl.mtyp == 4 && epl.src == 240
EPL PRes	epl && epl.mtyp == 4
EPL	epl
<	>
Double click to edit. Drag to move. Rules are pr	ocessed in order until a match is found.
+ - Pa 🕞 Foreground	Background Apply as filter C: Users hahna AppDatireshark colorfilters
ОК	Copy from  Cancel Import Export Help

Figure 64: Coloring Rules Settings

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# 12.2. WinSCP

WinSCP is a popular sFTP and FTP client for Microsoft Windows. It copies files between a local computer and remote servers using FTP, FTPS, SCP, SFTP, WebDAV or S3 file transfer protocols.

Refer to <u>https://winscp.net</u> for detailed information.

WinSCP is used to transfer files over the simulator network connections. This can be used to test the FTP interface of a CDI2 device or to connect to the Simulation Computer (VisionBox) to access test cases and results.

### 12.2.1. Connect

💫 Login  $\times$ Session 📑 New Site Powerlink Nodes File protocol: Encryption: Powerlink Node 1 FTP No encryption Powerlink Node 2 Powerlink Node 3 Host name: Port number: Powerlink Node 4 192.168.100.1 21 Powerlink Node 5 Powerlink Node 6 User name: Password: 🚽 Powerlink Node 7 anonymous ..... Powerlink Node 8 Powerlink Node 9 Edit Powerlink Node 10 Powerlink Node 11 Powerlink Node 12 Powerlink Node 13 Powerlink Node 14 Powerlink Node 15 Powerlink Node 16 3 BSM Simulator Visionbo Tools • Manage 된 Login 🤇 Close Help

A set of connection options is preconfigured on the GUI PCs.

#### Figure 65: WinSCP connect

- (1) Connection pre-set for connecting to the Powerlink node with id 1.
- (2) Connection pre-set for a connection to the Simulation Computer.
- (3) To open the selected connection, click Login.



CDI2SIM: Error! Use the Home tab to apply Titel to

the text that you want to appear here.

A / - Bowarlink Nodes/Bowarlink Node 1 - Winger					_		×
						-	^
Local Mark Files Commands Session Options Remote Help							
🗄 🔁 🔁 Synchronize 🗖 🦨 🧟 🎒 Queue 🗸 Transfer Set	tings Default 🔹 🥖 🖓						
Powerlink Nodes/Powerlink Node 1 🔛 New Session							
🐛 C: OS 🔹 🔹 🚰 😨 🗢 🔹 🖻 🛣 🛃 💺	/ <root></root>		🖻 🏠 🎜 🖻	Find Files			
🛯 🙀 Upload 👻 📝 Edit 👻 🗶 📝 🕞 Properties 🍄 New 📲 🛨 🂙	📱 📄 Download 👻 📝 Edit 👻 💢 🕞 P	ropertie	s 😭 New 🗸	+ - 🗸			
C:\Acceptance Tests\20180801\BSM-002\	1						
Name	Name	Size	Changed	Rights	Own		
<u>₹</u>	€		-	-			
	allscans.bin	0 KB	4/17/1987	rw-rw-rw-	cdi2		
	with the second	0 KB	4/17/1987	rr	cdi2		
	📓 dev_stat.xml	0 KB	4/17/1987	rr	cdi2		
	W device_config.xml	4 KB	4/17/1987	rw-rw-rw-	cdi2		
	W device_info.xml	4 KB	4/17/1987	rr	cdi2		
	i error_log.xml	0 KB	4/17/1987	rr	cdi2		
	🗋 firmware.bin	0 KB	4/17/1987	rw-rw-rw-	cdi2		
	astscan.bin	0 KB	4/17/1987	rw-rw-rw-	cdi2		
	Market Ma	0 KB	4/17/1987	rw-rw-rw-	cdi2		
	Machine_info.xml	1 KB	4/17/1987	rw-rw-rw-	cdi2		
	myparam.cfg	0 KB	4/17/1987	rw-rw-rw-	cdi2		
	SpecialReadService_Bin.bin	0 KB	4/17/1987	rw-rw-rw-	cdi2		
	SpecialReadService_Text.txt	0 KB	4/17/1987	rw-rw-rw-	cdi2		
	SpecialWriteService_Bin.bin	0 KB	4/17/1987	rw-rw-rw-	cdi2		
	SpecialWriteService_Text.txt	0 KB	4/17/1987	rw-rw-rw-	cdi2		
	n stat.txt	0 KB	4/17/1987	rw-rw-rw-	cdi2		
<							
0 B of 0 B in 0 of 0	0 B of 7.55 KB in 0 of 16			F			
				A FTP		0:0	1:24
					西	0.0	

Figure 66: WinSCP main

After the connection is established, WinSCP shows the connection as a tab (1). The local file system is shown on the left pane (2) and the remote filesystem in the right pane (3). It is possible to open additional connections by clicking "New Session" (4).

#### 12.2.2. Edit and Download

• • • • • •		/ <root></root>	• 🚰 🕎 🦛 •	-> - En 6	1 <b>2</b> 1	Find Files	
Properties	🔐 New 🕂 🕴	Download -	🎽 Edit 👻 💢	Properties	s 🛗 New 🕶	+ - 🗸	
2\	Changed	/ Name	^	Size	Changed	Rights	Own
irectory	8/1/2018 11:12:44 AW 7/25/2018 9:45:37 AW	allscans.bin current_error.xml dev.stat.xml dev.stat.xml device_config.xml device_info.xml firmware.bin lastscan.bin lastscan.bin lastscan.bin SpecialReadSen SpecialReadSen SpecialReadSen SpecialWriteSen stat.txt	Open Edit Duplicate Move To Delete Rename File Custom Cc File Names Properties	3 0 KB 0 KB 4 K	4/17/1987 4/17/1987 4/17/1987 4/17/1987 4/17/1987 4/17/1987 DOwnloa Downloa Downloa Downloa Downloa A/17/1987 4/17/1987 4/17/1987 4/17/1987	2 Tw-rw-rw- r-r-r- r-r-r- rw-rw-rw- rr-r- rw-rw-rw- di in Background d and Delete F6 rw-rw-rw- rw-rw-rw- rw-rw-rw- rw-rw-rw- rw-rw-rw- rw-rw-rw-	cdi2 cdi2 cdi2 cdi2 cdi2 cdi2 cdi2 cdi2

Figure 67: WinSCP Edit and Download

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To save a file to the GUI PC, right click the file in the right pane (1), then select "Download..." (2) and "Download...". It is also possible to edit the file (3), when the file is saved in the editor it is automatically uploaded.

### 12.2.3. Upload

🖺 BSM-002 - Powerlink Nodes/Powerlink Node 1 - WinSCP		
Local Mark Files Commands Session Options Remote Help		
🕀 🛃 😓 Synchronize 🛛 🕼 🔝 🔅 🎒 Queue 🔹 Transfer Settings Default 🔹 🥰 🗸		
🖵 Powerlink Nodes/Powerlink Node 1 📑 New Session		
🐛 C: OS 🔹 🕈 🚰 🕎 🖛 🔹 🖈 😰 😭 🏠 🤔 📴 📕 / <root> 🔹 🚰 💟 🖛 🔹 🔶</root>		/
🛿 🛃 Upload 🔻 📝 Edit 🕶 🗶 🧊 🕞 Properties  New 🕶 🗄 👘 👻 🕼 Download 👻 📝 Edit 👻 🖉 🍡 Pr	opertie	es
C:\Acceptance Tests\20180801\BSM-002\ /		
Name Size Type Changed Name	Size	C
🔁 Parent directory 8/1/2018 11:14:42. 🛃		
device_info.xml 4 KB XML File 4/17/1987 12:00:00 allscans.bin	0 KB	4
☐ firmwa 0 2 7/25/2018 9:45:37 . ≧ current_error.xml	0 KB	4
dev_stat.xml	0 KB	4
device_config.xml	4 KB	4
Upload F5 F 🔄 Upload	4 KB	4
Delete F8 🙀 Upload in Background rror_log.xml	0 KB	4
📝 Rename F2 🙀 Upload and Delete F6 firmware.bin	0 KB	4
File Custom Commands	0 KB	4
File Names	0 KB	4
Properties EQ	1 KB	4
Cystem Manu	0 KB	4
System Menu	0 KB	4
SpecialReadService_Text.txt	0 KB	4
		۰.

Figure 68: WinSCP Upload

To upload a file (e.g. firmware.bin), first navigate to the containing folder on the left pane. Right click the file which should be uploaded (1), select "Upload..." (2), and then "Upload...".

### 12.2.4. New Session

💫 / - Powerlink No	odes/Powerli	nk Node 1 - WinSCP	1						
Local Mark Files Commands Session Options Remote Help									
🕀 🔁 📮 Synchr	🕀 🚼 📮 Synchronize 🗖 🚰 🔛 🍰 🗿 Queue 👻 Jransfer Settings Default								
Powerlink Node	es/Powerlink l	🖬 🖬 New Sess	ion						
🐛 C: OS	🐛 C: OS 🔹 📲 🕎 🖕 🔹 👻 📩 🖓 🐉 🔩 📕 / <root> 🔹 🚰 🕎 🖕 🔹 🖈 🖓 🚱 🔩</root>								
🗐 🔄 Upload 👻	Edit 👻 🗙	Properties	🕆 New 🕶 🛨 🔭	📲 🙀 Download 👻 📝 Edit 👻 💢 🕞 Pr	opertie	s 🖆 New 🕶 🛛	+ - V		
C:\Acceptance Tests	\20180801\B	SM-002\		1					
Name	Size	Туре	Changed	Name	Size	Changed	Rights		
<u>.</u>		Parent directory	8/1/2018 11:14:42	🔁					
Mevice_info.xml	4 KB	XML File	4/17/1987 12:00:00	allscans.bin	0 KB	4/17/1987	rw-rw-rw-		
📄 firmware.bin	1,024 KB	BIN File	7/25/2018 9:45:37	w current_error.xml	0 KB	4/17/1987	rrr		
				📓 dev_stat.xml	0 KB	4/17/1987	rrr		
				W device_config.xml	4 KB	4/17/1987	rw-rw-rw-		

#### Figure 69: WinSCP New Session

Connections are managed in tabs (1) to create a new connection click "New Session" (2).



### 12.3. USB Devices

The device manager of Windows 10 provides useful information about the installed USB devices. It can be used to check if the USB devices of the simulator have been detected properly and to identify the proper COM port number of serial devices.

🛃 Device Manager	_	×
File Action View Help		
> 📷 IDE ATA/ATAPI controllers		^
> 🔤 Keyboards		
> Memory technology devices		
Whice and other pointing devices		
> Monitors		
<ul> <li>Vetwork adapters</li> </ul>		
SIX AX88178 USB2.0 to Gigabit Ethernet Adapter		
Bluetooth Device (Personal Area Network) #2		
Bluetooth Device (RFCOMM Protocol IDI)		- 10
- D-Link DUB-1312/1332 USB3.0 to Gigabit Ethernet Adapter		
W5811e Snapdragon™ X7 LIE		
→ Intel(R) Dual Band Wireless-AC 8265		
Intel(K) Ethernet Connection (5) 1219-LM		
WAN Miniport (IPV0)		
WAN Miniport (L2TP)		
WAN Miniport (PPPOE)		
WAN Miniport (CFTP)		
Intel/(P) Active Management Technology - SOL (COM3)		
ISB Serial Port (COM5)		
> The Sensors		
> Smart card readers		
> Software devices		
Sound, video and game controllers		
Storage controllers		~

Figure 70: List of detected USB devices (BSMS)

- ProfiShark Network Analyser (shown as ASIX AX88178) This USB device shall be present on the BSMS and on the DS.
- (2) USB Network Adapter for Powerlink Gateway (shown as D-Link DUB-1312/1332) This USB device shall be present on the BSMS only.
- (3) USB-to-Serial Converter (shown as USB Serial Port) used for remote control of the transport simulator. The COM number displayed here must be selected in the Transport Simulator Tool [12.6], e.g. COM5.

This USB device shall be present on the BSMS only.

If a USB device is not detected properly the device manager will not list the desired USB device. Figure 71 shows an example of missing USB devices. In case of a missing USB device, try to plug-out the USB cable, wait some seconds, plug-in the USB cable again and watch if the device is added.

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📕 Device Manager  $\times$ 6 File Action View Help 🔶 🏟 📧 🛛 🖬 💆 Biometric devices Bluetooth Cameras Computer Computer ControlVault Device 🕳 Disk drives \_ Display adapters Firmware Human Interface Devices TDE ATA/ATAPI controllers Keyboards Memory technology devices Mice and other point Monitors Network adapters Bluetooth Device (Personal Area Network) #2 Bluetooth Device (RFCOMM Protocol TDI) 🧊 DW5811e Snapdragon™ X7 LTE Intel(R) Dual Band Wireless-AC 8265 Intel(R) Ethernet Connection (5) I219-LM WAN Miniport (IKEv2) WAN Miniport (IP) WAN Miniport (IPv6) WAN Miniport (L2TP) 🕎 WAN Miniport (Network Monitor) WAN Miniport (PPPOE) WAN Miniport (PPTP WAN Miniport (SSTP) Ports (COM & LPT) Intel(R) Active Management Technology - SOL (COM3) Print queues rocessors 

#### Figure 71: Missing USB components

- (1) USB network adapters not detected (ASIX AX88178 nor D-Link DUB-1312/1332)
- (2) USB-to-Serial Converter (shown as USB Serial Port) not detected

### 12.4. PuTTY

PuTTY is a terminal program to establish a console connection via SSH or a serial line. SSH is commonly used to open a console via the network, using the IP address of the node. The connection via the serial line is used when no network connection is available; this is mainly for debugging and installation purposes.

PuTTY is not needed for conducting testcases, but it is an important tool for debugging and when a software update of simulator components is needed (see 7.2.4).

PuTTY Download and Documentation https://www.putty.org/



the text that you want to appear here.



Figure 72: PuTTY connections and settings



Figure 73: PuTTY command line

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# 12.5. PicoScope

Pico Technology, PICOSCOPE 2204A https://www.picotech.com

### 12.5.1. Hardware Setup

The PicoScope unit is connected to the GUI-PC via an USB connection. Connect the measuring probes as depicted in [Figure 74].



Figure 74: Picoscope connections

- (1) USB cable
- (2) Probe A input
- (3) use blue colour marker for Probe A
- (4) Probe B input
- (5) use red colour marker for Probe B



the text that you want to appear here.



Figure 75: Picoscope probes

(1) and (2): The attenuation switches on both probes shall be set to x10 (10:1)

Figure 76 shows an example of how to connect to the signals of a breakout box.



Figure 76: Picoscope connection example

- (1) Ground connections
- (2) Signal tap

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### 12.5.2. PicoScope Tool



Figure 77: Picoscope overview

- (1) Channel A (blue) SettingsY Scale = +/- 5V, DC Coupling, Probe Setting = 1:10
- (2) Channel B (red) SettingsY Scale = +/- 5V, DC Coupling, Probe Setting = 1:10
- (3) Trace A (blue)
- (4) Trace B (red)
- (5) Measurements Windows
- (6) Trigger Status and Control Running/Stopped
- (7) Trigger ModeAuto ... for periodic signals, e.g. a clock signalSingle ... for single events, e.g. a reset signal
- (8) Trigger Edge select rising or falling edge for trigger
- (9) Add/Remove Measurements add new measurements to measurements window
- (10) Time scale



the text that you want to appear here.



Figure 78: Picoscope pulse width measurement example

#### (1) Trigger Marker

Indicates the trigger position and threshold, the marker can be moved to change the trigger threshold

#### (2) Pulse Width Readout

The actual pulse width is measured, display shows actual, min, max and average values.



# 12.6. Transport Simulator Tool

The transport simulator, also known as "Detector Test Rig" [Ref 3.], can be remote controlled by a software tool on the GUI-PC. The program *Adaptor2\_SerialSimulator.exe* is available in folder *C:\CDI2\08-DNB-Tools.* 

The tool uses a serial connection to the transport simulator to send transport on/off and speed control commands as specified in chapter 5.2.1 of [Ref 3.]

🔜 Adaptor2_SerialSimulator		_ 🗆 🗵
Serial Port: COM3	TRANSPORT=ON	
	TRANSPORT=OFF	
	4 Speed (m/s): [4.0 SPEED=40	

Figure 79: TS control

(1) Serial port selection

refer to [12.3] USB-to-Serial Converter also

- (2) Start transport
- (3) Stop transport
- (4) Select speed in m/s units

The speed can be set with a resolution of 0.1 m/s

(5) Send speed select command to TS. The selected speed is applied at the next Start transport command The SPEED button shows the raw value which is sent on the serial line, e.g. 40 for 4.0m/s



### 12.7. XML validation

A set of XML schema files is provided to support offline validation of XML files. The validation can be done by any commonly available tool which supports XML Schema 1.1, e.g. ALTOVA XMLSpy. Generally, the validation procedure requires two files, the XML file to be validated (.xml) and an XML schema file (.xsd). On the GUI PC the validation of XML files can be done with pre-configured batch scripts that call the command-line tool *SimpleXsdValidator.jar*. One test script, *check-examples.bat*, is configured to run XML validation on a set of example XML files provided together with the schema files. Another batch script, *checkXML.bat*, is setup to run the validation on user supplied XML files.

### 12.7.1. Schema and Example Files

Schema files and examples can be found in folder

C:\CDI2\21-xml-verification

XML schema files

C:\CDI2\21-xml-verification\schema

DeviceInfo.xsd	schema for device_info.xml and device_config.xml
MachineInfo.xsd	schema for machine_info.xml
CdiErrorLog.xsd	schema for error_log.xml
DeviceStatus.xsd	schema for DeviceStatus dev_stat.xml
CdiStorage.xsd	schema for XML storage file

Valid XML example files folder

C:\CDI2\21-xml-verification\examples

DeviceInfo	XML in this folder to be validated with DeviceInfo.xsd
MachineInfo	XML in this folder to be validated with MachineInfo.xsd
CdiErrorLog	XML in this folder to be validated with CdiErrorLog.xsd
DeviceStatus	XML in this folder to be validated with DeviceStatus.xsd
CdiStorage	XML in this folder to be validated with CdiStorage.xsd

#### User XML files

C:\CDI2\21-xml-verification\xml\_to\_test

XML in this folder to be validated with DeviceInfo.xsd
XML in this folder to be validated with MachineInfo.xsd
XML in this folder to be validated with CdiErrorLog.xsd
XML in this folder to be validated with DeviceStatus.xsd
XML in this folder to be validated with CdiStorage.xsd

Validation tool and script

#### C:\CDI2\21-xml-verification\

check-examples.bat... batch script, runs validation of all XML in the examples foldercheckXML.bat... batch script, runs validation of all XML in the xml\_to\_test folderSimpleXsdValidator.jar... XML validation tool, takes .xml and .xsd and runs validation

#### **12.7.2.** Use of XML Validation Scripts

The validation scripts *check\_example.bat* and *checkXML.bat* are started with a double-click to the .bat file. On activation a new window with the validation output is shown. Figure 80 shows the XML validation



folder with the .bat scripts and Figure 81 shows a successful validation of the example files with *check\_example.bat*.



Figure 80: XML validation folder

C:\WINDOWS\system32\cmd.exe	N		_		×
Validate all XML example files	2				^
Validating 'examples\CdiErrorLog\error_log.xml' against 'CdiErrorLog' Successfully validated examples\CdiErrorLog\error_log.xml against schema\CdiErrorLog.xsc Validating 'examples/CdiErrorLog.asinigationst' cdiErrorLog.xsc	đ				
Variadering examples\cdiFrorlog\minimal.xml against cdiFrorlog Successfully validated examples\CdiFrorlog\minimal.xml against schema\CdiFrorlog.xsd Validating 'examples\CdiFrorlog\spec.xml' against 'CdiFrorlog'					
Successfully validated examples\\ditrorLog\spec.xml against schema\\ditrorLog.xsd Validating 'examples\\ditsorage\2018.10-0112-59-53_1_Austria-0eB5.xml' against 'ddits Successfully validated examples\\ditsorage\2018-10-01_12-59-53_1_Austria-0eB5.xml agains	brage' st schema\	CdiStor	age.x	sd	
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Validating 'examples\MachineInfo\spec.xml' against 'MachineInfo' Successfully validated examples\MachineInfo\spec.xml against schema\MachineInfo.xsd					
Press any key to continue					

Figure 81: Output of a successful validation of the examples folder

The following example shows how to validate a user supplied *device\_info.xml* file. First, the XML file is placed in the appropriate folder. In this case the XML must conform to the *DeviceInfo.xsd* schema and must be placed into *xml\_to\_test\DeviceInfo* therefore (see Figure 82). The use *checkXML.bat* to validate all files in *xml\_to\_test*. Figure 83 shows the output of a successful validation and Figure 84 the output of a failing validation. In the shown case the attribute 'Nodel**D**' was invalid because the correct spelling is 'Nodel**d**'.

User-Manual-CDI2SIM-v1r10-tracked.docx



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20-RestartTestController		_							
21-xml-verification									
examples									
📙 schema									
xml_to_test									
CDI2-Installation									
📙 Dell	~								
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Validate all XML example fi Validating 'xml_to_test\Dev Successfully validated xml_t	les riceInfo o_test	⊃\device_info.xml' a DeviceInfo\device_i	↔ gainst 'DeviceInf nfo.xml against s	o' chema	\DeviceIn	fo.xsd		^	
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C:\WINDOWS\system32\cmd.exe	-		$\times$
Validate all XML example files			^
Validating 'xml_to_test\DeviceInfo\device_info.xml' against 'DeviceInfo' Error validating xml_to_test\DeviceInfo\device_info.xml against schema\DeviceInfo.xsd: org.xml.sax.SAXParseException; systemId: file:///C:/CDI2/21-xml-verification/xml_to_test/DeviceInfo/devi eNumber: 2; columnNumber: 47; cvc-complex-type.3.2.2: Attribute 'nodeID' is not allowed to appear in ele em'. Press any key to continue	ce_inf ment '	o.xml; CameraS	lin yst



### 12.8. Chart Evaluation and Image Quality Tools

The GUI PC has a set of tools installed to verify the image quality of a camera system. The tools can be found in the folder

C:\CDI2\11-EvalChartTools

along with their documentation and manuals.

**EvalChart tools** 

Programs\Testchart\_A\EvalChart\_A.exe Programs\Testchart\_B\EvalChart\_B.exe Programs\Testchart\_C\EvalChart\_C.exe Programs\Testchart\_P\EvalChart\_P.exe

EvalChart documentation

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Descriptions\EvalChart\_A Description.pdf Descriptions\EvalChart\_B Description.pdf Descriptions\EvalChart\_C Description.pdf Descriptions\EvalChart\_P Description.pdf

For convenient summarisation und judgement of the results generated by the EvalChart tools, an OpenDocument spreadsheet and support scripts are provided.

C:\CDI2\05-LibreOffice-Tools\Image Quality\ ImageQuality\_V1\_2.ods EvalChartA\_merge&run.bat EvalChartB\_merge&run.bat EvalChartC\_merge&run.bat

The tools are used for acceptance test "Image quality tools (CS-003)". Follow the instructions described for that test.

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7	Load B	TestChart B file:	Test Chart B Re	sult List FRONT.	CSV						
8	Load C	Testchart C file:	Test Chart C Re	sult List FRONT.	CSV						5-20
10	Device under Test:		DS – Test	images							
11	Date of Test:		25.08.2018								
13	Date of foot.										
14	Deservation	14-1			_						
15	Parameter	value	min ta ba abaalua	max	Rest	JIT					
10	MTE(1   D/mm)	0.66	0.7	a seperatly	Not (	אר					
10	MTF(2 LP/mm)	0.00	0.7		Not C	)K					
10	Moiré	7.1	0.4	10	OK	<i>///</i>					
20	Colour Linearity Error (CLE)	14.84		25 DN	OK						
21	Spectral Responsivity		to be checked	d seperatly						_	
22	ResolutionX [mm]	0.2	0.199	0.201	OK						
23	ResolutionY [mm]	0.2	0.199	0.201	OK						
24	Distortion [mm]	0.2		0.500	OK						
25	Non-uniformity	2.31%		0.50%	Not C	ОК					
26	Signal to Noise (SNRmax)	40	40 dB		OK						
27	Dynamic Range (DR)	51.9	50 dB		OK						
28	Darkness	8.3	1 DN	5 DN	Not C	Ж					
29	Stray Light 1	8.1		20 DN	OK						
30	Brightness P	208.0	195 DN	20E DN	Not C						
22	Brightness G	200.5	195 DN	205 DN	Not C	)K					
32	Brightness B	208.6	195 DN	205 DN	Not C	DK					
34		200.0	100 5.1	200 5.4							
35	Colour Order	R	G	в	Resu	ılt					
36	Area L17	147	14	28	OK						
37	Area L18	3	85	27	OK						
38	Area L19	2	17	103	OK						
39											
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. ₩. ◄	Verview	Tolerances	A_raw B_ra	w C_raw							
Shee	et 1 of 5	Default	Engl	lish (USA)			ß	Average: ; Sum: 0		+	100%

Figure 85: Image Quality Analysis Tool



### 12.9. TTS Breakout Box

To access the electrical signals of the TTS, a breakout box is supplied together with the PicoScope. It can be plugged between a BSM and a device's TTS connection using the two D-Sub connectors. The patch panel then offers a way to measure or disconnect any single connection of the TTS. To measure a signal with the PicoScope, it is recommended to connect one of the supplied patch cables to the probe on one side and to the patch panel on the other. The TTS breakout box is required for acceptance tests "BSMS - Electrical specification of TTS signals (BSM-032)" and " DS - correct reaction to TTS Reset length (DEV-014)".



Figure 86: TTS Breakout Box

- (1) D-Sub HD DE-15 male
- (2) D-Sub HD DE-15 female
- (3) Patch panel
- (4) Patch cables

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# 12.10. TS Trigger Breakout Box

The TS Trigger Box can be used to tap the clock and trigger signals sent by the TS to the BSMS. It is initially used to calibrate the TC rate (see 7.8 and acceptance test "BSMS - TS transport speed and TC accuracy (BSMS-005)") and to troubleshoot connection problems between the TS and the BS.



#### Figure 87: TS Trigger Breakout Box

- (1) D-sub DE-9 male
- (2) Patch panel
- (3) D-sub DE-9 female
- (4) Patch cables



### 12.11. Flutter Detector and Analysis

A set of tools is provided to gather and summarise the measured data samples of the flutter detector [Ref 4.].

The flutter detector tool is used to gather and display the measurement data during actual testing. Finally, after capturing has been completed the raw data is saved into a file for later import into the Analyses tool for more in-depth analyses.

### 12.11.1. Flutter Detector Capture Tool (Banknote Displacement Detector Tool)

Tool location:



C:\CDI2\05-DNB-Tools\BDD\_SerialSimulator.exe

Figure 88: Flutter Tool - Start Screen

- (1) Detector Type: select type of Flutter Detector, either Camera System casing or Detector casing. Must set correctly at start-up before performing any other operation.
- (2) Detector Output: select Byte mode always
- (3) COM port of Flutter Detector, select COM ports as detected by Windows. If not known, use the Device Manager to identify the port number [see 12.3]
- (4) Start calibration: must be done before a Capture command is issued. Make sure that the banknote transport is switched off and no banknote is in the laser path during calibration. Calibration needs about 1 sec.
- (5) Capture Data: enable capture mode, measurements are taken when Flutter Detector is triggered
- (6) Banknote displacement view of selected banknote
- (7) List of captured banknotes
- (8) Details of selected banknote
- (9) Stop: disable capture mode

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Depending on the kind of flutter detector, either in CS or in Detector casing, different tool settings are required. The following order is recommended during startup.

- 1. Select type of Flutter Detector, see Figure 88 (1)
- 2. Select COM port, Figure 88 (3)
- 3. Start calibration, Figure 88 (4)
- 4. Capture Data, Figure 88 (5)

Figure 89 shows the main screen in Camera casing mode and Figure 90 how it looks like in Detector casing mode.



Figure 89: Capture Mode - Camera System casing



the text that you want to appear here.



Figure 90: Capture Mode - Detector casing

The Banknote displacement view can be altered in the *Options* menu using *Graph Single Display* (Figure 91). If checked, it displays a single banknote, otherwise an overlay of banknotes is shown (see Figure 92).



Figure 91: Options



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Figure 92: Banknote overlay display

When capturing is completed, measurement data can be saved to a file for later analyses in an external tool by menu option *File->Save All...* (Figure 93).



#### Figure 93: File Options

Version information about the tool is displayed with menu option About (Figure 94)



Figure 94: About Version Info

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**Flutter Analyses** 

the text that you want to appear here.

12.11.2.

For the evaluation of the measurements recorded by the flutter detector an OpenDocument spreadsheet is available. It can import the saved data and provides further analyses and chart views of the data.

#### C:\CDI2\05-LibreOffice-Tools\Flutter\_analysis V1\_1.ods

The tool is opened with *LibreOffice Calc* by a double-click to the .ods file. Use the "Load Data" button to import a previously captured data set from the flutter detector tool (chapter 12.11.1). Figure 95 and Figure 96 show the main display areas.



#### Figure 95: Flutter Analyses Tool

- (1) Load Data: Import a previously captured data set from the flutter detector tool (chapter 11.11.1).
- (2) Main Settings for limit checking
- (3) Analyses Overview with number of scanned banknotes and checking results
- (4) Flutter per Banknote: Shows the maximum and average top 5 values
- (5) Flutter histogram: Shows a histogram of the maximum and average top 5 values

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Figure 96: Flutter Analyses Tool (cont.)

- (6) Banknote Length per Banknote: Shows the measured length for each banknote
- (7) StartPos per Banknote: Shows the starting position for each banknote
- (8) Raw scans of all Banknotes: Shows an overlay of all scanned banknotes

Note that the analyses information is valid when data has been captured by a Flutter Detector in CS casing. In case of data coming from a Flutter Detector in Detector casing, some analyses information is invalid or is not shown properly. Specifically, displays (6) and (7) shall be ignored.



# **13.** Technical Specification

These specifications apply to the BSM simulator and the Device simulator.

#### **Operating Conditions**

AC Input Voltage range	100-240V, 50/60Hz, 500W max.
Operating Temperature	10 to 40°C
Conducted & Radiated EMI	EN 61326, CISPR 11, Class B
	EN 61000-3-2, Class A
	EN 61000-3-3
Immunity	EN 61326
	IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4, IEC 61000-4-5,
	IEC 61000-4-6, IEC 61000-4-8, IEC 61000-4-11



# 14. Annex: Description of BSMS Test Sets for BSM Acceptance

### 14.1. BSMS\_CS-007 Sorting to stackers

This test case is used together with the *TS* which is filled with two banknotes one *FIT* and one *UNFIT*. It verifies that the *CS* reports *FIT* and *UNFIT* alternately.

#### 14.1.1. Functionality

- 1. Bring the system to FEED\_OFF
- 2. Wait until **Continue** is pressed
- 3. Transition to SORTING
- 4. Check that the CS reports FIT and UNFIT alternately

#### 14.1.2. Inheritance

Test case inherits from *BSMS\_DEV-G01\_CS Internal Trigger*. See there for parameter descriptions.

### 14.2. BSMS\_DET-003 Sorting to stackers

This test case is used together with the *TS* which is filled with two banknotes one *FIT* and one *UNFIT*. It verifies that the *Detector* reports *FIT* and *UNFIT* alternately.

#### 14.2.1. Functionality

- 1. Bring the system to FEED\_OFF
- 2. Wait until Continue is pressed
- 3. Transition to SORTING
- 4. Check that the *Detector* reports *FIT* and *UNFIT* alternately

#### 14.2.2. Inheritance

Test case inherits from BSMS\_CS-007 Sorting to stackers. See there for parameter descriptions.

### 14.3. BSMS\_DEV-003 HTTP and additional services

This test set is used to check that a device supports an HTTP web server as well as mandatory and, optionally, device specific Additional Services in certain states.

#### 14.3.1. Functionality

The test case runs the startup sequence until the device reaches the DS\_FEED\_OFF state. It displays a link to the HTTP port of the device, allowing the user to open the Service and Maintenance page of the device. Further, the user may access the FTP file services of the device using an FTP client (e.g. WinSCP). On **Continue** the BSMS enters BS\_ERROR allowing to test if HTTP server of the device is still offered in the DS\_ERROR state.

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#### 14.3.2. Inheritance

Test case inherits from *BSMS\_BSM-020* HTTP and additional services. See there for parameter descriptions.

### 14.4. BSMS\_DEV-005 State Transitions

This test case performs various state transitions and checks if the DUT reacts correctly. When it reaches the BS\_SORTING state the second time, it waits for one of the connected devices to go to the DS\_ERROR state.

#### 14.4.1. Functionality

This test expects the device to follow the BSMS and make following devices state transitions. DS\_START\_UP, DS\_INITIALISATION, DS\_INITIALISED, DS\_FEED\_OFF, DS\_READY\_TO\_SORT, DS\_SORTING, DS\_FEED\_OFF, DS\_READY\_TO\_SHUT\_DOWN, DS\_SHUT\_DOWN, DS\_START\_UP, DS\_INITIALISATION, DS\_INITIALISED, DS\_FEED\_OFF, DS\_READY\_TO\_SORT, DS\_SORTING, DS\_ERROR, DS\_READY\_TO\_SHUT\_DOWN and DS\_SHUTDOWN.

#### 14.4.2. Inheritance

Test case inherits from *BSMS\_DEV-005 State Transitions*. See there for parameter descriptions.

#### 14.5. BSMS\_DEV-006 Powerlink Errors

Checks the correct reaction of a device to specific Powerlink errors.

#### 14.5.1. Functionality

- 1. Transitions the BSMS to BS\_FEED\_OFF
- 2. Waits until Continue is pressed
- 3. Injects a CRC error in the PReq frame for the DUT. The DUT is expected to detect a "Loss of PReq" error.
- 4. Checks that the device transitions to DS\_ERROR
- 5. Waits until **Continue** is pressed
- 6. Transitions the BSMS to BS\_FEED\_OFF
- 7. Injects a CRC error in a SoC frame for the DUT. The DUT is expected to detect a "Loss of SoC" error.
- 8. Checks that the device transitions to DS\_ERROR

#### 14.5.2. Inheritance

Test case inherits from *BSMS\_BSM-G01 Sorting*. See there for parameter descriptions.

### 14.6. BSMS\_DEV-007 Software Update

This test case checks that the DUT can be updated with a software update as described by CDI2.

#### 14.6.1. Functionality

The test performs the following steps:

1. Go to BS\_FEED\_OFF and waits for the user to **Continue**.



- 2. The user uploads a "firmware.bin" to the device using a standard FTP client, e.g. WinSCP
- 3. Upon **Continue** the test performs the software update sequence and resets the device.
- 4. The BSMS waits until the device has done the software update and it is ready again.
- 5. The BSMS enters BS\_FEED\_OFF

#### 14.6.2. Inheritance

Test case inherits from *BSMS\_BSM-023 Software Updates*. See there for parameter descriptions.

### 14.7. BSMS\_DEV-010 TTS Error

This test set checks the response of a device to different TTS errors.

### 14.7.1. Functionality

Runs the following tests:

- 1. "Loss of TC" (E)
- 2. "TC out of range" (W)
- 3. "BP without BNID" (W)
- 4. "BNID without BP" (W)

For each test the following steps are performed:

- 1. Transitions the system up to FEED\_OFF and wait until **Continue** is pressed
- 2. Inject error
- 3. Retrieve and display error state and current\_error.xml
- 4. Wait until **Continue** is pressed
- 5. Transitions the system up to FEED\_OFF

#### 14.7.2. Inheritance

Test case inherits from *BSMS\_BSM-G01 Sorting*. See there for parameter descriptions.

### 14.8. BSMS\_DEV-014 TTS Reset

This test case checks that the DUT reacts correctly to TTS reset signals with different lengths.

#### 14.8.1. Functionality

The test performs the following steps:

- 1. Go to FEED\_OFF
- 2. Perform a reset with a short reset pulse on **Continue**
- 3. Check that the device ignores this reset pulse
- 4. Perform a proper reset pulse on **Continue**
- 5. Check that the device resets properly

#### 14.8.2. Inheritance

Test case inherits from *BSMS\_BSM-032 Reset Devices*. See there for parameter descriptions.



# 14.9. BSMS\_DEV-G01\_CS Internal Trigger

This test supports the testing of a single camera system.

### 14.9.1. Functionality

First, the system starts up, initialises and transitions into the state BS\_FEED\_OFF. Then it waits for the user to prepare the various network analysis tools (e.g. ProfiTap, Wireshark, ...). Upon **Continue** the test sorts 1000 banknotes and shuts down. After that the user can start analysing the network logs.

#### **Device Settings**

The camera system is expected to use node id 1.

### 14.9.2. Inheritance

Test case inherits from *BSMS\_BSM-G01 Sorting*. See there for parameter descriptions.

### 14.10. BSMS\_DEV-G01\_DET Internal Trigger

This test supports the testing of a single detector.

#### 14.10.1. Functionality

First, the system starts up, initialises and transitions into the state BS\_FEED\_OFF. Then it waits for the user to prepare the various network analysis tools (e.g. ProfiTap, Wireshark, ...). Upon **Continue** the test sorts 1000 banknotes and shuts down. After that the user can start analysing the network logs.

#### **Device Settings**

The camera system is expected to use node id 1.

#### 14.10.2. Inheritance

Test case inherits from *BSMS\_BSM-G01 Sorting*. See there for parameter descriptions.

### 14.11. BSMS\_DEV-G01\_IEU Internal Trigger

This test supports the testing of a single IEU.

#### 14.11.1. Functionality

First, the system starts up, initialises and transitions into the state BS\_FEED\_OFF. Then it waits for the user to prepare the various network analysis tools (e.g. ProfiTap, Wireshark, ...). Upon **Continue** the test sorts 1000 banknotes and shuts down. After that the user can start analysing the network logs.

#### **Device Settings**

The IEU is expected to use node id 1.

#### 14.11.2. Inheritance

Test case inherits from *BSMS\_BSM-G01 Sorting*. See there for parameter descriptions.



# 14.12. BSMS\_IEU-002 IDB Error

Checks the correct reaction to specific IDB errors.

During sorting, the *BSMS* injects a minor error for which the *IEU* is expected to continue operation. After that sorting is continued to allow for the IDB connection to be manually disconnected.

### 14.12.1. Functionality

- 1. The system is brought up to SORTING
- 2. 100 banknotes are sorted, containing a single IDB error
- 3. The system goes to FEED\_OFF
- 4. Waits until **Continue** is pressed
- 5. Sorts another 1000 banknotes to allow for the IDB cable to be unplugged manually.

#### 14.12.2. Inheritance

Test case inherits from BSMS\_DEV-G01\_IEU Internal Trigger. See there for parameter descriptions.



# 15. Annex: Description of DS Simulator-only Test Sets for BSMS Acceptance

### 15.1. DS\_CS-007 Sorting to Stackers

This test simulates a single camera system that always reports FIT, UNFIT as fitness results.

#### 15.1.1. Functionality

The camera system is compliant with the CDI2 spec and reacts to all state transitions normally. It reports FIT, UNFIT as fitness result alternately.

#### **Device Settings**

The camera system is configured with node id 1.

#### 15.1.2. Inheritance

Test case inherits from DS\_BSM-G01 Sorting. See there for parameter descriptions.

### 15.2. DS\_DET-003 Sorting to Stackers

This test simulates a single detector that always reports FIT, UNFIT as fitness results.

#### 15.2.1. Functionality

The detector is compliant with the CDI2 spec and reacts to all state transitions normally. It reports FIT, UNFIT as fitness result alternately.

#### **Device Settings**

The camera system is configured with node id 1.

#### 15.2.2. Inheritance

Test case inherits from *DS\_BSM-G01 Sorting*. See there for parameter descriptions.

### 15.3. DS\_DEV-003 HTTP and additional services

This test set supports *BSMS* in testing the HTTP and additional services of a device.

#### 15.3.1. Functionality

The device follows the BSMS states and enters DS\_ERROR when the BSMS transitions to BS\_ERROR. It provides the HTTP and additional services in DS\_ERROR as well.

#### 15.3.2. Inheritance

Test case inherits from *DS\_BSM-G01 Sorting*. See there for parameter descriptions.


## 15.4. DS\_DEV-006 Powerlink Errors

This test case provides a device which follows the BSM to all states while it is checking for correct behaviour on Powerlink errors. It has to be stopped by pressing **Stop**.

## 15.4.1. Inheritance

Test case inherits from DS\_BSM-G01 Sorting. See there for parameter descriptions.

## 15.5. DS\_DEV-007 Software Update

This test case verifies that the *BSMS* can perform a software updates of a device.

## 15.5.1. Functionality

The test performs the following steps:

- 6. Go to DS\_FEED\_0FF
- 7. Follow software update
- 8. Checks that the received "firmware.bin" is correct
- 9. Follows the BSM through the software update procedure and enters DS\_FEED\_OFF finally.

### 15.5.2. Inheritance

Test case inherits from *DS\_BSM-023*. See there for parameter descriptions.

## 15.6. DS\_DEV-G01\_CS Sorting

This test set simulates a single camera system as a standalone device. It is a general test set to be used in different test cases.

### 15.6.1. Functionality

The camera system is compliant with the CDI2 spec and reacts to all state transitions normally. The test succeeds if the CS receives 1000 banknote triggers and is shut down cleanly.

### **Device Settings**

The camera system is configured with node id 1.

### 15.6.2. Inheritance

Test case inherits from DS\_BSM-G01 Sorting. See there for parameter descriptions.

## 15.7. DS\_DEV-G01\_DET Sorting

This test simulates a single detector. It is a general test set to be used in different test cases.

### 15.7.1. Functionality

The detector is compliant with the CDI2 spec and reacts to all state transitions normally. The test succeeds if it receives 1000 banknote triggers and is shut down cleanly.

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### **Device Settings**

The detector is configured with node id 1.

### 15.7.2. Inheritance

Test case inherits from DS\_BSM-G01 Sorting. See there for parameter descriptions.

## 15.8. DS\_DEV-G01\_IEU Sorting

This test simulates a single IEU. It is a general test set to be used in different test cases.

### 15.8.1. Functionality

The IEU is compliant with the CDI2 spec and reacts to all state transitions normally. The test succeeds if it receives 1000 triggers and is shut down cleanly.

### **Device Settings**

The IEU is configured with node id 1.

### 15.8.2. Inheritance

Test case inherits from *DS\_BSM-G01 Sorting*. See there for parameter descriptions.



# **16.** Annex: Description of DS Test Sets for Device Acceptance

## 16.1. DS\_BSM-002 Distance

This test case tests the worst case distances and timeouts that are allowed by the CDI2 spec. To test all device types it provides 4 devices, namely 1 CS, 1 IEU, and 2 detectors.

## 16.1.1. Functionality

All *BNRESULTs* have the Judgement code FIT, so that it can easily be checked that no specimen was sorted to sorting gate REJECT. All devices are set up to provide their results as late as possible:

- 10. The CS provides its images as late as possible: tIMAGE\_BFA = tBP\_BFA + tMaxBN + 5 ms
- 11. The IEU provides its BNRESULT as late as possible: tRES\_IEU = tIMAGE + 45 ms
- 12. The detectors provide their BNRESULT as late as possible:  $tRES_DET = tBP + tMaxBN + 20$  ms

## 16.1.2. Inheritance

Test case inherits from *DS\_BSM-G01 Sorting*. See there for parameter descriptions.

## 16.2. DS\_BSM-006 Flutter

This test provides a way to deploy and trigger the flutter detector. The flutter detector is connected to TTS1 of the BSM and thus receiving clock and trigger via TTS. The device simulator supports the startup protocol on the DMB, instead of the flutter detector. The device actually operates in the non-TTS mode.

## 16.2.1. Inheritance

Test case inherits from DS\_BSM-G01 Sorting. See there for parameter descriptions.

## 16.3. DS\_BSM-014 Sort test charts

This test follows the BSM when sorting test charts. It checks that the BSM overrules the *BNRECOGINTION* received from the CS and sends a fixed *BNRECOGNITION* with Series=0 (Test/Calibration), Denomination=1 (Blank Sheet) and Orientation=1 (Front) instead.

## 16.3.1. Inheritance

Test case inherits from DS\_BSM-G01 Sorting. See there for parameter descriptions.

## 16.4. DS\_BSM-017 Powerlink and Nettime

This test supports the testing of the Powerlink protocol and its timing, and that the real-time master clock is transmitted by the BSM. It uses the *DS-BSM Standard Setup* and configures it for the *BSM-017 Powerlink and Nettime* test.

## 16.4.1. Functionality

The behaviour of the devices is compliant with the CDI2 specification. They react to all state transitions and expect to receive 1000 banknotes.

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Additionally, the devices display and update the received Nettime in their status message.

### 16.4.2. Inheritance

Test case inherits from DS\_BSM-G01 Sorting. See there for parameter descriptions.

## 16.5. DS\_BSM-020 HTTP and additional services

Checks that the BSM offers a HTTP browser, supports Additional Services in certain states and that it supports device specific Additional Services.

### 16.5.1. Functionality

- 1. Follows the BSM state changes
- 2. Offers HTTP and additional service files
- 3. Uploads to writable files are printed to the message field
- 4. Pressing Continue lets one device transition to DS\_ERROR
- 5. To end the test press **Stop**

### 16.5.2. Inheritance

Test case inherits from *DS\_BSM-G01 Sorting*. See there for parameter descriptions.

## 16.6. DS\_BSM-021 State Transitions

This test case uses the DS-BSM Standard Setup and configures it for the BSM-021 State Transitions test.

## 16.6.1. Functionality

The devices react normally to the state transitions of the BSM except for nodes 3 and 8. Device **#3** takes the maximum allowed time to transition between states. The times are configurable using the test case parameters. To guarantee that the times are in the allowed range they are compensated for the transmission time (10 ms).

When the BSM reaches BS\_SORTING for the second time, the user is prompted to click **Continue**. When the **Continue** is clicked in this state, the device **#8** will transition to DS\_ERROR, which should trigger the BSM and consequently all other devices to transition into the ERROR state.

This test records the BSM state transitions. The BSM is expected to run through following states. BS\_FEED\_OFF, BS\_REQUEST\_TO\_SORT, BS\_SORTING, BS\_FEED\_OFF, BS\_REQUEST\_TO\_SHUT\_DOWN, BS\_SHUTDOWN, BS\_INITIALISATION, BS\_FEED\_OFF, BS\_REQUEST\_TO\_SORT, BS\_SORTING, BS\_ERROR, BS\_REQUEST\_TO\_SHUT\_DOWN and BS\_SHUTDOWN.

### 16.6.2. Inheritance

Test case inherits from DS\_BSM-G01 Sorting. See there for parameter descriptions.

## 16.7. DS\_BSM-022 Powerlink Errors

This test injects errors on the Powerlink and checks the reaction by the BSM.



## 16.7.1. Functionality

If this node has the node id specified in the parameters it will perform the following steps:

- 6. Waits for SYS\_FEED\_OFF
- 7. Waits until **Continue** is pressed
- 8. Disable Powerlink transmitter for four cycles (misses one PRes)
- 9. Checks if the BSM transitioned to BS\_ERROR
- 10. Waits until SYS\_FEED\_OFF is reached again
- 11. Waits until **Continue** is pressed
- 12. Disable Powerlink transmitter for 1000 cycles (simulating loss of device)
- 13. Checks if the BSM transitioned to BS\_ERROR
- 14. Done

All other nodes will just follow the state transitions of the system.

## 16.7.2. Inheritance

Test case inherits from *DS\_BSM-G01 Sorting*. See there for parameter descriptions.

## 16.8. DS\_BSM-023 Software Update

This DS test set is used to check, that the BSM can perform software updates of a device.

### 16.8.1. Functionality

The test performs the following steps:

- 15. Go to DS\_FEED\_OFF
- 16. Follow software update
- 17. Check that the received "firmware.bin" is correct
- 18. Follow BSM back to DS\_FEED\_OFF

### 16.8.2. Inheritance

Test case inherits from *DS\_BSM-G01 Sorting*. See there for parameter descriptions.

## 16.9. DS\_BSM-024 Non-TTS Operation

This test case uses the *DS-BSM-Non-TTS* setup and checks that the BSM supports devices without a physical TTS connection.

## 16.9.1. Functionality

This test case sorts 1000 banknotes in non-TTS mode. In fact, it behaves exactly the same as the *DS\_BSM-G01* test case, except that all devices operate in the non-TTS mode.

### 16.9.2. Inheritance

Test case inherits from *DS\_BSM-G01 Sorting*. See there for parameter descriptions.

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## 16.10. DS\_BSM-030 IDB Error

Checks the BSM for correct reaction to specific IDB errors.

During sorting, the DS injects a minor error for which the BSM is expected to continue operation. After that sorting is continued to allow for the IDB connection to be manually disconnected.

### 16.10.1. Functionality

13. The simulator is set up to report FIT for all banknotes.

14. The IDB sender is set up to introduce a single error into the IDB stream.

### 16.10.2. Inheritance

Test case inherits from *DS\_BSM-G01 Sorting*. See there for parameter descriptions.

## 16.11. DS\_BSM-031 Sorting to Stackers

This test case uses the *DS-BSM Standard Setup* and configures it for the "BSM-031 Sorting to Stackers" test.

### 16.11.1. Functionality

The devices expect to receive 400 banknotes. They are prepared to set the Judgement Code to a certain value. All devices set the first 100 banknotes to FIT, the next 100 to REJECT, the next 100 to UNFIT, and the last 100 to SPECIAL1.

### 16.11.2. Inheritance

Test case inherits from *DS\_BSM-G01 Sorting*. See there for parameter descriptions.

## 16.12. DS\_BSM-033 XML Error

During this test case the CS sends an invalid XML string, which should cause an error on the BSM.

### 16.12.1. Parameters:

### Device Info Content

The content of the device\_info.xml that is send by the device to the BSM.

### 16.12.2. Inheritance

Test case inherits from DS\_BSM-G01 Sorting. See there for parameter descriptions.

## 16.13. DS\_BSM-G01-HR Sorting

This test case provides the *DS-BSM Standard Setup* with 16 devices and sorts 1000 banknotes. In contrast to DS\_BSM-G01, in DS\_BSM-G01-HR the IDB sender is configured for the transmission of optional streams, with different image sizes and higher resolution.

Stream 0 : 488x920 Stream 1 : 488x920 Stream 2 : 488x920



Stream 3: 488x920 Stream 4 : 488x920 Stream 5: 488x920 Stream 6 : 488x920 Stream 7: 488x920 Stream 8 : 488x920 Stream 9:488x920 Stream 10 : 488x920 Stream 11: 488x920 Stream 12:488x920 Stream 13 : 488x920 Stream 14 : 488x920 Stream 15 : 976x1840 Stream 16 : 976x1840 Stream 17 : 976x1840 Stream 18 : 976x16 Stream 19 : 976x16

## 16.13.1. Functionality

The devices behave correctly according to the CDI2 standard and react to the state changes of the BSM. The devices expect to be initialised and brought into the DS\_FEED\_OFF state. After DS\_FEED\_OFF they expect to go to the DS\_SORTING state, via the DS\_READY\_TO\_SORT state, and to receive exactly 1000 banknote triggers. The test finishes when the devices are shut down and stopped cleanly.

## 16.13.2. Triggering

The devices in TTS mode use the TTS-BP signal, while devices in non-TTS mode use the trigger announcements received with the *BSMINFO* packet.

## 16.13.3. Parameters

This test case supports input parameters, allowing the user to adapt the testcase to different use cases.

### Number of Banknotes

The expected number of banknotes to sort.

### **Run Forever**

- 19. False: The device stops the testcase after the expected number of banknotes.
- 20. True: The device does not abort when a BSM testcase stops and/or enters BS\_ERROR. Instead, it accepts a new startup sequence of the BSM and continues normal operation. The Number of Banknotes parameter is ignored.

### **Device Command Line**

An extra command line argument to the simulated component.

#### **Fitness Results**

A comma separated list of values (FIT, UNFIT, REJECT, SPECIAL1, SPECIAL2, SPECIAL3 SPECIAL4 or SPECIAL5) that is returned as result code for each banknote. When the end of the list is reached the next result will start again with the first entry.

#### **DS Command Line**

An extra command line argument to the simulated component.

#### Static recognition

If not empty, a set of three comma separated integers specifying orientation, series and denomination

#### **Poweroff Stop Count**

The stop count decrements with every NMTStopCmd the device receives. When it reaches 0 the device will power down and check if the test has passed. An initial value of 0 disables this feature.

#### Short Self-Test Duration (ms)

Time in milliseconds the devices will need to perform a short self-test, including system state transition times (10ms). If specified as *min:max*, a random value between min and max is chosen.

#### Intensive Self-Test Duration (ms)

Time in milliseconds the devices will need to perform an intensive self-test, including system state transition times (10ms). If specified as *min:max*, a random value between min and max is chosen.

### Stall Short Self-Test (duration:cycle)

Let a Short Self-Test take a certain duration (ms) at a specific self-test cycle (cycle counting starts at 0). This is done once and overrides the Short Self-Test Duration parameter.

### Stall Intensive Self-Test (duration:cycle)

Let an Intensive Self-Test take a certain duration (ms) at a specific self-test cycle (cycle counting starts at 0). This is done once and overrides the Intensive Self-Test Duration parameter.

### Set Maintenance State at Short Self-Test (state@cycle)

Set maintenance status flags at a specific Short Self-Test cycle (cycle counting starts at 0). The state code may range from 0 to 15. The maintenance status flags are reset to 0 at the next, either short or intensive self-test.

### Set Maintenance State at Intensive Self-Test (state@cycle)

Set maintenance status flags at a specific Intensive Self-Test cycle (cycle counting starts at 0). The state code may range from 0 to 15. The maintenance status flags are reset to 0 at the next, either short or intensive self-test.

#### Test Tag

Operator-specified textual metadata that is stored along with the BSM results package.



### **IDB Sender**

The IDB sender module sends prepared images on the IDB whenever it is triggered by the CS. This module generates a message that indicates the number of images it has sent.

## 16.13.4. Debugging

Logfiles are provided in the result package. See *idb\_x.log* in the *IDB\_DEV* folder for the IDB receiver and *everything.log* in the *DMB\_DEVICE\_results/log* folders for CN logs.

## 16.14. DS\_BSM-G01-HRMAX Sorting

This test case provides the *DS-BSM Standard Setup* with 16 devices and sorts 1000 banknotes.

In contrast to DS\_BSM-G01, in DS\_BSM-G01-HRMAX the IDB sender is configured for the transmission of optional streams with different image sizes and higher resolution. The testcase transmits 33 streams and utilizes maximum IDB bandwidth.

Stream 0: 488x920 Stream 1: 488x920 Stream 2:488x920 Stream 3 : 488x920 Stream 4 : 488x920 Stream 5 : 488x920 Stream 6: 488x920 Stream 7: 488x920 Stream 8 : 488x920 Stream 9:488x920 Stream 10 : 488x920 Stream 11: 488x920 Stream 12 : 488x920 Stream 13: 488x920 Stream 14 : 488x920 Stream 15 : 976x1840 Stream 16 : 976x1840 Stream 17:976x1840 Stream 18 : 976x1840 Stream 19 : 488x920 Stream 20 : 488x920 Stream 21: 488x920 Stream 22 : 488x920 Stream 23 : 488x920 Stream 24 : 488x920 Stream 25 : 488x920 Stream 26 : 488x920 Stream 27 : 488x920 Stream 28 : 488x920 Stream 29 : 488x920 Stream 30 : 488x920

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Stream 31 : 488x920 Stream 32 : 488x920

## 16.14.1. Functionality

The devices behave correctly according to the CDI2 standard and react to the state changes of the BSM. The devices expect to be initialised and brought into the DS\_FEED\_OFF state. After DS\_FEED\_OFF they expect to go to the DS\_SORTING state, via the DS\_READY\_TO\_SORT state, and to receive exactly 1000 banknote triggers. The test finishes when the devices are shut down and stopped cleanly.

## 16.14.2. Triggering

The devices in TTS mode use the TTS-BP signal, while devices in non-TTS mode use the trigger announcements received with the *BSMINFO* packet.

### 16.14.3. Parameters

This test case supports input parameters, allowing the user to adapt the testcase to different use cases.

### **Number of Banknotes**

The expected number of banknotes to sort.

### **Run Forever**

- 21. False: The device stops the testcase after the expected number of banknotes.
- 22. True: The device does not abort when a BSM testcase stops and/or enters BS\_ERROR. Instead, it accepts a new startup sequence of the BSM and continues normal operation. The Number of Banknotes parameter is ignored.

### **Device Command Line**

An extra command line argument to the simulated component.

### **Fitness Results**

A comma separated list of values (FIT, UNFIT, REJECT, SPECIAL1, SPECIAL2, SPECIAL3 SPECIAL4 or SPECIAL5) that is returned as result code for each banknote. When the end of the list is reached the next result will start again with the first entry.

### **DS Command Line**

An extra command line argument to the simulated component.

### Static recognition

If not empty, a set of three comma separated integers specifying orientation, series and denomination

### **Poweroff Stop Count**

The stop count decrements with every NMTStopCmd the device receives. When it reaches 0 the device will power down and check if the test has passed. An initial value of 0 disables this feature.

### Short Self-Test Duration (ms)

Time in milliseconds the devices will need to perform a short self-test, including system state transition times (10ms). If specified as *min:max*, a random value between min and max is chosen.



## **Intensive Self-Test Duration (ms)**

Time in milliseconds the devices will need to perform an intensive self-test, including system state transition times (10ms). If specified as *min:max*, a random value between min and max is chosen.

### Stall Short Self-Test (duration:cycle)

Let a Short Self-Test take a certain duration (ms) at a specific self-test cycle (cycle counting starts at 0). This is done once and overrides the Short Self-Test Duration parameter.

### Stall Intensive Self-Test (duration:cycle)

Let an Intensive Self-Test take a certain duration (ms) at a specific self-test cycle (cycle counting starts at 0). This is done once and overrides the Intensive Self-Test Duration parameter.

### Set Maintenance State at Short Self-Test (state@cycle)

Set maintenance status flags at a specific Short Self-Test cycle (cycle counting starts at 0). The state code may range from 0 to 15. The maintenance status flags are reset to 0 at the next, either short or intensive self-test.

### Set Maintenance State at Intensive Self-Test (state@cycle)

Set maintenance status flags at a specific Intensive Self-Test cycle (cycle counting starts at 0). The state code may range from 0 to 15. The maintenance status flags are reset to 0 at the next, either short or intensive self-test.

### Test Tag

Operator-specified textual metadata that is stored along with the BSM results package.

### IDB Sender

The IDB sender module sends prepared images on the IDB whenever it is triggered by the CS. This module generates a message that indicates the number of images it has sent.

### 16.14.4. Debugging

Logfiles are provided in the result package. See *idb\_x.log* in the *IDB\_DEV* folder for the IDB receiver and *everything.log* in the *DMB\_DEVICE\_results/log* folders for CN logs.

## 16.15. DS\_BSM-G01-RF-HR Sorting (Run Forever)

This test case inherits from *DS\_BSM-G01-HR Sorting* and uses *Run Forever mode = true* default parameters. It can be used for continuous operation, as it does not terminate when the BSM stops operation and will accept re-initialization.

### 16.15.1. Inheritance

Test case inherits from DS\_BSM-G01-HR Sorting. See there for parameter descriptions.



## 16.16. DS\_BSM-G01-RF Sorting (Run Forever)

This test case inherits from *DS\_BSM-G01 Sorting* and uses *Run Forever mode = true* default parameters. It can be used for continuous operation, as it does not terminate when the BSM stops operation and will accept re-initialization.

### 16.16.1. Inheritance

Test case inherits from DS\_BSM-G01 Sorting. See there for parameter descriptions.

## 16.17. DS\_BSM-G01 Sorting

This test case provides the DS-BSM Standard Setup with 16 devices and sorts 1000 banknotes.

### 16.17.1. Functionality

The devices behave correctly according to the CDI2 standard and react to the state changes of the BSM. The devices expect to be initialised and brought into the DS\_FEED\_OFF state. After DS\_FEED\_OFF they expect to go to the DS\_SORTING state, via the DS\_READY\_TO\_SORT state, and to receive exactly 1000 banknote triggers. The test finishes when the devices are shut down and stopped cleanly.

### 16.17.2. Triggering

The devices in TTS mode use the TTS-BP signal, while devices in non-TTS mode use the trigger announcements received with the *BSMINFO* packet.

### 16.17.3. Parameters

This test case supports input parameters, allowing the user to adapt the testcase to different use cases.

### Number of Banknotes

The expected number of banknotes to sort.

### **Run Forever**

- 1. False: The device stops the testcase after the expected number of banknotes.
- 2. True: The device does not abort when a BSM testcase stops and/or enters BS\_ERROR. Instead, it accepts a new startup sequence of the BSM and continues normal operation. The Number of Banknotes parameter is ignored.

### **Device Command Line**

An extra command line argument to the simulated component.

### **Fitness Results**

A comma separated list of values (FIT, UNFIT, REJECT, SPECIAL1, SPECIAL2, SPECIAL3 SPECIAL4 or SPECIAL5) that is returned as result code for each banknote. When the end of the list is reached the next result will start again with the first entry.

### DS Command Line

An extra command line argument to the simulated component.



### Static recognition

If not empty, a set of three comma separated integers specifying orientation, series and denomination

### **Poweroff Stop Count**

The stop count decrements with every NMTStopCmd the device receives. When it reaches 0 the device will power down and check if the test has passed. An initial value of 0 disables this feature.

### Short Self-Test Duration (ms)

Time in milliseconds the devices will need to perform a short self-test, including system state transition times (10ms). If specified as *min:max*, a random value between min and max is chosen.

### **Intensive Self-Test Duration (ms)**

Time in milliseconds the devices will need to perform an intensive self-test, including system state transition times (10ms). If specified as *min:max*, a random value between min and max is chosen.

### Stall Short Self-Test (duration:cycle)

Let a Short Self-Test take a certain duration (ms) at a specific self-test cycle (cycle counting starts at 0). This is done once and overrides the Short Self-Test Duration parameter.

### Stall Intensive Self-Test (duration:cycle)

Let an Intensive Self-Test take a certain duration (ms) at a specific self-test cycle (cycle counting starts at 0). This is done once and overrides the Intensive Self-Test Duration parameter.

### Set Maintenance State at Short Self-Test (state@cycle)

Set maintenance status flags at a specific Short Self-Test cycle (cycle counting starts at 0). The state code may range from 0 to 15. The maintenance status flags are reset to 0 at the next, either short or intensive self-test.

### Set Maintenance State at Intensive Self-Test (state@cycle)

Set maintenance status flags at a specific Intensive Self-Test cycle (cycle counting starts at 0). The state code may range from 0 to 15. The maintenance status flags are reset to 0 at the next, either short or intensive self-test.

### Test Tag

Operator-specified textual metadata that is stored along with the BSM results package.

### **IDB Sender**

The IDB sender module sends prepared images on the IDB whenever it is triggered by the CS. This module generates a message that indicates the number of images it has sent.

### 16.17.4. Debugging

Logfiles are provided in the result package. See *idb\_x.log* in the *IDB\_DEV* folder for the IDB receiver and *everything.log* in the *DMB\_DEVICE\_results/log* folders for CN logs.

# 17. Annex: Description of BSMS Simulator-only Test Set for DS Acceptance

# 17.1. BSMS\_BSM-002 Distance

This test case tests the worst case distances and timeouts that are allowed by the CDI2 spec. The BSMS sorts 1000 banknotes and measures the timeouts.

## 17.1.1. Functionality

the text that you want to appear here.

The test case is limited to 4 devices, namely 1 CS, 1 IEU, and 2 detectors. Every device should be set up to deliver its *BNRESULT* at the last possible moment allowed by the CDI2 spec. The test case will measure the time between the BP signal and the arrival of the *BNRESULT*. If a *BNRESULT* does not arrive in time, the test fails immediately.

Furthermore, the Wireshark network analyser is used to record the Powerlink network packets for further analyses. The CDI2 statistics plugin provides means to measure the trigger to *BNRESULT* as well.

## 17.1.2. Inheritance

Test case inherits from *BSMS\_BSM-G01 Sorting*. See there for parameter descriptions.

# 17.2. BSMS\_BSM-006 Flutter

This test sorts 1000 banknotes using the TS to test the flutter detector.

## 17.2.1. Inheritance

Test case inherits from *BSMS\_BSM-G01 Sorting*. See there for parameter descriptions.

## 17.3. BSMS\_BSM-014 Sort test charts

This test runs the simulator to sort the test charts and an additional 1000 blanks. It overrules the series information from the *BNRECOGNITION* to be Series=0 (Test/Calibration), Denomination=1 (Blank Sheet) and Orientation=1 (Front). During the test it checks if all devices gave a judgment of FIT.

## 17.3.1. Inheritance

Test case inherits from *BSMS\_BSM-G01 Sorting*. See there for parameter descriptions.

# 17.4. BSMS\_BSM-017 Powerlink and Nettime

This test set supports the testing of the Powerlink protocol and its timing, and testing of the real-time master clock.

## 17.4.1. Functionality

First, the system starts up, initialises and transitions into BS\_FEED\_OFF. Then it stops and the user may prepare the various network analysis tools (e.g. ProfiTap, Wireshark, ...). Then the user may start sorting by pressing **Continue**. The test will sort 1000 banknotes and shutdown when finished. After that the user can analyse the recorded network logs.



## 17.4.2. Inheritance

Test case inherits from *BSMS\_BSM-G01 Sorting*. See there for parameter descriptions.

## 17.5. BSMS\_BSM-020 HTTP and additional services

This test case provides access to the HTTP and additional services on the DS. It provides links to the HTTP interface and to offered files.

## 17.5.1. Functionality

- 15. Transitions up to BS\_FEED\_OFF
- 16. Follows devices going to DS\_ERROR
- 17. Offers links to all devices in the instructions section

## 17.5.2. Inheritance

Test case inherits from *BSMS\_BSM-G01 Sorting*. See there for parameter descriptions.

## 17.6. BSMS\_BSM-021 State Transitions

This test case performs various state transitions and checks if the devices react correctly. When it reaches the BS\_SORTING state the second time, it waits for one of the connected devices to go to the DS\_ERROR state.

## 17.6.1. Functionality

The BSMS runs through following states. BS\_FEED\_OFF, BS\_REQUEST\_TO\_SORT, BS\_SORTING, BS\_FEED\_OFF, BS\_REQUEST\_TO\_SHUT\_DOWN, BS\_SHUTDOWN, BS\_FEED\_OFF, BS\_REQUEST\_TO\_SORT, BS\_SORTING, BS\_ERROR, BS\_REQUEST\_TO\_SHUT\_DOWN and BS\_SHUTDOWN.

## 17.6.2. Inheritance

Test case inherits from *BSMS\_BSM-G01 Sorting*. See there for parameter descriptions.

## 17.7. BSMS\_BSM-022 Powerlink Errors

This test reacts to Powerlink errors in a decent way.

## 17.7.1. Functionality

- 18. Transitions up to BS\_FEED\_OFF
- 19. Waits for a Powerlink error
- 20. Waits until **Continue** is pressed
- 21. Transitions back to BS\_FEED\_OFF
- 22. Waits for another Powerlink error

### 17.7.2. Inheritance

Test case inherits from *BSMS\_BSM-G01 Sorting*. See there for parameter descriptions.



## **17.8. BSMS\_BSM-023 Software Updates**

This test performs a software update procedure for a device and measures the timing of the process.

## 17.8.1. Inheritance

Test case inherits from BSMS\_BSM-G01 Sorting. See there for parameter descriptions.

## 17.9. BSMS\_BSM-024 Non-TTS Operation

This test case configures the *BSMS* for the *DS-BSM-Non-TTS* setup and checks that the devices work properly in non-TTS operation.

## 17.9.1. Functionality

This test case sorts 1000 banknotes in non-TTS mode. In fact, it behaves exactly the same as the *BSMS\_BSM-G01* test case, except that all devices operate in the non-TTS mode.

The *BSMS* is setup to work with devices in non-TTS operation. Hence, all checks regarding the TTS-Ready signal are omitted.

## 17.9.2. Inheritance

Test case inherits from BSMS\_BSM-G01 Sorting. See there for parameter descriptions.

## 17.10. BSMS\_BSM-030 IDB Error

This test allows the DS to test for IDB error reaction. First it sorts 100 BNs, then it waits for user input and sends another 900 banknotes.

### 17.10.1. Functionality

- 23. Transition up to SYS\_SORTING
- 24. Sort 100 banknotes
- 25. Transition to SYS\_FEED\_0FF
- 26. Wait until Continue is pressed
- 27. Sort another 900 banknotes

### 17.10.2. Inheritance

Test case inherits from *BSMS\_BSM-G01 Sorting*. See there for parameter descriptions.

## 17.11. BSMS\_BSM-031 Sorting to Stackers

This test sorts 400 banknotes to different stackers. It expects the devices to set the Judgement code to specific values. The first 100 banknotes must be set to FIT, the next 100 to REJECT, the next 100 to UNFIT, and the last 100 to SPECIAL1.

### 17.11.1. Functionality

The BSMS automatically checks the responses of the devices and reports a result message.



## 17.11.2. Inheritance

Test case inherits from *BSMS\_BSM-G01 Sorting*. See there for parameter descriptions.

## 17.12. BSMS\_BSM-032 Reset Devices

This test checks if the DS supports device resets.

### 17.12.1. Functionality

- 28. Transitions the system up to FEED\_OFF
- 29. Waits until **Continue** is pressed
- 30. Performs a reset
- 31. Transitions the system back up to FEED\_OFF

### 17.12.2. Inheritance

Test case inherits from *BSMS\_BSM-G01 Sorting*. See there for parameter descriptions.

## 17.13. BSMS\_BSM-033 XML Error

During this test case the CS sends an invalid XML string, which should cause an error on the BSM.

### 17.13.1. Parameters:

### XML Error Target

Specifies the node id of the device the manipulated XMLs should be send to.

### **Device Config Content**

Contains the content that is send as device\_config.xml to the node specified by XML Error Target.

### Machine Info Content

Contains the content that is send as machine\_info.xml to the node specified by XML Error Target.

### 17.13.2. Inheritance

Test case inherits from *BSMS\_BSM-G01 Sorting*. See there for parameter descriptions.

## 17.14. BSMS\_BSM-G01-HR Sorting

This test case provides the BSM configuration for a *DS-BSM Standard Setup* with 16 devices and sorts 1000 banknotes. It is set up to broadcast the Powerlink NetTime and RelativeTime in each SoC frame, and it fulfils all TTS requirements.

In contrast to BSMS\_BSM-G01, in BSMS\_BSM-G01-HR the IDB receiver is configured to receive 20 streams (mandatory + optional streams).

### 17.14.1. Functionality

Initially the test brings all devices to the FEED\_OFF state. After all devices reached the FEED\_OFF state it goes to the SORTING state, via the READY\_TO\_SORT state, and sorts 1000 banknotes. Then it shuts itself



and the devices down and checks if it has received all of the 1000 *BNRESULTs* for all of the banknotes from all devices.

### 17.14.2. Parameters

This test case supports input parameter, allowing the user to adapt the testcase to different use cases.

### Number of Banknotes

The number of banknotes to sort.

#### Manual Mode

- 32. False: The BSMS starts sorting immediately after BS\_FEED\_OFF is reached.
- 33. True: The BSMS stops at BS\_FEED\_OFF and waits for the user to press Continue. This option is used when the test requires further preparations before sorting starts. For example a measurement instrument has to be connected or the transport simulator needs time to reach nominal speed.

#### **Trigger source**

- 34. Internal: The BSMS generates an internal banknote trigger as well as an internal transport clock.
- 35. External: Configures the BSMS to use an external transport clock and trigger signal, usually provided by the transport simulator. The external clock is expected to have a resolution of 0.1 mm.

### Trigger distance (ms)

When trigger source is set Internal: Specifies the time between two simulated banknotes are triggered. Use 20 ms to set a sorting speed of 50 banknotes per second.

### Internal TC Clock Rate (Hz)

Clock rate of the transport clock when in Internal trigger mode. The TC is counting tenths of millimeters so a value of 125000 results in a transport speed of 12.5 m/s.

### **BSM Command Line**

An extra command line argument to the simulated component.

### No Camera System

- 36. False: Normal operation. BNINFO packets are generated upon reception of BNRECOGNITION from a Camera System.
- 37. True: BSMS provides simulated BNINFO packets. Use this option only in case no Camera System is installed.

### **First BNID**

Starting point of banknote identifications allocated during this test run.

### **BN Series**

BN series sent out in BNINFO (Only relevant in "No Camera System" mode).

### **BN** Denomination

BN denomination sent out in BNINFO (Only relevant in "No Camera System" mode).



## **BN Orientation**

BN orientation sent out in BNINFO (Only relevant in "No Camera System" mode).

### **BNINFO Delay (ms)**

Delay in milliseconds before the BSM sends out the BNINFO (Only relevant in "No Camera System" mode).

### SORTING Timeout (ms)

Wait this many milliseconds for expected BNRESULT messages before aborting the running test. Set to 0 to wait forever.

### Short Self-Test Cycle (BN)

Sort this many BNs between short self-tests. Set to 0 for no short self-tests. The BSMS transitions from BS\_SORTING to BS\_REQUEST\_TO\_SORT to allow detectors to run a short self-test.

### Intensive Self-Test Cycle (BN)

Sort this many BNs between intensive self-tests. Set to 0 for no intensive self-tests. The BSMS transitions from BS\_SORTING to BS\_FEED\_OFF to allow detectors to run an intensive self-test. The Intensive Self-Test Cycle interval shall be longer than the Short Self-Test Cycle interval.

### Test Tag

Operator-specified textual metadata that is stored along with the BSM results package.

## 17.14.3. IDB Receiver

The IDB receiver module stores images received on the IDB and checks the IDB network quality. This module generates a message that indicates the number of images it has received as well as the number of errors they contained. The IDB receiver stores up to 100 banknote images, depending on image size and main memory size.

### 17.14.4. Debugging

Logfiles are provided in the result package. See *idb\_x.log* in the *IDB\_BSM* folder for the IDB receiver and *everything.log* in the *BSM\_SIM\_results/log* folder for MN logs.

## 17.15. BSMS\_BSM-G01-HRMAX Sorting

This test case provides the BSM configuration for a *DS-BSM Standard Setup* with 16 devices and sorts 1000 banknotes. It is set up to broadcast the Powerlink NetTime and RelativeTime in each SoC frame, and it fulfils all TTS requirements.

In contrast to BSMS\_BSM-G01, in BSMS\_BSM-G01-HRMAX the IDB receiver is configured to receive 33 streams at maximum IDB bandwidth.

### 17.15.1. Functionality

Initially the test brings all devices to the FEED\_OFF state. After all devices reached the FEED\_OFF state it goes to the SORTING state, via the READY\_TO\_SORT state, and sorts 1000 banknotes. Then it shuts itself



and the devices down and checks if it has received all of the 1000 *BNRESULTs* for all of the banknotes from all devices.

### 17.15.2. Parameters

This test case supports input parameter, allowing the user to adapt the testcase to different use cases.

### Number of Banknotes

The number of banknotes to sort.

#### Manual Mode

- 38. False: The BSMS starts sorting immediately after BS\_FEED\_OFF is reached.
- 39. True: The BSMS stops at BS\_FEED\_OFF and waits for the user to press Continue. This option is used when the test requires further preparations before sorting starts. For example a measurement instrument has to be connected or the transport simulator needs time to reach nominal speed.

#### **Trigger source**

- 40. Internal: The BSMS generates an internal banknote trigger as well as an internal transport clock.
- 41. External: Configures the BSMS to use an external transport clock and trigger signal, usually provided by the transport simulator. The external clock is expected to have a resolution of 0.1 mm.

### Trigger distance (ms)

When trigger source is set Internal: Specifies the time between two simulated banknotes are triggered. Use 20 ms to set a sorting speed of 50 banknotes per second.

### Internal TC Clock Rate (Hz)

Clock rate of the transport clock when in Internal trigger mode. The TC is counting tenths of millimeters so a value of 125000 results in a transport speed of 12.5 m/s.

### **BSM Command Line**

An extra command line argument to the simulated component.

### No Camera System

- 42. False: Normal operation. BNINFO packets are generated upon reception of BNRECOGNITION from a Camera System.
- 43. True: BSMS provides simulated BNINFO packets. Use this option only in case no Camera System is installed.

### **First BNID**

Starting point of banknote identifications allocated during this test run.

### **BN Series**

BN series sent out in BNINFO (Only relevant in "No Camera System" mode).

### **BN** Denomination

BN denomination sent out in BNINFO (Only relevant in "No Camera System" mode).



## **BN Orientation**

BN orientation sent out in BNINFO (Only relevant in "No Camera System" mode).

### **BNINFO Delay (ms)**

Delay in milliseconds before the BSM sends out the BNINFO (Only relevant in "No Camera System" mode).

### SORTING Timeout (ms)

Wait this many milliseconds for expected BNRESULT messages before aborting the running test. Set to 0 to wait forever.

### Short Self-Test Cycle (BN)

Sort this many BNs between short self-tests. Set to 0 for no short self-tests. The BSMS transitions from BS\_SORTING to BS\_REQUEST\_TO\_SORT to allow detectors to run a short self-test.

### Intensive Self-Test Cycle (BN)

Sort this many BNs between intensive self-tests. Set to 0 for no intensive self-tests. The BSMS transitions from BS\_SORTING to BS\_FEED\_OFF to allow detectors to run an intensive self-test. The Intensive Self-Test Cycle interval shall be longer than the Short Self-Test Cycle interval.

### Test Tag

Operator-specified textual metadata that is stored along with the BSM results package.

## 17.15.3. IDB Receiver

The IDB receiver module stores images received on the IDB and checks the IDB network quality. This module generates a message that indicates the number of images it has received as well as the number of errors they contained. The IDB receiver stores up to 100 banknote images, depending on image size and main memory size.

## 17.15.4. Debugging

Logfiles are provided in the result package. See *idb\_x.log* in the *IDB\_BSM* folder for the IDB receiver and *everything.log* in the *BSM\_SIM\_results/log* folder for MN logs.

## 17.16. BSMS\_BSM-G01 Sorting

This test case provides the BSM configuration for a *DS-BSM Standard Setup* with 16 devices and sorts 1000 banknotes. It is set up to broadcast the Powerlink NetTime and RelativeTime in each SoC frame, and it fulfils all TTS requirements.

## 17.16.1. Functionality

Initially the test brings all devices to the FEED\_OFF state. After all devices reached the FEED\_OFF state it goes to the SORTING state, via the READY\_TO\_SORT state, and sorts 1000 banknotes. Then it shuts itself and the devices down and checks if it has received all of the 1000 *BNRESULTs* for all of the banknotes from all devices.

User-Manual-CDI2SIM-v1r10-tracked.docx



## 17.16.2. Parameters

This test case supports input parameter, allowing the user to adapt the testcase to different use cases.

### Number of Banknotes

The number of banknotes to sort.

### Manual Mode

- 1. False: The BSMS starts sorting immediately after BS\_FEED\_OFF is reached.
- 2. True: The BSMS stops at BS\_FEED\_OFF and waits for the user to press Continue. This option is used when the test requires further preparations before sorting starts. For example a measurement instrument has to be connected or the transport simulator needs time to reach nominal speed.

### Trigger source

- 1. Internal: The BSMS generates an internal banknote trigger as well as an internal transport clock.
- 2. External: Configures the BSMS to use an external transport clock and trigger signal, usually provided by the transport simulator. The external clock is expected to have a resolution of 0.1 mm.

### Trigger distance (ms)

When trigger source is set Internal: Specifies the time between two simulated banknotes are triggered. Use 20 ms to set a sorting speed of 50 banknotes per second.

### Internal TC Clock Rate (Hz)

Clock rate of the transport clock when in Internal trigger mode. The TC is counting tenths of millimeters so a value of 125000 results in a transport speed of 12.5 m/s.

### **BSM Command Line**

An extra command line argument to the simulated component.

### No Camera System

- 1. False: Normal operation. BNINFO packets are generated upon reception of BNRECOGNITION from a Camera System.
- 2. True: BSMS provides simulated BNINFO packets. Use this option only in case no Camera System is installed.

### **First BNID**

Starting point of banknote identifications allocated during this test run.

### **BN Series**

BN series sent out in BNINFO (Only relevant in "No Camera System" mode).

### **BN** Denomination

BN denomination sent out in BNINFO (Only relevant in "No Camera System" mode).

### **BN Orientation**

BN orientation sent out in BNINFO (Only relevant in "No Camera System" mode).



## **BNINFO Delay (ms)**

Delay in milliseconds before the BSM sends out the BNINFO (Only relevant in "No Camera System" mode).

### SORTING Timeout (ms)

Wait this many milliseconds for expected BNRESULT messages before aborting the running test. Set to 0 to wait forever.

### Short Self-Test Cycle (BN)

Sort this many BNs between short self-tests. Set to 0 for no short self-tests. The BSMS transitions from BS\_SORTING to BS\_REQUEST\_TO\_SORT to allow detectors to run a short self-test.

### Intensive Self-Test Cycle (BN)

Sort this many BNs between intensive self-tests. Set to 0 for no intensive self-tests. The BSMS transitions from BS\_SORTING to BS\_FEED\_OFF to allow detectors to run an intensive self-test. The Intensive Self-Test Cycle interval shall be longer than the Short Self-Test Cycle interval.

### Test Tag

Operator-specified textual metadata that is stored along with the BSM results package.

## 17.16.3. IDB Receiver

The IDB receiver module stores images received on the IDB and checks the IDB network quality. This module generates a message that indicates the number of images it has received as well as the number of errors they contained. The IDB receiver stores up to 1000 banknote images, depending on image size and main memory size.

## 17.16.4. Debugging

Logfiles are provided in the result package. See *idb\_x.log* in the *IDB\_BSM* folder for the IDB receiver and *everything.log* in the *BSM\_SIM\_results/log* folder for MN logs.



## 18. Annex: BSMS utility testcases

## 18.1. BSM-003 Get Version Infos

This test case retrieves the software versions of the installed packages.

### 18.1.1. Functionality

This test case calls a shell script that collects the information from the controller and all DMB nodes. The results are logged to versions.log and versions-summary.txt (see download package folder IDB\_BSM/log).

## 18.2. BSMS-999 Shutdown

This test case performs a shutdown of all CDI2 components.

### 18.2.1. Functionality

This test case calls a shell script that shuts down all CDI2 components one by one.

## **19.** Annex: DS utility test cases

## 19.1. DS-003 Get Version Infos

This test case retrieves the software versions of the installed packages.

### 19.1.1. Functionality

This test case calls a shell script that collects the information from the controller and all DMB nodes. The results are logged to versions.log and versions-summary.txt (see download package folder IDB\_DEV/log).

## 19.2. DS-999 Shutdown

This test case performs a shutdown of all CDI2 components.

## 19.2.1. Functionality

This test case calls a shell script that shuts down all CDI2 components one by one.



# 20. Disclaimer

This document describes the usage of the CDI2 BSM and CDI2 Device Simulator for testing and developing CDI2 banknote sorting machines and CDI2 detectors. It was prepared with care and all information contained herein was reviewed. However, AIT accepts no responsibility or liability whatsoever with regard to the content of the document, and assumes no liability for any loss or damage, either direct or indirect, arising from the use or implementation of information contained in this document, including mistakes, incompleteness or discrepancies between this document and the product described.

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