Dedicated Links Connectivity Specifications

V0.2

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1. Introduction

The aim of this document is to provide information to the DiCoAs to set up a connection to T2S in a dedicated link connectivity scenario.

1.1. Description of the network connection to T2S

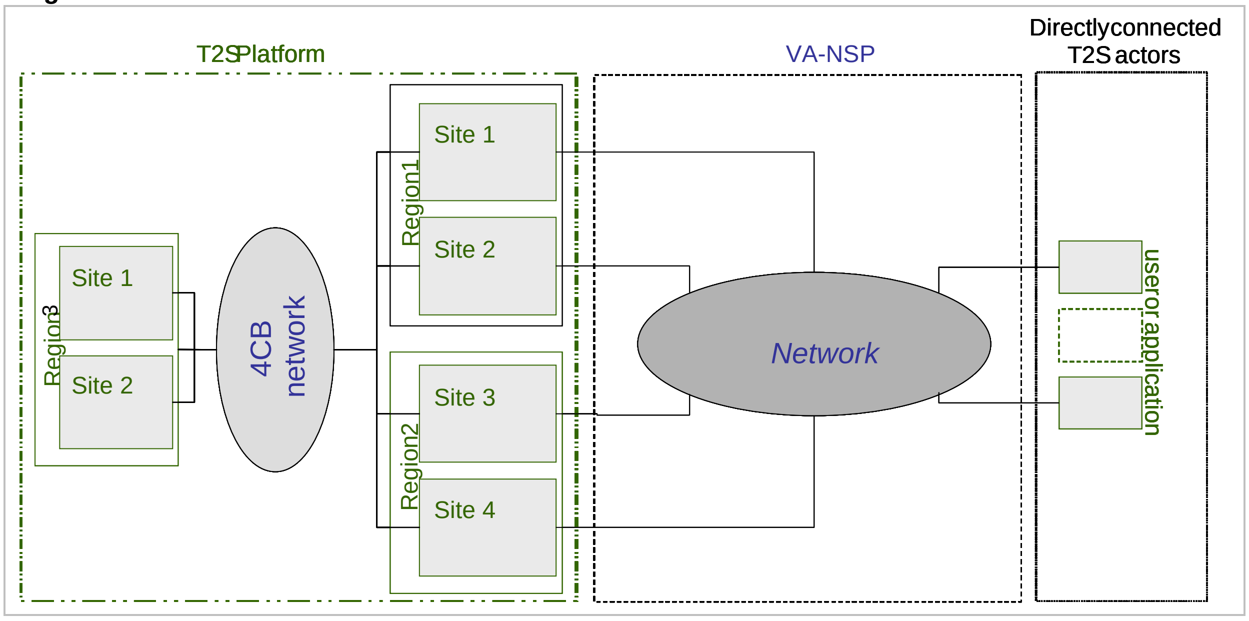
The technical environments that compose the T2S technical platform are located in three regions, two per region (six sites):

- Region 1 Italy;
- Region 2 Germany;
- Region 3 France.

Directly Connected T2S Actors (DiCoAs) will access the platform through two different channels:

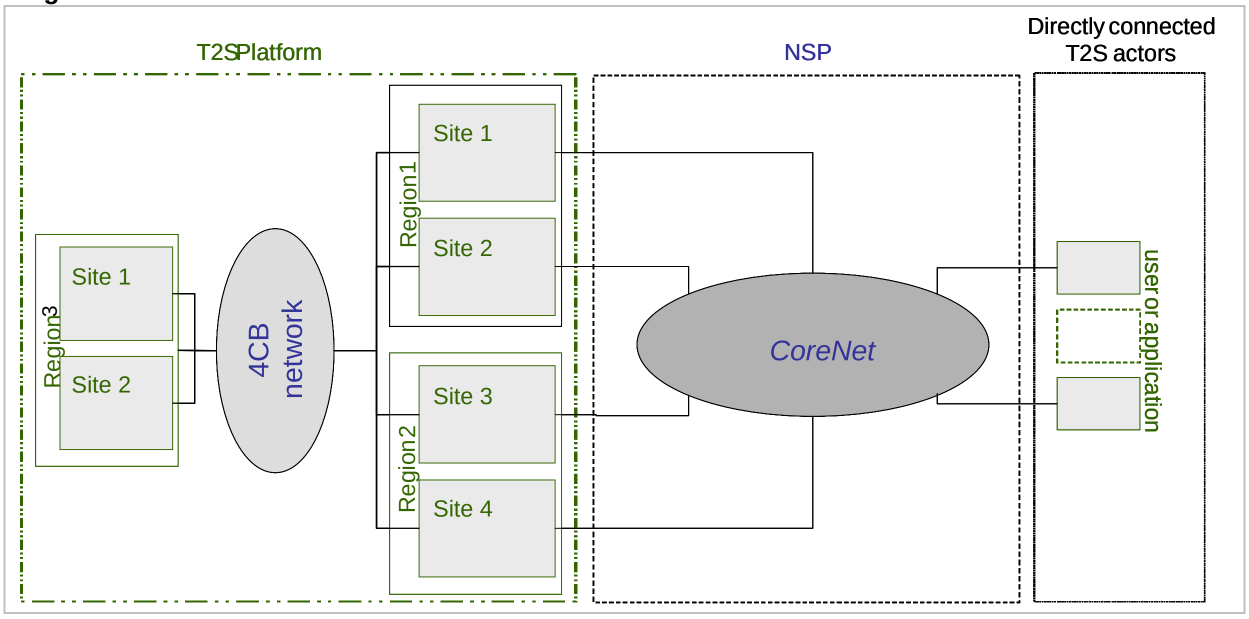
- One using Network Service Providers (NSP) offering Value Added Services (VA-NSP): in this case the NSP will be asked to de-couple the interface with the T2S Platform and the interface with the DiCoAs and to offer all services required to the T2S Platform and to the DiCoAs;

Figure 1: DiCoAs connected to T2S via VA-NSP



- One using NSP offering Dedicated Lines (CORENET): in this case a connection between DiCoAs and the T2S platform will be established and all services must be implemented both at T2S Platform and at DiCoAs sites.

Figure 2: DiCoAs connected to T2S via CORENET



T2S Platform will be accessible also via Internet, but limited to very low-volume DiCoAs and for contingency reasons.

The DiCoAs will be able to access the T2S Platform via VA-NSP and via CORENET.

1.2. T2S technical environments

The technical platform consists of different environments.

Each of them is logically separated from the others and has a specific role in the T2S application life cycle.

T2S environments can be grouped into 2 logical categories:

· "Production", for live operations (one environment only);

ENVIRONMENT	DESCRIPTION	SHORT NAME
PROD	production	F

· "Test & Training": this category includes several environments (up to six) dedicated to development, testing and acceptance activities

Only the "External" test environments are reachable by the DiCoAs via a network connection provided by VA-NSP or CORENET.

ENVIRONMENT	DESCRIPTION	SHORT NAME
EAC	external acceptance test	E
UTEST	user test	U
MIG1	additional user test	G
MIG2	additional user test	M

All T2S environments periodically swap between Region1 and Region2 (periodical rotation) to ensure that technical and human resources are always adequate to provide production services. Rotation is performed during a week-end (outside of service time) 1 or 2 times per year, with the aim to move the Production environment from one Region to the other and, viceversa, the T&T environments from the second Region to the first one.

1.3. The communication modes

The T2S Platform can be accessed by the Directly Connected Participant in two modes: "**application to application**" (A2A) and "**user to application**" (U2A).

In the context of the **U2A specification**, DiCoAs will access the T2S application via a browser using the HTTPs protocol. Although it is expected that the U2A will be utilized mainly to query T2S data, it can also be used to submit updates.

The U2A interface between T2S and the VA-NSP or CORENET is based on the standard HTTPs protocol established between end-user's workstation and T2S. In this context the VA-NSP has to provide mainly connectivity, CGU[1] and PKI services, while CORENET has to provide only the connectivity when the additional services (CGU and PKI) are provided by T2S.

For the **A2A mode**, the T2S Platform communicates with the DiCoAs (via VA-NSP or CORENET) in two modes: "real-time" and "store-and-forward". Business data will be exchanged as a "message" or a "file" in "real-time" or "store-and-forward".

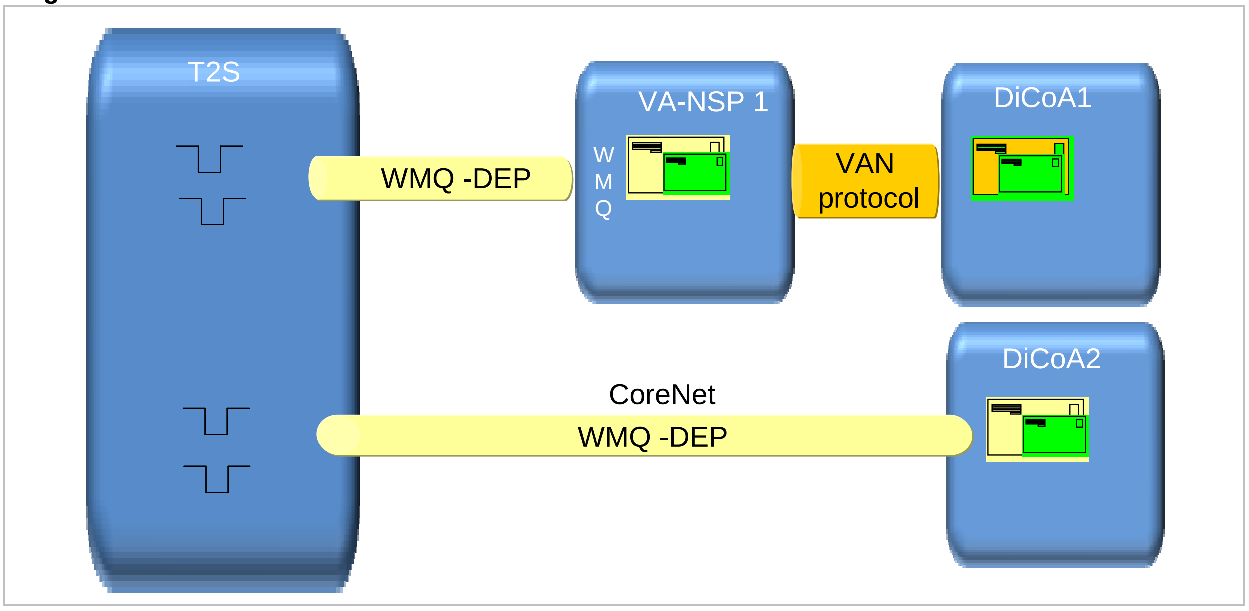
- The "real-time" service (message or file) requires that both parties, the sender and the receiver, are available at the same time to exchange messages or files. In case of unavailability of the receiver, **no retry** mechanism is foreseen.
- The "store-and-forward" service (message or file) enables the sender to transmit messages or files even if the receiver is not available; the sender can be granted when the delivery of the data to the receiver is successful.

A2A relies on messaging based applications. The messages are in XML format based on the ISO20022 standard; files are in XML format.

[1] Closed Group or Users

The A2A message and file exchange between T2S and the VA-NSP or between T2S and the DiCoAs connected via CORENET is based on a T2S protocol named DEP (Data Exchange Protocol).

Figure 3: A2A scenarios



In the connection managed by VA-NSP the DEP protocol is used in the communication between the VA-NSP gateway and T2S, while in the connection managed by CORENET the DEP protocol is used between the DiCoAs and T2S.

The protocol is based on primitives in XML format, transported over an WMQ connection and containing all the relevant information to address and describe messages and files.

1.4. Overall communication schema and data exchange scenario

Diagram 1 below shows the overall flow for the inbound and outbound data exchanged between DiCoAs and the T2S Platform. In this diagram, with reference to an A2A scenario, DiCoAs' application needs to communicate with T2S platform through a network connectivity service.

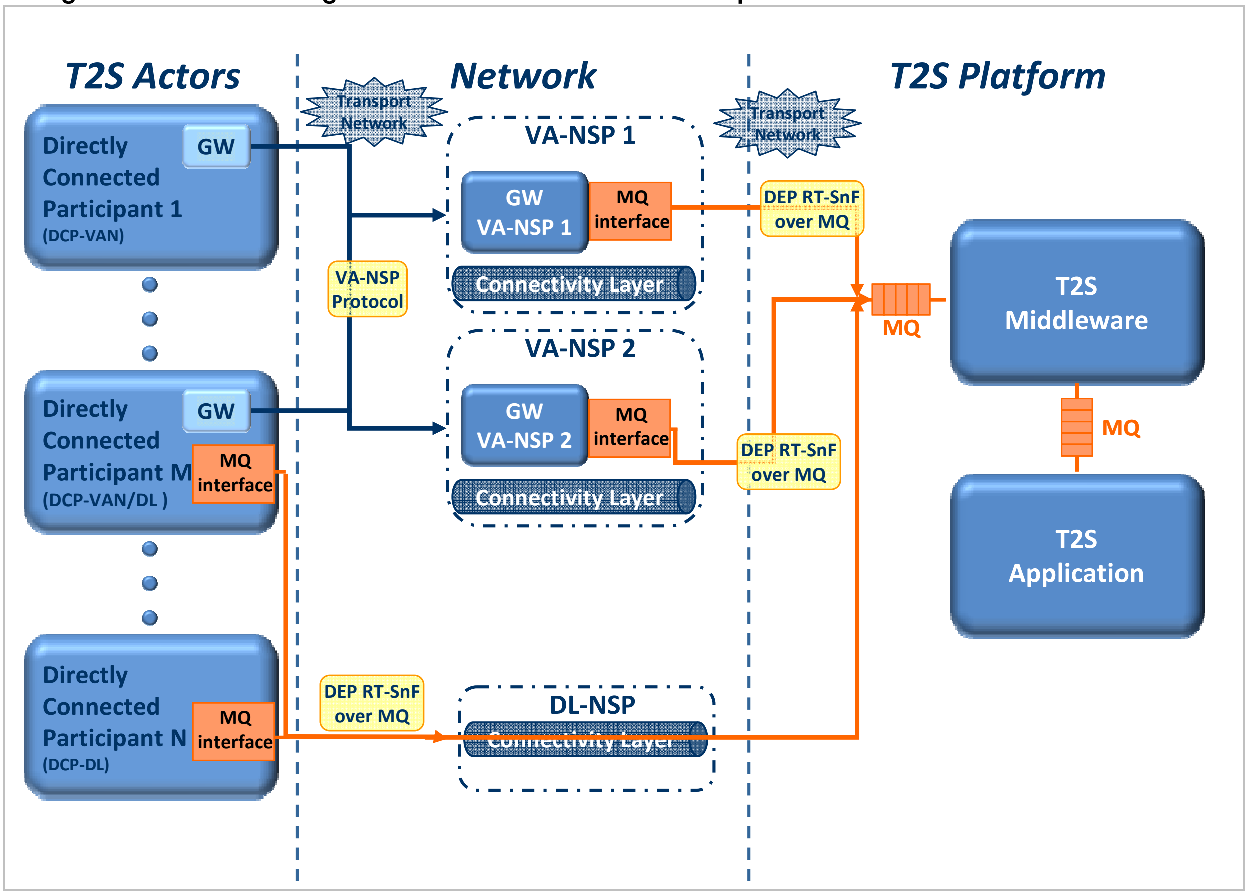
For the A2A scenario, DiCoAs can be classified into three categories:

1. **DiCoA-VAN**: DiCoAs which communicate with the T2S platform through a **VA-NSP intermediation** (e.g. DiCoA-1 in the diagram below). In this case, the data exchange is compliant with a protocol defined by the relevant NSP and it is managed by the gateway of the DiCoA (i.e. the original sender) and the gateway of the NSP. Then, the VA-NSP offers connectivity services and manages the bi-directional data exchange with T2S Platform according to the DEP, using real-time or store-and-forward data (message / file) exchange. DEP messages are encapsulated in WMQ standard messages. The VA-NSP offers several functionalities: Technical Sender Authentication, CGU, non-repudiation of emission, encryption, proprietary protocol transformation into DEP.

2. **DiCoA-DL**: DiCoAs which communicate **directly with the T2S platform**, using a DL-NSP only for transport connectivity services (e.g. DiCoA-N in the diagram). In this case, the DiCoA and the T2S platform communicate directly according to the DEP, using real-time or store-and-forward data exchange. DEP messages are encapsulated in WMQ standard messages. In this case, Technical Sender Authentication, non-repudiation of emission and encryption functionalities are managed by the middleware layer client of the DiCoA gateway.

3. DiCoAs which can communicate **both** via the intermediation of a **VA-NSP** (category 1) or **directly via a DL-NSP** (category 2). In this case, the DiCoA (e.g. DiCoA-M in the diagram) has to define a gateway for VA-NSP communication, in compliance with communication protocol adopted by the relevant NSP, plus a WMQ interface for DEP data exchanges over the WMQ connection.

Diagram 1: Data exchange between DiCoAs and the T2S platform



The T2S platform's logical architecture comprises a first level, named T2S middleware component, which represents the T2S DEP interface towards DiCoAs and VA-NSP.

2. The network connectivity for Dedicated Links

During the 322nd Governing Council meeting held on 16-17 November 2011, the Governing Council "approved the use of CoreNet as provider of the dedicated link solution". The description of CoreNet is out of the Dedicated Links Connectivity Specifications' scope.

3. Application to Application (A2A)

3.1. T2S Application to Application communication interface

The communication interface is based on the IBM WebSphere MQ product (WMQ). WMQ is a message oriented middleware that ensures asynchronous communication, linking applications that run on a wide range of different technical platforms. IBM WebSphere WMQ is largely used in communication among T2S internal applications and in the interface to the NSPs and CoreNet, ensuring technical demarcation and separation of duties, as well as independence between the different layers (e.g. NSP's equipments and the T2S middleware and back-end application).

The WMQ product offers options to ensure the persistence of the exchanged information, avoiding loss of messages and double deliveries.

WMQ is scalable and can run very large amounts of messages. Thanks to its clustering features (including Queue Sharing configuration based on Parallel Sysplex in z/os environment[2]), this product ensures full support of the T2S business continuity and high availability requirements.

For the above reasons it is used as transport protocol for A2A communication.

3.1.1. WMQ description

WMQ enables messages to be exchanged, either synchronously or asynchronously, between application programs running on one or more target systems.

Messages exchanged between programs are stored on **WMQ message queues**, the message repositories where messages are accumulated until they are retrieved by programs that ''consume" the queues.

The queues are under the control of a service provider called "queue manager". The "queue manager" provides the queuing services to the application programs.

Messages destined to a different system from the one on which they were created, will be communicated to the queue manager on that system via an **WMQ channel**. On the source platform the channel would be defined as a sender and on the destination platform as a receiver. It is the sender channel definition that contains the connectivity information, such as the destination platform's name or IP address. Channels must have the same name on both the source and the destination platform.

The connections are controlled by another WMQ component named "Channel Initiator".

To the programmer WMQ is presented as an application programming interface (API) which is unified across the supported hardware and software platforms.

[2] For any information regarding Queue sharing and Parallel Sysplex configuration please refer to the IBM official documentation

WMQ can be configured to ensure the delivery of the messages; this means that, even if the hardware or software platforms crash, the messages within the system will still be delivered once the platforms are brought back up.

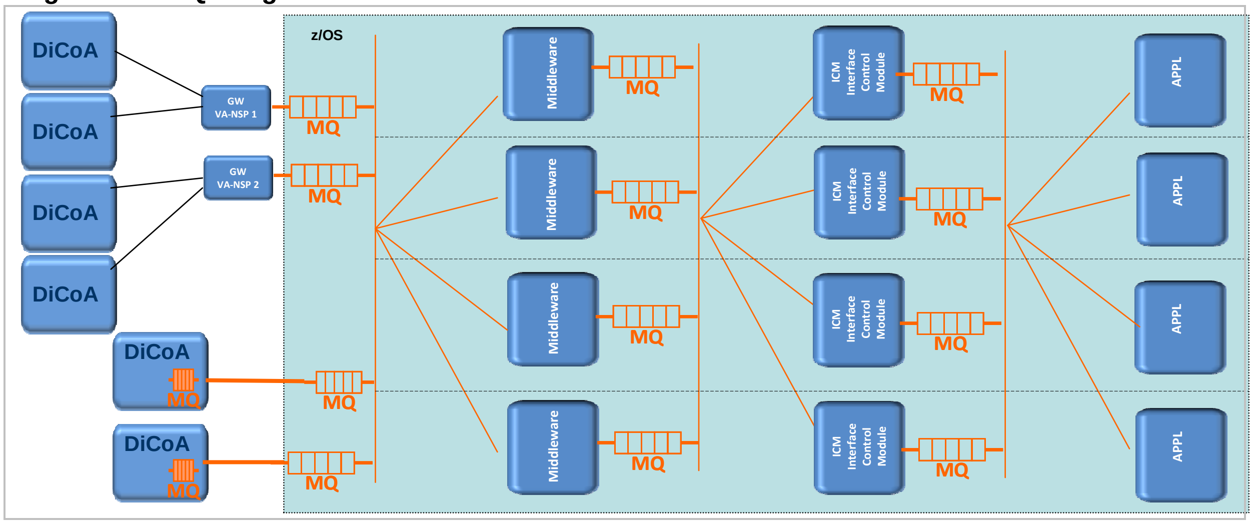
3.2. T2S Queue manager configuration overview

WMQ protocol is largely used in the T2S environment as base for the application-to-application data exchange.

It is used for the internal communication between the different application modules as well as for the external communication with the VAN providers and the T2S actors connected via CoreNet.

The T2S WMQ configuration is in SERVER mode and it is based on z/OS to fit the requirements related to high availability and high volumes.

Figure 4: WMQ usage in T2S



The WMQ Servers exploit the "parallel sysplex" functions and are configured in a Queue Sharing Group composed at least of 2 images for each logical environment and of 2 coupling facilities used to balance the workload of the shared queues and for mutual recovery.

The WMQ resources are configured in T2S following rules to ensure segregation of traffic and availability of the services.

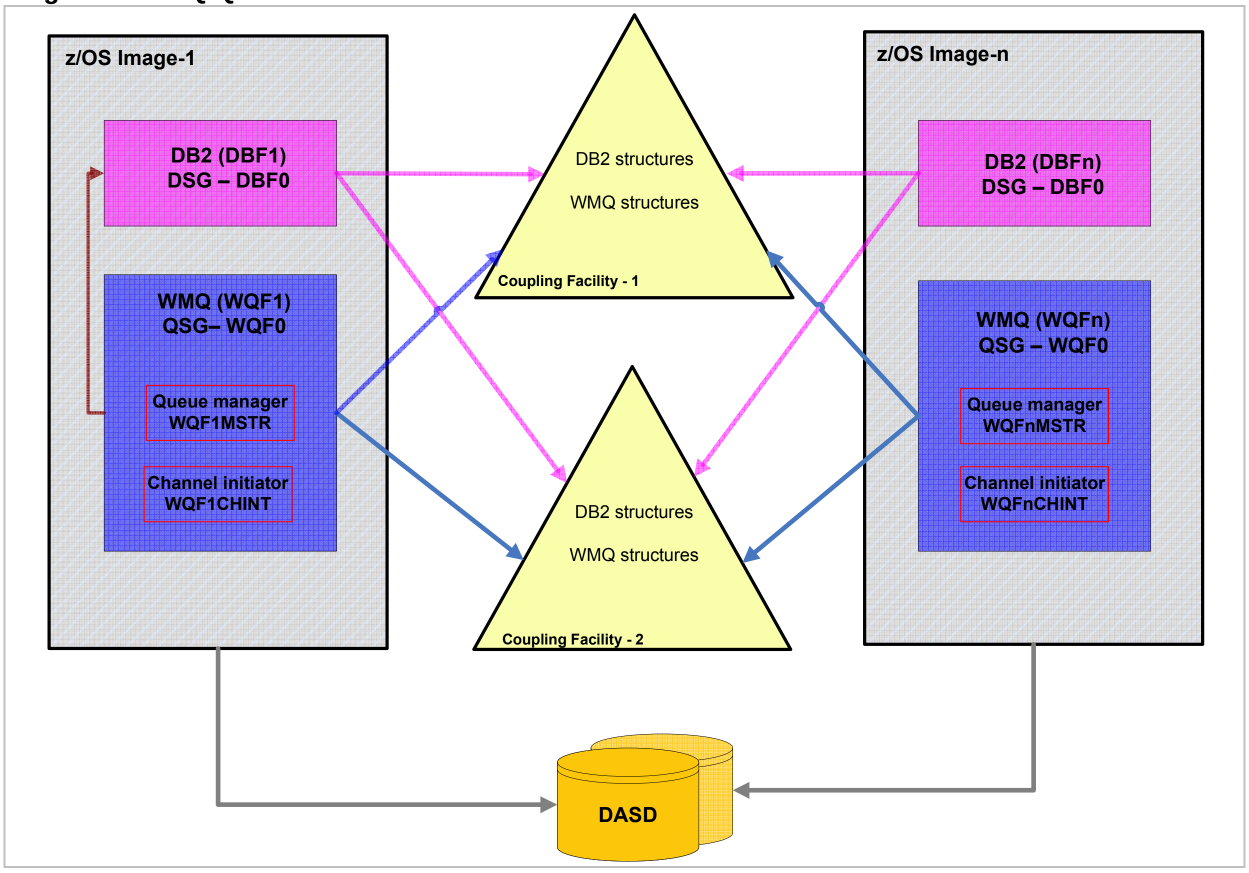
Servers, channel and queues are dedicated to each logical environment and are segregated by traffic type (including addressee or producer of traffic, messaging services or message size).

The WMQ queue manager server is configured to have an automatic recovery in case of failure of one of the components (queue manager instance or connectivity manager).

The resources definitions are agnostic to a maximum extent, towards the physical implementation to simplify any migration or recovery scenario. This is ensured by the usage of aliases to avoid the tight link with the real resources name and usage of virtual IP address (VIPA).

In the following picture an example of a T2S logical WMQ environment is reported.

Figure 5: WMQ QSG infrastructure



The following table shows the name of the WMQ server instances in the T2S environments.

LOGICAL ENVIRONMENT	DESCRIPTION	SHORT NAME	SERVICE NAME	QUEUE MANAGERS	QSG NAME
EAC	external acceptance test	E	EAC	WQE1-WQE2	WQE0
UTEST	user test	U	UTEST	WQU1-WQU2	WQU0
MIG1	additional user test	G	MIG1	WQG1-WQG2	WQG0
MIG2	additional user test	M	MIG2	WQM1-WQM2	WQM0
PROD	production	F	PROD	WQF1-WQF2-WQF3-WQF4	WQF0

3.3. The connection

T2S supports external connections in server-server mode.

The policy used to connect to T2S follows the rules reported below:

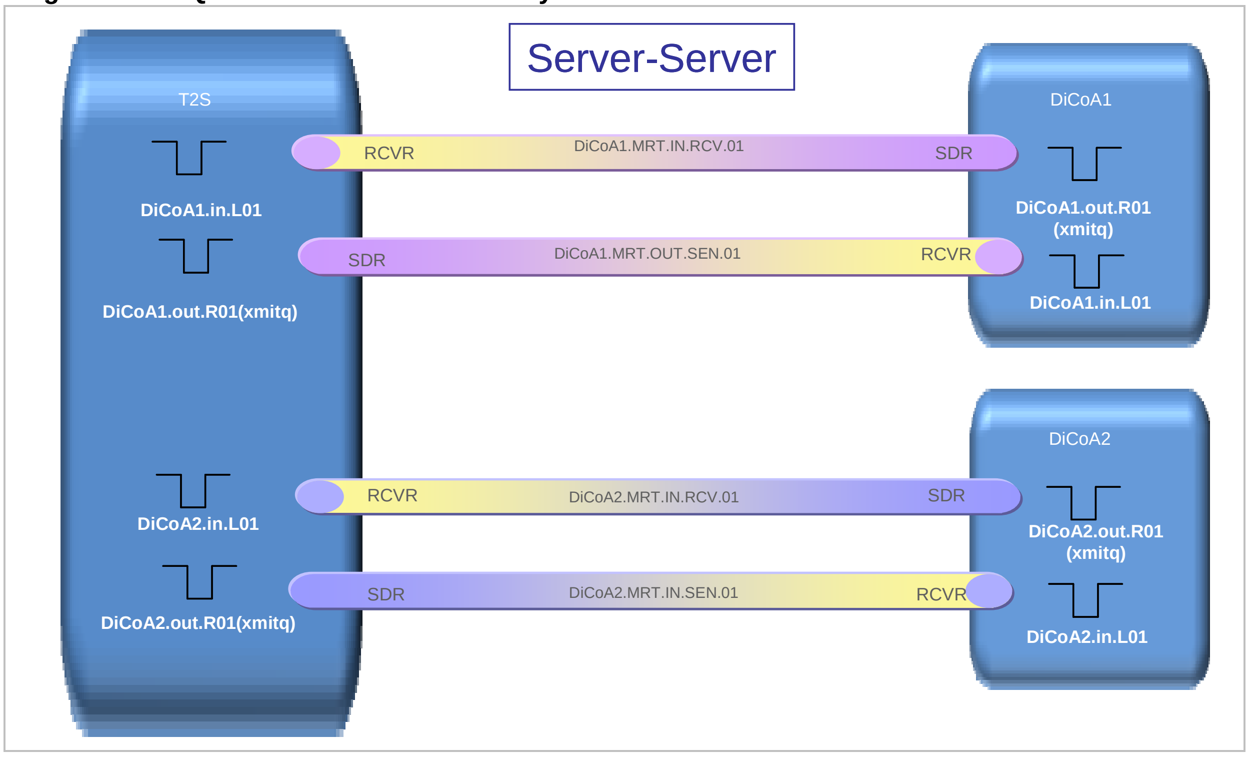
- each DiCoA or VA-NSP provider has its own dedicated set of channels;
- each set of channels is composed by:
  - at least a couple of channels (incoming and outgoing from T2S) for each message/file flow;
  - channels dedicated to technical acknowledges.
- Connectivity is protected by SSL with mutual authentication based on digital certificates provided by T2S.

3.3.1. Server-server with sender-receiver channels

For dedicated link connectivity the Server-Server configuration is envisaged for recovery and availability reason:

- in this configuration the presence of transmission queue on both communication systems ensures the local storage of messages before they are sent to the receiver.
- The removal of messages from the transmission queue is executed only when a commit is performed on the remote queue.
- Synchronization and sequence control of messages is executed automatically by the message channel agent (MCA).

Figure 6: WMQ Server-Server connectivity



To establish a connection between T2S and a DiCoA, a set of configuration information need to be exchanged. The following information must be available in both sides:

- Local Qmanager name (or Queue Sharing Group name)
- IP address (or preferably DNS name)
- Channel Initiator IP Port number
- Name of local queues to be mapped as Remote queues (or preferably alias name of queues to avoid link with the physical name of the queues)

Channel configuration parameters shall be agreed based on the throughput expected for each traffic type.

3.3.1.1. Channels naming convention

The T2S naming convention follows the rule reported below:

ccc.mmmm.ddd.ttt.nn

ccc	connector identifier
mmmm	messaging service identifier
ddd	direction
ttt	Type
nn	number

example:
SWI.MRT.IN.SRV.01

The name of the channel is limited to 20 characters.

In the following table detailed information are reported about the field values and their description.

FIELD	VALUES EG.	DESCRIPTION
ccc	Swi	Connector name or application identifier or DiCoA identifier
mmmm	MRT	Messaging services identifier. Accepted values are MRT: messages RT MSF: messages SnF FRT: Files RT FSF: Files SnF MRTK: ACK for messages RT MSFK: ACK for messages SnF FRTK: ACK for files RT FSFK: ACK for files SnF CMD: command
ddd	IN	Direction of messages in T2S. values accepted are: IN OUT
ttt	SRV	Channel Type. Accepted values are SRV server connection CLI client connection REC receiver SEN Sender
nn	01	Sequential number

3.3.1.2. Channel security

The channels used to connect WMQ QSG with VAN providers or DiCoAs establish an SSL connection. The following parameters control the connections:

SSLCAUTH: it is set to "yes"

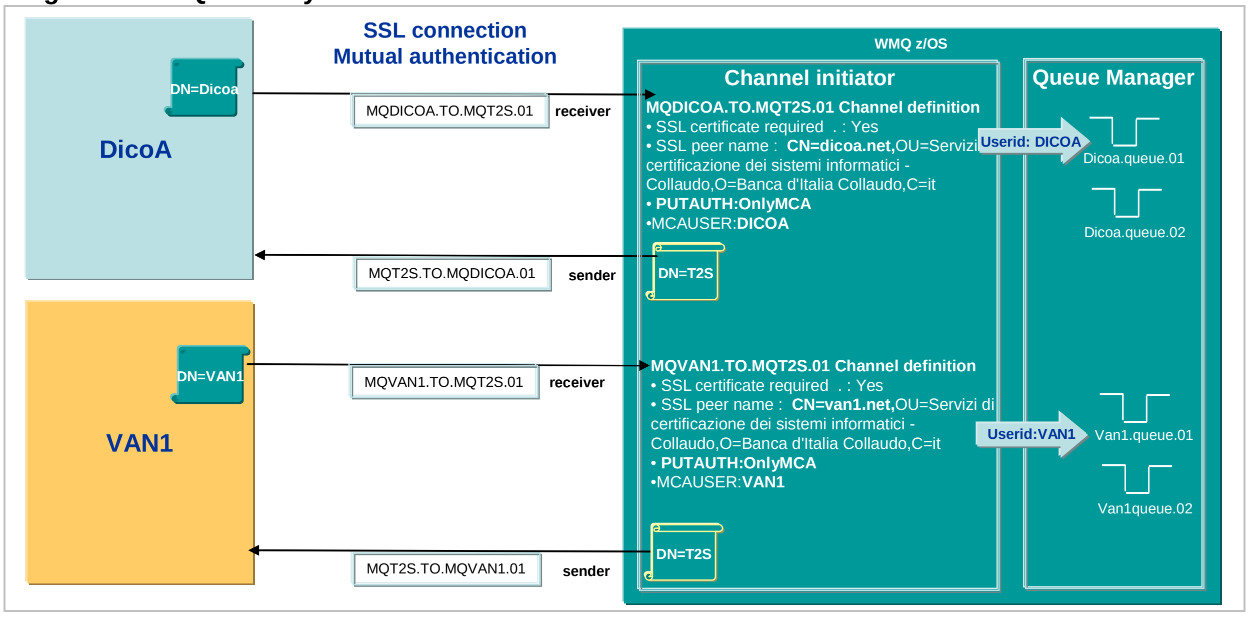
SSLCIPH: it is set to the algorithm used for the encryption of the traffic (TLS_RSA_WITH_AES_128_CBC_SHA).

SSLPEER: it is used to establish the SSL connection, to filter the Distinguished Name (DN) of the certificate from the peer queue manager or client to the other end of a WMQ channel. The connection is established only if the DN received from the peer matches with the SSLPEER value.

PUTAUTH: this parameter describes what type of authorization must be provided to put messages on the queues. It is set to ONLYMCA

MCAUSER: it is the RACF userid granted to access the WMQ message queues.

Figure 7: WMQ security


SSL connection
Mutual authentication
DicoA
DN=Dicoa
VAN1
DN=VAN1
MQDICOA.TO.MQT2S.01
receiver
MQT2S.TO.MQDICOA.01
sender
MQVAN1.TO.MQT2S.01
receiver
MQT2S.TO.MQVAN1.01
sender
WMQ z/OS
Channel initiator
Queue Manager
MQDICOA.TO.MQT2S.01 Channel definition
• SSL certificate required . : Yes
• SSL peer name : CN=dicoa.net,OU=Servizi certificazione dei sistemi informatici - Collaudo,O=Banca d'Italia Collaudo,C=it
• PUTAUTH:OnlyMCA
•MCAUSER:DICOA
DN=T2S
MQVAN1.TO.MQT2S.01 Channel definition
• SSL certificate required . : Yes
• SSL peer name : CN=van1.net,OU=Servizi di certificazione dei sistemi informatici - Collaudo,O=Banca d'Italia Collaudo,C=it
• PUTAUTH:OnlyMCA
•MCAUSER:VAN1
DN=T2S
Userid: DICOA
Dicoa.queue.01
Dicoa.queue.02
Userid:VAN1
Van1.queue.01
Van1queue.02

The management of certificates and the process to acquire them is described in the section ''Security Services"

3.4. Message Queues

The T2S queues are divided in different categories:

- **The system related queues**: they are the queues needed by WMQ to work properly.
- **The T2S application queues**: they are the queues used by the T2S modules to communicate within the T2S core system.
- **The T2S VAN communication queues**: they are the queues used to exchange incoming and outgoing message traffic to be handled by the VAN provider. More specifically they are the queues used to exchange data between the T2S middleware and the VAN gateways.
- **The T2S DiCoA communication queues**: they are the dedicated queues used to exchange messages between remote directly connected actors and the T2S middleware.

The T2S queues are identified by a specific naming convention**.**

The queue names are made up of 3 parts separated by a dot (.);

- The first part identifies the application or the connection (VA-NSP or DL) name.
- The second part identifies the 'purpose' of the queue (that is the messaging service or the type of message it refers to).
- The third part is an identifier of the queue type (from a T2S configuration point of view), for example shared, local or remote and a sequence number (from 01 to 99).

The name of the queue is limited to 48 characters

cbbl.ddd.xxxxxxxxxx.ttnn

cbb	block-module / domain / van name/DiCoA
l	logical environment (optional)
ddd	direction
xxxxxxxxxx	name suggested by application supplier
tt	queue type
nn	progressive number (optional)

example:

swi.in.msg_rt.SHnn

FIELD	VALUES EG.	DESCRIPTION
Cbb	SWI	Connector name or application identifier or DiCoA identifier
L	N	Accepted value E EAC U UTEST G MIG1 M MIG2 F PROD
Ddd	IN	Direction of messages in T2S. values accepted are: IN OUT
xxxxxxxxx	MSG_RT	Free text. For the interface to the network the following is acceptable MSG_RT MSG_RT.ACK MSG_SNF MSG_SNF.ACK FILE_RT FILE_RT.ACK FILE_SNF FILE_SNF.ACK CMD
Tt	SH	Queue Type. Accepted values are SH shared L local R remote
Nn	01	Sequential number

Furthermore, specific queue types are supported for each category in order to correctly manage the system.

3.4.1. Considerations about the usage of Queues

In the following sections information and rules used in the WMQ T2S configuration are reported.

Shared queues

In general, the majority of queues in T2S environment are defined as ''shared". This means that they can be accessed by a set of queue managers that are part of the same Queue sharing group.

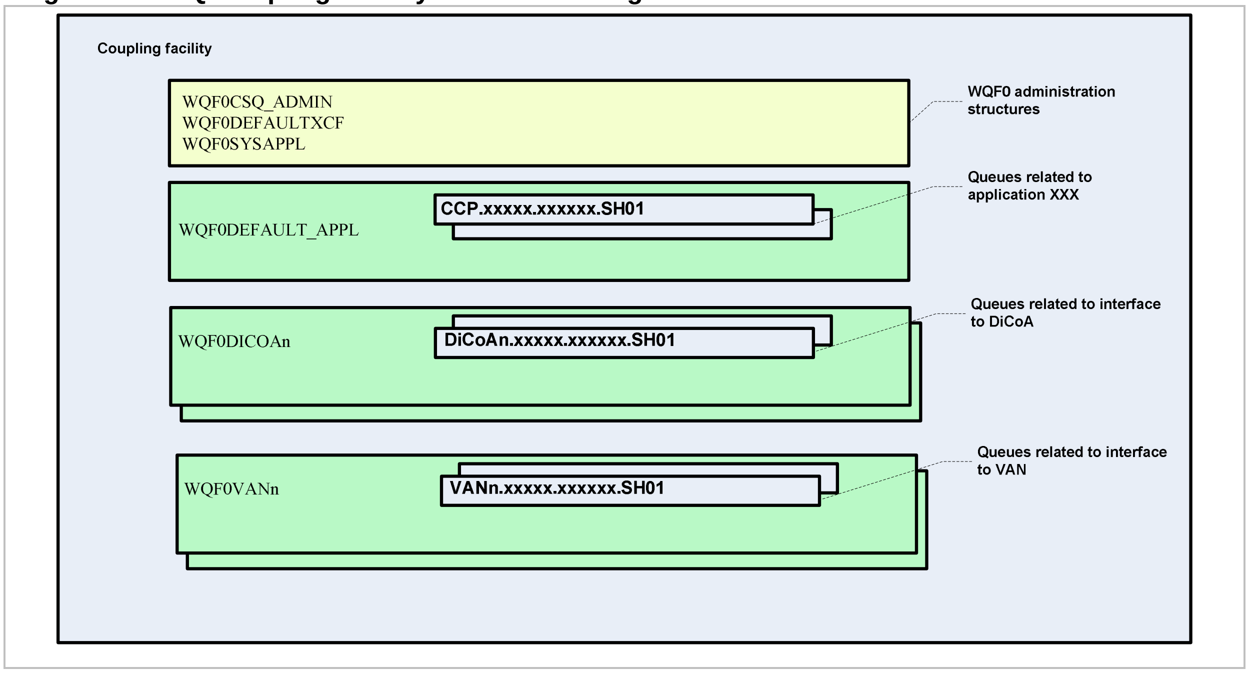
They are physically allocated into the Coupling Facility[3] .

Using list structures to store the messages means that WMQ can take advantage of many of the facilities provided by the Coupling Facility to efficiently implement queuing primitives, including: the ordering of messages, atomic updates to the data and list depth monitoring (for triggering and get-wait processing).

Each shared queue is represented in the list structure by a separate list, up to 512 queues can be defined in each structure.

The following picture is an example of the internal coupling facility structure segregation for each category of queues.

Figure 8: WMQ Coupling Facility Structure configuration



Local queues

[3] For any details about the coupling facility please refer to the IBM official documentation

Queues defined as local can be accessed only by a specific queue manager. They are physically located on the same system as the related queue manager.

In T2S this queue category is used only for limited purposes (eg. Backout error queues).

Remote queues

Remote queues are used in order to provide put access to queues that are local to a remote system. Any message put onto a remote queue is automatically routed to the associated platform and local queue by the queue manager via the channels mechanism.

Remote queues only allow programs to put messages on (but not to get messages from).

Persistent and Non-persistent Messages

Persistence of messages ensures the availability of the message even in case of WMQ system failure. All persistent messages are logged and can be recovered from the logs in the event of a CF outage or structure failure in case of shared queues, and in case of WMQ failure for local queues.

Non-persistent messages are not logged, so they cannot survive to a WMQ server failure. They cannot be recovered from the log if there is a structure or CF outage (in case of shared queues) or WMQ failure (in case of local queues).

Due to performance constraints and to the high volume and throughput required by the T2S business, the persistence of the messages is evaluated case by case (or, more generally, for messaging service typology). In fact, persistence causes a performance overhead due to the write operation on the WMQ logs. In case of usage of non persistent messages, the application that writes the messages into the queue must persist them on a DB before writing them in the MQ queues. This is especially requested for the implementation of the communication with T2S. An application that sends messages to T2S and does not want to use the MQ messages persistence, must provide functionalities to be able to re-send the messages in case of failure (see section '' re-transmission of messages and files in case of DiCoA (or network) unavailability").

Dead letter queue (DLQ)

The T2S installation does not use the Dead letter queue due to the necessity to ensure the order of messages processing (to the maximum extent possible for a parallel environment). This forces the applications to manage the errors returned by the queue manager in case of ''erroneous" addressing of messages to unavailable queues.

Backout queues

In case of errors in reading a message from a queue, it could be useful to create a backout queue to avoid that applications start looping in reading the erroneous or wrongly formatted message.

Every time a message is backed out on the queue, the value of a ‵′backout counter″ is increased. It is possible to indicate:

- the name of the backout queue to be used to redirect the wrongly formatted messages.
- The backout threshold to indicate what is the value of message backout attempts after which the message is routed to the backout queue.
- The retention interval after which the requeued messages in the backout queue can be automatically dropped by WMQ (after a cleanup process is run).

In T2S the backout queues must be used by the application developer to avoid that wrongly formatted messages can cause loop in the application. Moreover, backout queues will be defined in all the WMQ instances as local queues to avoid filling the coupling facilities with orphan messages.

Putting messages and managing connections

Here below some recommendations for the usage of the ‵′T2S incoming queues″ are listed:

- Avoid the execution or multiple MQPUT calls in a synchpoint without committing them. The affected queues may fill up with messages that are currently inaccessible by the receiving T2S middleware.
- Properly close and disconnect the connections prior to disconnection or shut-down of the putting application. Failure to do so will result in hung connections, which will increase resource consumption and cause the saturation of available connections.

Queue security is managed by RACF specific profiles, defined to restrict access to the content of the queue only the allowed users. The naming convention adopted for the queue names facilitate the profile definition.

Access to the DiCoA dedicated queues is controlled by a specific RACF userid associated via the mechanism explained in paragraph ‵′Channel Security″.

In the testing environment, access to the content of the queues is allowed to the WMQ administrators.

In the production environment, the content of the queues can be accessed by the WMQ administrators for debugging or recovery purposes only after a specific security request to activate the auditable RACF Group defined for last level support intervention.

3.4.1.1. Configuration example in a sender-receiver scenario (from a T2S perspective)

QUEUE NAME T2S	SCOPE	CONSUMER	MESSAGE DIRECTION	QUEUE TYPE (T2S)	TRANSMISSION QUEUE	CHANNEL	CHANNEL TYPE
ABC.in.msg_rt.SHnn	msg rt incoming request	T2S middleware	t2s incoming flow	shared (local)		ABC.MRT.IN.REC.01	receiver
ABC.in .msg_rt.ack.SHnn	msg rt incoming ack from GW	T2S middleware	t2s incoming flow	shared (local)		ABC.MRTK.IN.REC.01	receiver
ABC.in.file_rt.SHnn	file rt incoming request	T2S middleware	t2s incoming flow	shared (local)		ABC.FRT.IN.REC.01	receiver
ABC.in.file_rt.ack.SHnn	file rt incoming ack from GW	T2S middleware	t2s incoming flow	shared (local)		ABC.FRTK.IN.REC.01	receiver
ABC.in.msg_snf.SHnn	msg snf incoming request	T2S middleware	t2s incoming flow	shared (local)		ABC.MSF.IN.REC.01	receiver
ABC.in.msg_snf.ack.SHnn	msg snf incoming ack from GW	T2S middleware	t2s incoming flow	shared (local)		ABC.MSFK.IN.REC.01	receiver
ABC.in.file_snf.SHnn	file snf incoming request	T2S middleware	t2s incoming flow	shared (local)		ABC.FSF.IN.REC.01	receiver
ABC.in.file_snf.ack.SHnn	file snf incoming request	T2S middleware	t2s incoming flow	shared (local)		ABC.FSFK.IN.REC.01	receiver
ABC.in.cmd.SHnn	command response from GW	T2S middleware	t2s incoming flow	shared (local)		ABC.CMD.IN.REC.01	receiver
ABC.out.msg_rt.Rnn	msg rt outgoing response	ABC gateway	t2s outgoing flow	Remote	ABC.out.msg_rt.trn.SHnn	ABC.MRT.OUT.SEN.01	sender
ABC.out.msg_rt.ack.Rnn	msg rt outgoing ack to GW	ABC gateway	t2s outgoing flow	Remote	ABC.out.msg_rt.trn.SHnn	ABC.MRTK.OUT.SEN.01	sender
ABC.out.file_rt.Rnn	file rt outgoing response	ABC gateway	t2s outgoing flow	Remote	ABC.out.file_rt.trn.SHnn	ABC.FRT.OUT.SEN.01	sender
ABC.out.file_rt.ack.Rnn	file rt outgoing ack to GW	ABC gateway	t2s outgoing flow	Remote	ABC.out.file_rt.trn.SHnn	ABC.FRTK.OUT.SEN.01	sender
ABC.out.msg_snf.Rnn	msg snf outgoing request	ABC gateway	t2s outgoing flow	Remote	ABC.out.msg_rt.trn.SHnn	ABC.MSF.OUT.SEN.01	sender
ABC.out.msg_snf.ack.Rnn	msg snf outgoing ack to GW	ABC gateway	t2s outgoing flow	Remote	ABC.out.msg_rt.trn.SHnn	ABC.MSFK.OUT.SEN.01	sender
ABC.out.file_snf.Rnn	file snf outgoing request	ABC gateway	t2s outgoing flow	Remote	ABC.out.file_snf.trn.SHnn	ABC.FSF.OUT.SEN.01	sender
ABC.out.file_snf.ack.Rnn	file snf outgoing ack to GW	ABC gateway	t2s outgoing flow	Remote	ABC.out.file_snf.trn.SHnn	ABC.FSFK.OUT.SEN.01	sender
ABC.out.cmd.Rnn	command request to GW	ABC gateway	t2s outgoing flow	Remote	ABC.out.cmd.trn.SHnn	ABC.CMD.OUT.SEN.01	sender

3.5. DiCoa-DL specific usage of DEP

The following sections describe the specific usage of DEP protocol by DiCoA using the DL-NSP connection.

3.5.1. Store-and-Forward messages exchange

It is expected that dep:DeliveryNotification flag, in case of DiCoA-DL, is set to NO to avoid useless messages to be exchanged between the DEP counterparts.

Moreover the retry mechanism in the DiCoA-DL is implemented at sender level and doesn't perform any suspension of store-and-forward messages/files traffic.

3.5.2. Exchange Header validation and tag usage

In case of DiCoA-DL the Exchange Header validation checks that the channel and the related WMQ queue is consistent with the user specified in the Sender: field of the ExchangeHeader.

T2S middleware checks that the TechnicalServiceId specified in the Exchange Header corresponds to the incoming queue used by the DiCoA-DL (this includes the selected "logical environment" control).

Obviously for a single DEP request/response primitive not all information contained in ExchangeHeader is significant for data exchange flow.

Next tables include an exhaustive list of the fields required for real-time and store-and-forward scenario. DEP validation functionality is applied on all the fields of the ExchangeHeader: so, if information is present that does not pertain to the primitive being handled, the outcome of the validation will be negative.

Table 1: DEP ExchangeHeader Fields in T2S outbound Real-Time communication schema

DEP EXCHANGE HEADER ELEMENTS IN T2S R-T OUTBOUND SCENARIO	T2S REQUEST	DICOA ACK	DICOA RESPONSE	T2S ACK
dep:Version	V[4]	V	V	V
dep:Sender	V [T2S]	V [DiCoA]	V [DiCoA]	V [T2S]
dep:Receiver	V [DiCoA]	V [T2S]	V [T2S]	V [DiCoA]
dep:TechnicalServiceId	V [with msg-pattern MSGRT or FILERT]	V[5]*	V*	V*
dep:RequestType	V	V*	V*	V*
dep:CommunicationId	X[6]	V	V*	V*
dep:T2SMessageId	V	V*	V*	V*
dep:T2SActorMessageId	X	X	V	V*
dep:EntryTimestamp	X	X	X	X
dep:SendTimestamp	V	V*	V	V*
dep:ReceiveTimestamp	X	V	X	V
dep:PDMHistory	X	X	X	X
dep:DeliveryMode	V [RT]	V [RT]	V [RT]	V [RT]
dep:DeliveryNotification	X	X	X	X
dep:NonRepudiationExchange	V	V*	V*	V*
dep:Compression	V	V*	V*	V*
dep:ExchangeStatus	X	V	V	V
dep:ErrorDescription	X	V [NAN, with ExchangeStatus =KO]	V [Only with ExchangeStatus =KO]	V [NAN, with ExchangeStatus =KO]
dep:MessageDigest	X	V [if NonRepu-diationExchang e is set]	X	V [if NonRepu-diationExchange is set]

[4] Element is present in this DEP message

[5] Element is present in this DEP message with the same value of previous received message

[6] Element is not present in this DEP message

Table 2: DEP ExchangeHeader Fields in T2S inbound Real-Time communication schema

DEP EXCHANGE HEADER ELEMENTS IN T2S R-T INBOUND SCENARIO	DICOA REQUEST	T2S ACK	T2S RESPONSE	DICOA ACK
dep:Version	V	V	V	V
dep:Sender	V [DiCoA]	V [T2S]	V [T2S]	V [DiCoA]
dep:Receiver	V [T2S]	V [DiCoA]	V [DiCoA]	V [T2S]
dep:TechnicalServiceId	V [with msg-pattern MSGRT or FILERT]	V*	V*	V*
dep:RequestType	V	V*	V*	V*
dep:CommunicationId	V	V*	V*	V*
dep:T2SMessageId	X	X	V	V*
dep:T2SActorMessageId	V	V*	V*	V*
dep:EntryTimestamp	X	X	X	X
dep:SendTimestamp	V	V*	V	V*
dep:ReceiveTimestamp	X	V	X	V
dep:PDMHistory	X	X	X	X
dep:DeliveryMode	V [RT]	V [RT]	V [RT]	V [RT]
dep:DeliveryNotification	X	X	X	X
dep:NonRepudiationExchange	V	V*	V*	V*
dep:Compression	V	V*	V*	V*
dep:ExchangeStatus	X	V	V	V
dep:ErrorDescription	X	V [NAN, with ExchangeStatus =KO]	V [Only with ExchangeStatus =KO]	V [NAN, with ExchangeStatus =KO]
dep:MessageDigest	X	V [if NonRepu-diationExchange is set]	X	V [if NonRepu-diationExchange is set]

Table 3: DEP ExchangeHeader Fields in T2S outbound Store-and-Forward communication schema

DEP EXCHANGE HEADER ELEMENTS IN T2S SNF OUTBOUND SCENARIO	T2S REQUEST	DICOA ACK
dep:Version	V	V
dep:Sender	V [T2S]	V [DiCoA]
dep:Receiver	V [DiCoA]	V [T2S]
dep:TechnicalServiceId	V [with msg-pattern MSGSNF or FILESNF]	V*
dep:RequestType	V	V*
dep:CommunicationId	X	V
dep:T2SMessageId	V	V*
dep:T2SActorMessageId	X	X
dep:EntryTimestamp	X	X
dep:SendTimestamp	V	V*
dep:ReceiveTimestamp	X	V
dep:PDMHistory	V [In case of retry]	V [In case of retry]
dep:DeliveryMode	V [SF]	V [SF]
dep:DeliveryNotification	V [not meaningful for DiCoA]	V*
dep:NonRepudiationExchange	V	V*
dep:Compression	V	V*
dep:ExchangeStatus	X	V
dep:ErrorDescription	X	V [NAN, with ExchangeStatus=KO]
dep:MessageDigest	X	V [if NonRepudiation-Exchange is set]

Table 4: DEP ExchangeHeader Fields in T2S inbound Store-and-Forward communication schema

DEP Exchange Header elements in T2S SnF inbound scenario	DiCoA request	T2S ack
dep:Version	V	V
dep:Sender	V [DiCoA]	V [T2S]
dep:Receiver	V [T2S]	V [DiCoA]
dep:TechnicalServiceId	V [with msg-pattern MSGSNF or FILESNF]	V*
dep:RequestType	V	V*
dep:CommunicationId	V	V*
dep:T2SMessageId	X	X
dep:T2SActorMessageId	V	V*
dep:EntryTimestamp	X	X
dep:SendTimestamp	V	V*
dep:ReceiveTimestamp	X	V
dep:PDMHistory	V [In case of retry]	V [In case of retry]
dep:DeliveryMode	V [SF]	V [SF]
dep:DeliveryNotification	V [not meaningful for DiCoA]	V*
dep:NonRepudiationExchange	V	V*
dep:Compression	V	V*
dep:ExchangeStatus	X	V
dep:ErrorDescription	X	V [NAN, with ExchangeStatus=KO]
dep:MessageDigest	X	V [if NonRepu-diationExchange is set]

3.6. Messaging services for data communication with DiCoA-DL

3.6.1. Real-time files and messages exchange

The following sections describe the real-time protocol for files and messages exchange, both for inbound and outbound flows.

3.6.1.1. DEP for real-time inbound messages

The sequence diagram below (Diagram 2) shows a typical scenario for an **A2A inbound real-time file/message exchange**.

Following the message sequence shown in the diagram, the Table 5 below describes the main interactions between the DiCoA and the T2S platform. The assumption underlying this description is that the T2S actor is a DiCoA connected to T2S via a direct link (a DiCoA-DL).

Diagram 2: Real-Time T2S inbound message – SD of the main Use Case

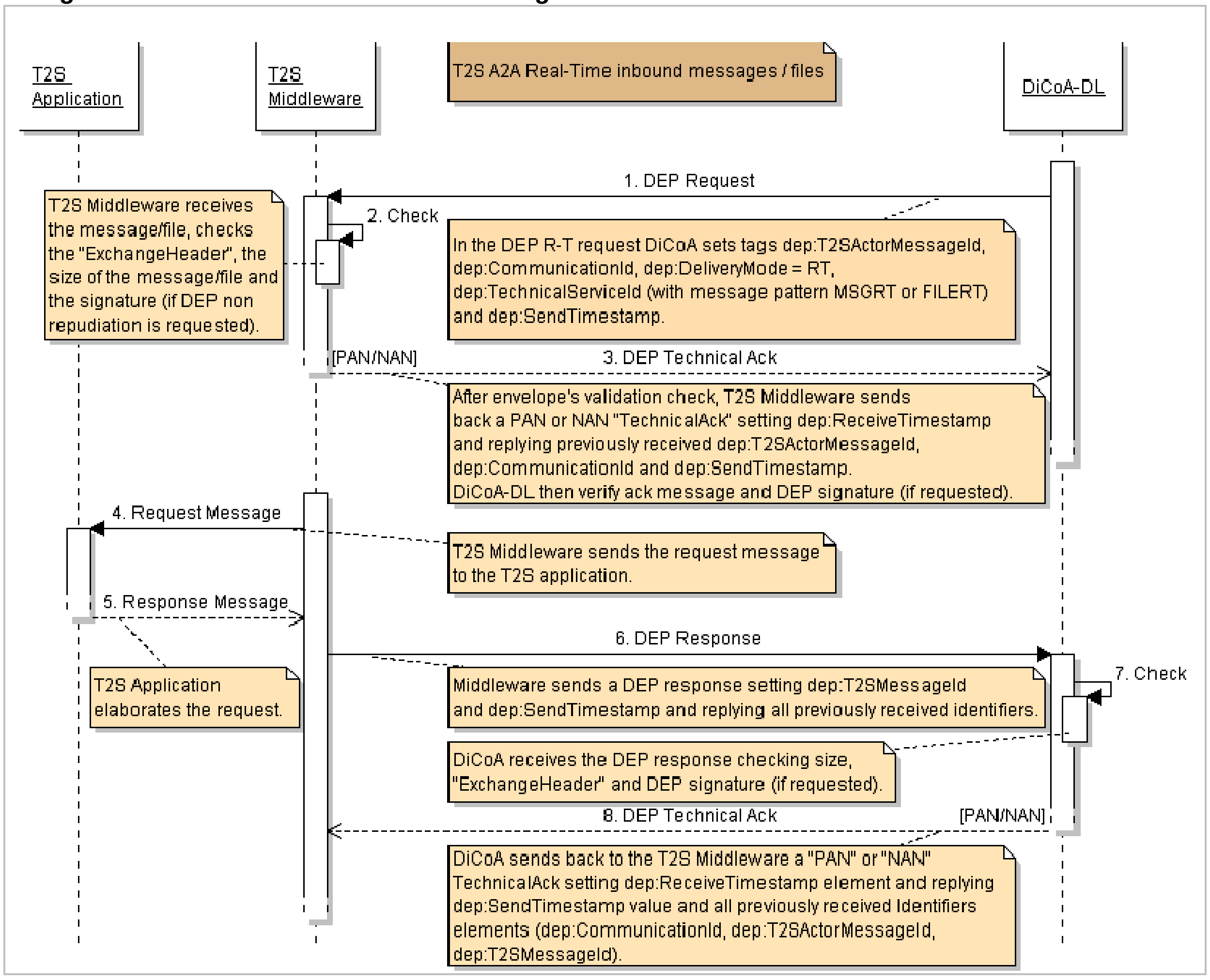
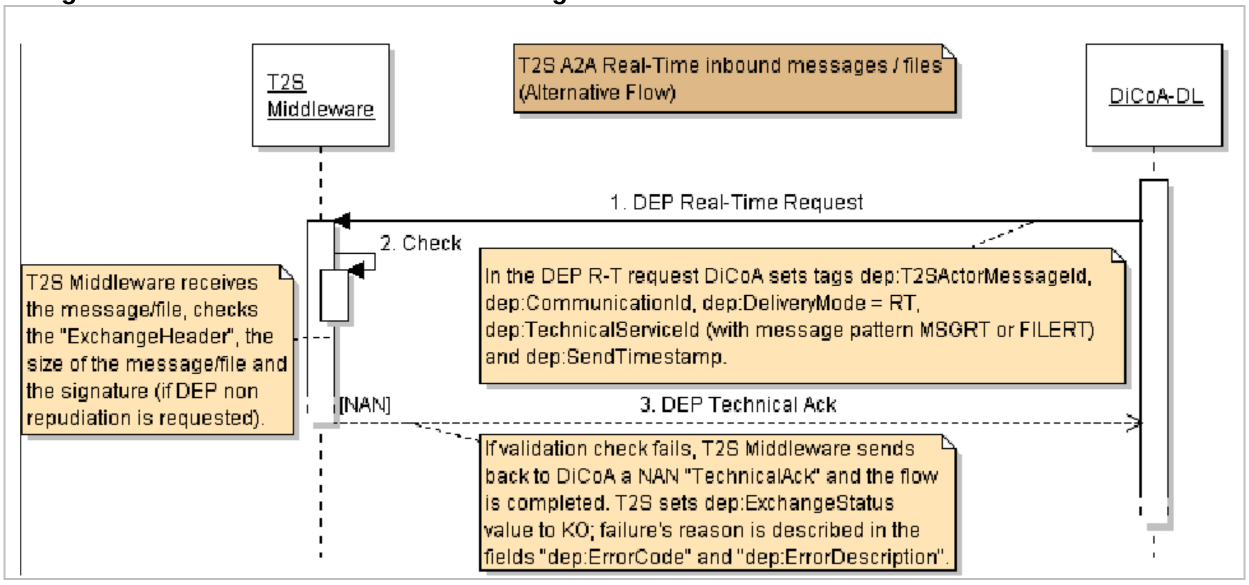

T2S Application
T2S Middleware
T2S A2A Real-Time inbound messages / files
DiCoA-DL
1. DEP Request
2. Check
T2S Middleware receives the message/file, checks the "ExchangeHeader", the size of the message/file and the signature (if DEP non repudiation is requested).
In the DEP R-T request DiCoA sets tags dep:T2SActorMessageId, dep:CommunicationId, dep:DeliveryMode = RT, dep:TechnicalServiceId (with message pattern MSGRT or FILERT) and dep:SendTimestamp.
[PAN/NAN]
3. DEP Technical Ack
After envelope's validation check, T2S Middleware sends back a PAN or NAN "TechnicalAck" setting dep:ReceiveTimestamp and replying previously received dep:T2SActorMessageId, dep:CommunicationId and dep:SendTimestamp. DiCoA-DL then verify ack message and DEP signature (if requested).
4. Request Message
T2S Middleware sends the request message to the T2S application.
5. Response Message
T2S Application elaborates the request.
6. DEP Response
7. Check
Middleware sends a DEP response setting dep:T2SMessageId and dep:SendTimestamp and replying all previously received identifiers.
DiCoA receives the DEP response checking size, "ExchangeHeader" and DEP signature (if requested).
8. DEP Technical Ack
[PAN/NAN]
DiCoA sends back to the T2S Middleware a "PAN" or "NAN" TechnicalAck setting dep:ReceiveTimestamp element and replying dep:SendTimestamp value and all previously received Identifiers elements (dep:CommunicationId, dep:T2SActorMessageId, dep:T2SMessageId).

Table 5: Real-Time T2S inbound message – Description of the main Use Case

STEP NUMBER	STEP DESCRIPTION
1)	The DiCoA-DL sends a real-time message/file to the T2S platform by a "Request" primitive. The "Delivery Mode" field is set to "RT". The field T2SActorMessageId has to be set by DiCoA to the unique message identification generated at Directly Connected T2S Actor gateway site, the field CommunicationId has to be set by DicoA to the unique message identification at communication level.
2)	The T2S Platform receives the message/file and performs the validation check of the "Exchange Header"; if the compression flag is set, the T2S middleware invokes the DEP decompression function. Finally, the T2S Middleware checks the size of the uncompressed message/file.
3)	After the validation of the envelope, the T2S Middleware sends back to the DL-DiCoA a PAN or NAN "Technical Ack" setting the "dep:ReceiveTimestamp" with the receiving time. If a NAN is returned the flow is completed and the reason of the failure is set in the field dep:ErrorCode and dep:ErrorDescription of the response message's header (ref. alternative scenario modeled in Diagram 3).
4)	The message/file is passed to the T2S Application.

5)	T2S Application sends a response message to the T2S Middleware. As an alternative case, if the response is handed over after the timeout, the T2S middleware has to manage this scenario as described in section 5.2.3 – Timeout Management
6)	The T2S Middleware sends the "response" message to the DL-DiCoA, setting in the "Exchange Header" the "dep:T2SMessageID" to a unique identifier and keeping all other fields as received in the "request" message. If the flag is set, the T2S Middleware invokes the DEP compression function. As an alternative case, if the response is oversized (over 32kB for message and over 32MB for file), the T2S middleware has to manage this scenario as described in section 5.2.4 - Oversize Management
7)	The DiCoA-DL receives the "response" and performs the validation check of the "Exchange Header" and of the size.
8)	If the response is ok, DiCoA-DL sends a PAN Technical Ack. If the validation process fails, or the size of the response is not in the allowed range, then DiCoA-DL sends back to the T2S Platform a "NAN Technical Ack" setting in the appropriate way the "dep:ExchangeStatus" and "dep:ErrorDescription" fields.

Diagram 3: Real-Time T2S inbound message – Alternative SD – NAN technical ack

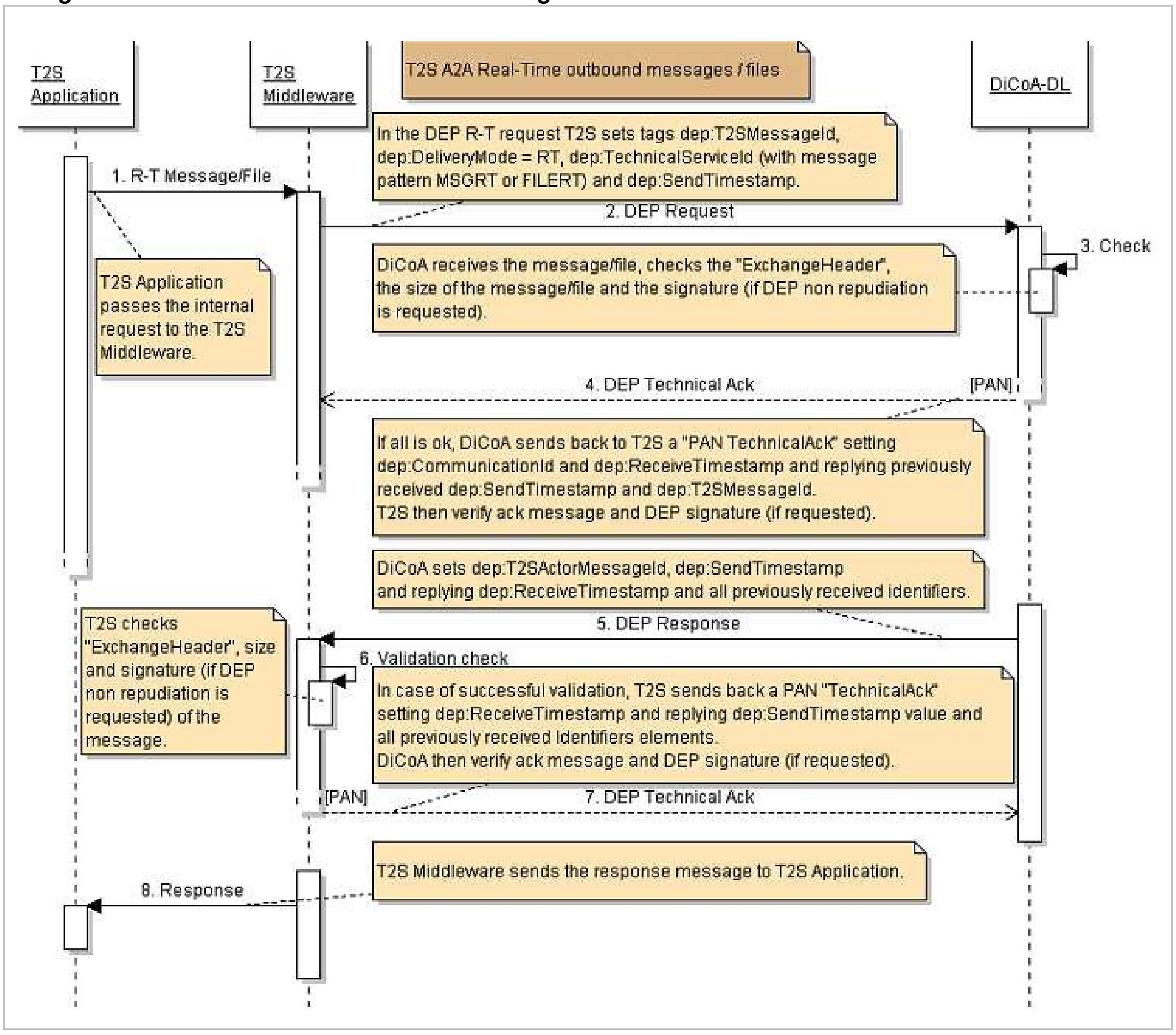

T2S Middleware
T2S A2A Real-Time inbound messages / files (Alternative Flow)
DiCoA-DL
1. DEP Real-Time Request
2. Check
In the DEP R-T request DiCoA sets tags dep:T2SActorMessageId, dep:CommunicationId, dep:DeliveryMode = RT, dep:TechnicalServiceId (with message pattern MSGRT or FILERT) and dep:SendTimestamp.
T2S Middleware receives the message/file, checks the "ExchangeHeader", the size of the message/file and the signature (if DEP non repudiation is requested).
[NAN]
3. DEP Technical Ack
If validation check fails, T2S Middleware sends back to DiCoA a NAN "TechnicalAck" and the flow is completed. T2S sets dep:ExchangeStatus value to KO; failure's reason is described in the fields "dep:ErrorCode" and "dep:ErrorDescription".

3.6.1.2. DEP for real-time outbound messages

The sequence diagram below (Diagram 4) shows a typical scenario for an A2A outbound real-time file/message exchange.

Currently there are no business cases for the usage of this service by T2S.

Diagram 4: Real-Time T2S outbound message – SD of the main Use Case


T2S Application
T2S Middleware
T2S A2A Real-Time outbound messages / files
DiCoA-DL
In the DEP R-T request T2S sets tags dep:T2SMessageId, dep:DeliveryMode = RT, dep:TechnicalServiceId (with message pattern MSGRT or FILERT) and dep:SendTimestamp.
1. R-T Message/File
2. DEP Request
3. Check
T2S Application passes the internal request to the T2S Middleware.
DiCoA receives the message/file, checks the "ExchangeHeader", the size of the message/file and the signature (if DEP non repudiation is requested).
4. DEP Technical Ack
[PAN]
If all is ok, DiCoA sends back to T2S a "PAN TechnicalAck" setting dep:CommunicationId and dep:ReceiveTimestamp and replying previously received dep:SendTimestamp and dep:T2SMessageId. T2S then verify ack message and DEP signature (if requested).
DiCoA sets dep:T2SActorMessageId, dep:SendTimestamp and replying dep:ReceiveTimestamp and all previously received identifiers.
T2S checks "ExchangeHeader", size and signature (if DEP non repudiation is requested) of the message.
5. DEP Response
6. Validation check
In case of successful validation, T2S sends back a PAN "TechnicalAck" setting dep:ReceiveTimestamp and replying dep:SendTimestamp value and all previously received Identifiers elements. DiCoA then verify ack message and DEP signature (if requested).
[PAN]
7. DEP Technical Ack
T2S Middleware sends the response message to T2S Application.
8. Response

3.6.2. Store-and-forward files and messages exchange

The following sections describe the **store-and-forward protocol for files and messages exchange**, both for inbound and outbound flows.

3.6.2.1. DEP for store-and-forward inbound messages

Following the message sequence shown in the diagram, Table 6 below describes the main interactions between the DiCoA-DL and the T2S platform.

The main scenario of an A2A **store-and-forward file/message exchange**, for a **T2S inbound**, is modelled in following sequence diagram.

Diagram 5: Store-and-Forward T2S inbound message – SD of the main Use Case

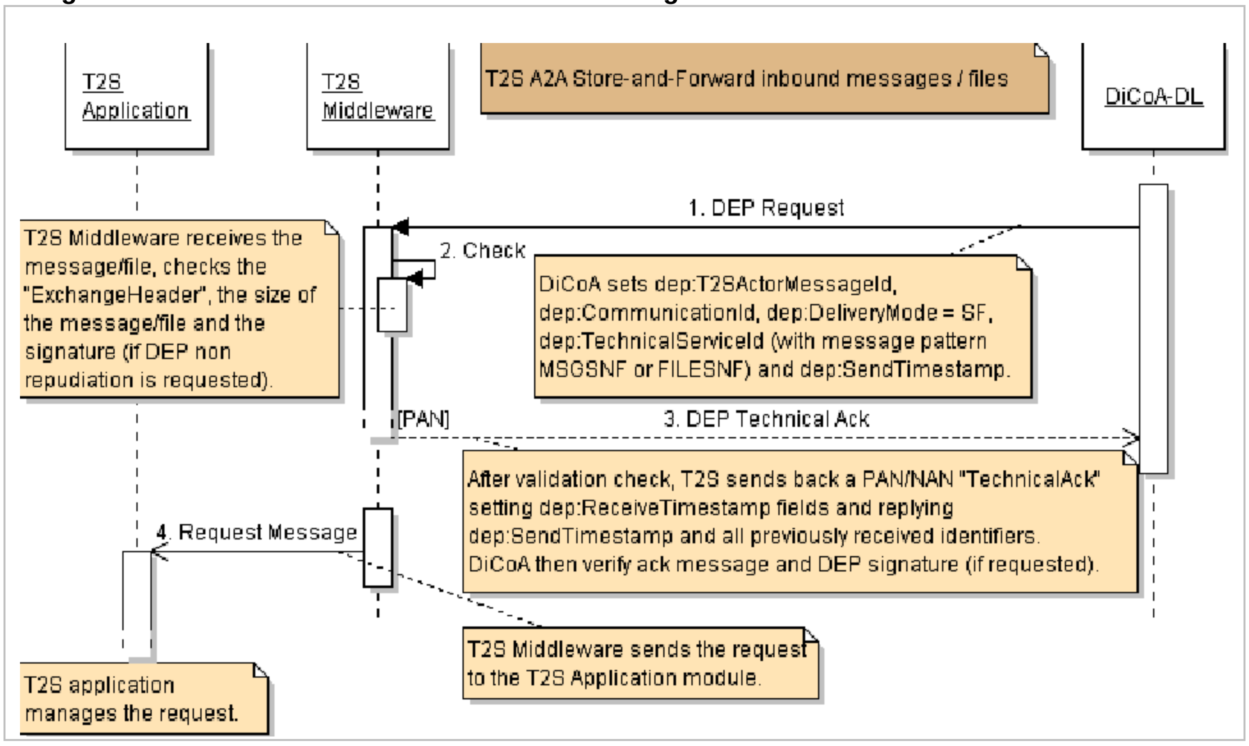

T2S Application
T2S Middleware
T2S A2A Store-and-Forward inbound messages / files
DiCoA-DL
1. DEP Request
2. Check
T2S Middleware receives the message/file, checks the "ExchangeHeader", the size of the message/file and the signature (if DEP non repudiation is requested).
DiCoA sets dep:T2SActorMessageId, dep:CommunicationId, dep:DeliveryMode = SF, dep:TechnicalServiceId (with message pattern MSGSNF or FILESNF) and dep:SendTimestamp.
[PAN]
3. DEP Technical Ack
After validation check, T2S sends back a PAN/NAN "TechnicalAck" setting dep:ReceiveTimestamp fields and replying dep:SendTimestamp and all previously received identifiers. DiCoA then verify ack message and DEP signature (if requested).
4. Request Message
T2S Middleware sends the request to the T2S Application module.
T2S application manages the request.

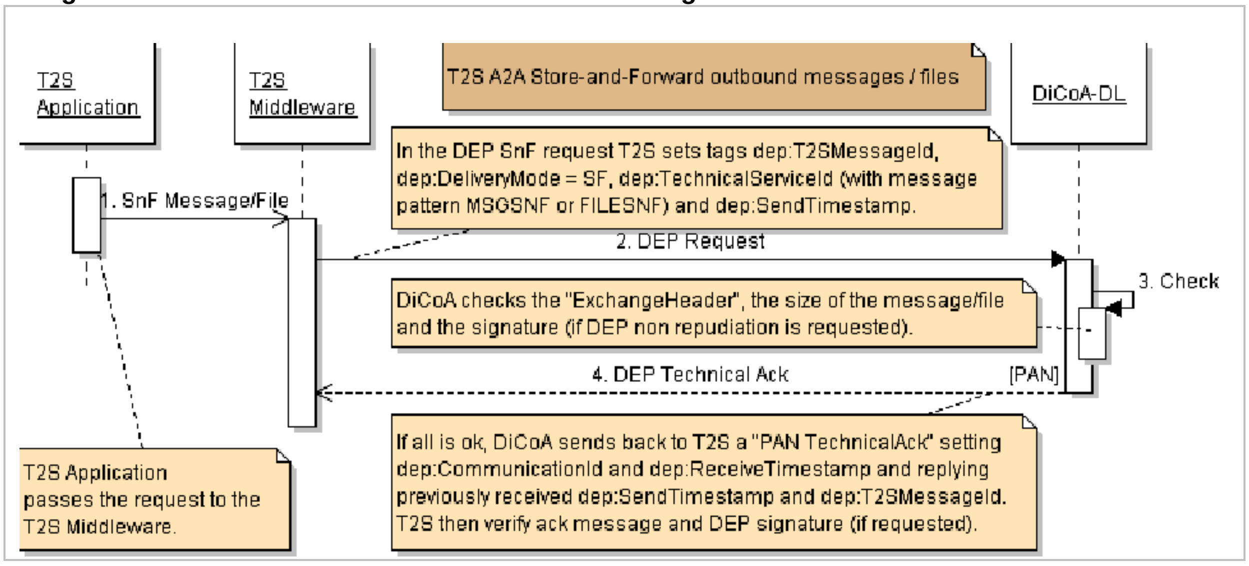
Table 6: Store & Forward T2S inbound message – Description of the main Use Case

STEP NUMBER	STEP DESCRIPTION
1)	The T2S Middleware receives the message/file and performs the validation check of the "envelope" part. if the compression flag is set, the T2S middleware invokes the DEP decompression function. Finally, the T2S Middleware checks the size of the uncompressed message/file.
2)	As an alternative flow, in case that the T2S Platform doesn't send the Technical Ack within 10 minutes, the DiCoA-DL shall manage the situation as described in requirement T2S.UC.TC.30195
3)	The T2S Middleware receives the message/file and performs the validation check of the "envelope" part. if the compression flag is set, the T2S middleware invokes the DEP decompression function. Finally, the T2S Middleware checks the size of the uncompressed message/file.
4)	As an alternative flow, in case that the T2S Platform doesn't send the Technical Ack within 10 minutes, the DiCoA-DL shall manage the situation as described in requirement T2S.UC.TC.30195

3.6.2.2. DEP for store-and-forward outbound messages

When the T2S Platform needs to send a message/file to its clients, it will go through an **Store-and-Forward (SnF) outbound scenario**. The main scenario of a A2A store-and-forward file/message exchange, for a T2S outbound, is modelled in Diagram 6.

Diagram 6: Store-and-Forward T2S outbound message – SD of the main Use Case


T2S Application
T2S Middleware
T2S A2A Store-and-Forward outbound messages / files
DiCoA-DL
In the DEP SnF request T2S sets tags dep:T2SMessageId, dep:DeliveryMode = SF, dep:TechnicalServiceId (with message pattern MSGSNF or FILESNF) and dep:SendTimestamp.
1. SnF Message/File
2. DEP Request
3. Check
DiCoA checks the "ExchangeHeader", the size of the message/file and the signature (if DEP non repudiation is requested).
4. DEP Technical Ack
[PAN]
If all is ok, DiCoA sends back to T2S a "PAN TechnicalAck" setting dep:CommunicationId and dep:ReceiveTimestamp and replying previously received dep:SendTimestamp and dep:T2SMessageId. T2S then verify ack message and DEP signature (if requested).
T2S Application passes the request to the T2S Middleware.

Following the message order showed by diagram, Table 7 describes the main interactions between T2S Platform and DiCoA-DL.

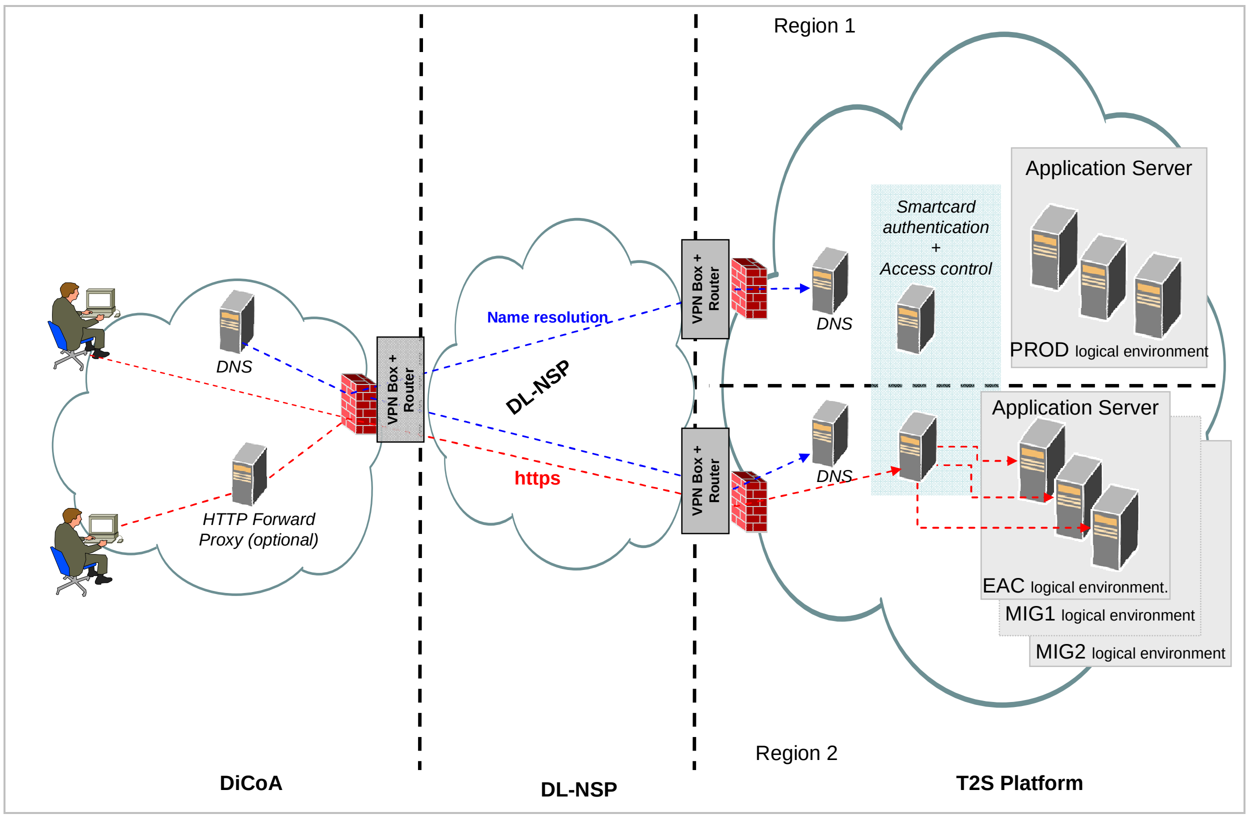
Table 7: Store & Forward T2S outbound message – Description of the main Use Case

STEP NUMBER	STEP DESCRIPTION
1)	The T2S Application passes the request to the T2S Middleware
2)	The T2S Middleware sends a "Request" message/file primitive to the DiCoA-DL. The "T2S Message Id" envelope field is generated by the T2S Platform (this identifier shall be unique at T2S level). The "Delivery Mode" field is set to "SF".
3)	The DiCoA-DL receives the message/file and performs the validation check of the "Envelope" part and the validation of the size of the message/file.
4)	If the validation check is passed, DiCoA-DL sends back to the T2S Platform a "PAN Technical Ack" setting "dep:CommunicationId" , "dep:ReceiveTimestamp" and "dep:T2SMessageId" with values generated for the incoming message with the receiving time. If the validation process fails, the DiCoA-DL sends back to the T2S Platform a "NAN Technical Ack" setting in the "dep:ExchangeStatus" and "dep:ErrorDescription" fields appropriately; the flow is so completed.

4. USER TO APPLICATION (U2A)

Using this communication mode, the Directly Connected T2S Actor can perform both query and update operations. Users can also see status reports of incidents and problems and access the Long Term Statistical Information system.

Access to T2S applications in U2A makes always use of a HTTPS connections as shown in the figure below.



The main components that are involved in the interaction are:

- the user workstation where the users interacts with a browser
- if present, a forward proxy in the DiCoA domestic network; anyway, a firewalling device in the DiCoA domestic network for filtering the traffic from authorized workstations.
- the DNS in the domestic network that is dedicated to Internet name resolution; the counterpart DNS in T2S network that resolves the T2S names with IP addresses.
- the DL-NSP network that interconnects the DiCoA systems to T2S Platform
- The T2S systems that are dedicated to authenticate the user with the certificate that is provided by the user and to authorize the access to the application
- The web application servers where the T2S applications run.

Different logical environments of the T2S applications can be accessed by the user at different URLs.

All U2A interactions are based on HTTPs protocol to assure confidentiality and integrity of the exchanged data. HTTPs traffic between the users' workstations and the T2S Platform must be enabled on the network devices at the DiCoA site, at the DL-NSP level and at T2S entry firewall.

End users at the Direct Connected T2S Actor who need to use U2A functionality shall be assigned a certificate; certificates and related private keys are stored in a smart-card or in a USB token..

The DiCoA shall check the authorization of the end users’ workstations to access the T2S Platform based on the Network level. The IP of the end user access point is checked by the DiCoA firewall to authorize the access to the requested T2S URLs when the end user browser tries to establish a HTTPS session with the T2S Platform.

This paragraph describes the flow performed in the U2A interactions.

At DiCoA site:

- The user opens a browser on a workstation that is connected to the DiCoA local network and enters the URL of one the T2S U2A applications.
- In case the user’s browser is configured to use a proxy in the DiCoA network, the URL request is forwarded to the proxy.
- The user’s workstation or the domestic proxy requests the domestic DNS to resolve the hostname in the URL; to perform this task the domestic DNS forward the name resolution request to the T2S DNS.
- The DiCoA network devices (e.g. the firewall or the proxy) performs a check whether the workstation of the end user is authorised to access the requested IP.
- If the check is successful, the end user is able to establish an HTTPs session with the T2S system at the IP address that is resolved by the DNS.
- If not authenticated, the user will be prompted to specify a valid certificate used for the authentication of the end user;
- If foreseen by the T2S application, an applet can be downloaded on the end user's workstation to sign the XML message for the purpose of non-repudiation; the end user sends signed data via a HTTPs session to the T2S web application server.

At the T2S Site:

- The web application server receives the request to establish a HPPTS request
- If not authenticated it redirects the user browser on a page where the certificate based authentication occurs;
- The T2S Platform validates the certificate by connecting to the T2S PKI for certificate validation (CRL, CSL).

- After authentication an identification phase can be necessary when the same certificate is associated to more than one "system user" in T2S platform; in this case the user has to select which "system user" he wants to access like in that specific U2A session.
- If the user has been authenticated, the HTTPS request is forwarded to the proper T2S web application server.
- If during the interaction an XML signed message is uploaded on the T2S web server, signature validation will be completed by the T2S Platform based on the certificate used for digital signature;
- The web Application sends a (business) acknowledgement via HTTPs session.

The usage of T2S DNS to resolve the hostname in the URL allows the user's browser to transparently access the T2S application server in the proper region where the requested logical environment is hosted.

5. Value Added Connectivity Services

5.1. Security services

Security is of paramount importance for T2S, as very sensitive information will be exchanged between the T2S Platform and its users.

T2S will provide a PKI infrastructure to generate:

- certificates associated to digital keys used to secure the direct link channel between the WMQ systems (SSL at T2S side);
- certificates associated to digital keys used for the signature of DEP ExchangeHeader and inside the Technical Acknowledgement when the non-repudiation have to be used at the DEP level;
- certificates used for the signature of business Information that are transported by the DEP protocol;
- certificates for users' authentication in U2A interaction.

For that purposes purpose it will identify a registration authority (RA) to be involved during the process of issuing and managing the life cycle of electronic certificates.

This infrastructure will be based on T2S PKI, which consists of:

- a Users Certification Authority, for issuing digital certificates to individual user (named "T2S CA for Users" in this document);
- an Application Certification authority, for issuing digital certificates to devices, applications (e.g. SSL certificates) or institutions ("T2S CA for Applications" in this document);
- a Registration Authority, for certificate life cycle management;

The "T2S CA for Users" has been assessed by the ESCB PKI Assessment Body and formally included in the relevant ESCB-trusted white lists. Digital certificates are issued on cryptographic devices like smart cards or USB tokens.

The "T2S CA for Applications" has been "cross-certified" by the Entrust 2048 CA with a chaining agreement, making it trusted by the most popular web browsers. Digital certificates can be issued on cryptographic hardware (such as HSMs) or software envelopes (PKCS#12). For T2s, the usage of FIPS 140-3 or CC EAL 4+ compliant HSMs is mandatory.

5.1.1. Certificate revocation list server availability

Both Users and Application Certification Authorities make CRLs available over Internet via HTTP and LDAP protocol.

The "T2S CA for Users", additionally, provides an OCSP service. All of these services are accessible from the Internet. The following table summarizes the CRL Distribution Points for both CAs and the OCSP service URL.

Table 8: Summary of CRL Distribution Points (e.g. Banca d'Italia PKI)

CA	HTTP CRL Distribution Point	LDAP CRL Distribution Point	OCSP
Users	www.firmadigitale.bancaditalia.it/crl/crl.crl	ldap.firmadigitale.bancaditalia.it/ cn=Banca%20d'Italia, ou=Servizi%20di%20certificazione, o=Banca%20d'Italia/00950501007, c=IT?certificateRevocationList	ocsp.firmadigitale.bancaditalia.it/ocsp
Application	www.certificazione.bancaditalia.it/crl/crlapp.crl	ldap.certificazione.bancaditalia.it/ ou=Servizi%20di%20certificazione %20dei%20sistemi%20informatici, o=Banca%20d'Italia, c=it?certificateRevocationList	N/A

T2S will provide also a CRL proxy that allows the DiCoA system to access the CRL over the Dedicated Link network service provider.

5.1.2. Provisioning and management of digital certificates

The following schemes represent the logical flow of certificate issuance to individual users and applications.

The identification of users by the T2S PKI Registration Authority will be delegated to the T2S Service Desk that can delegate some tasks to the National Central Bank of the DiCoA's respective Country.

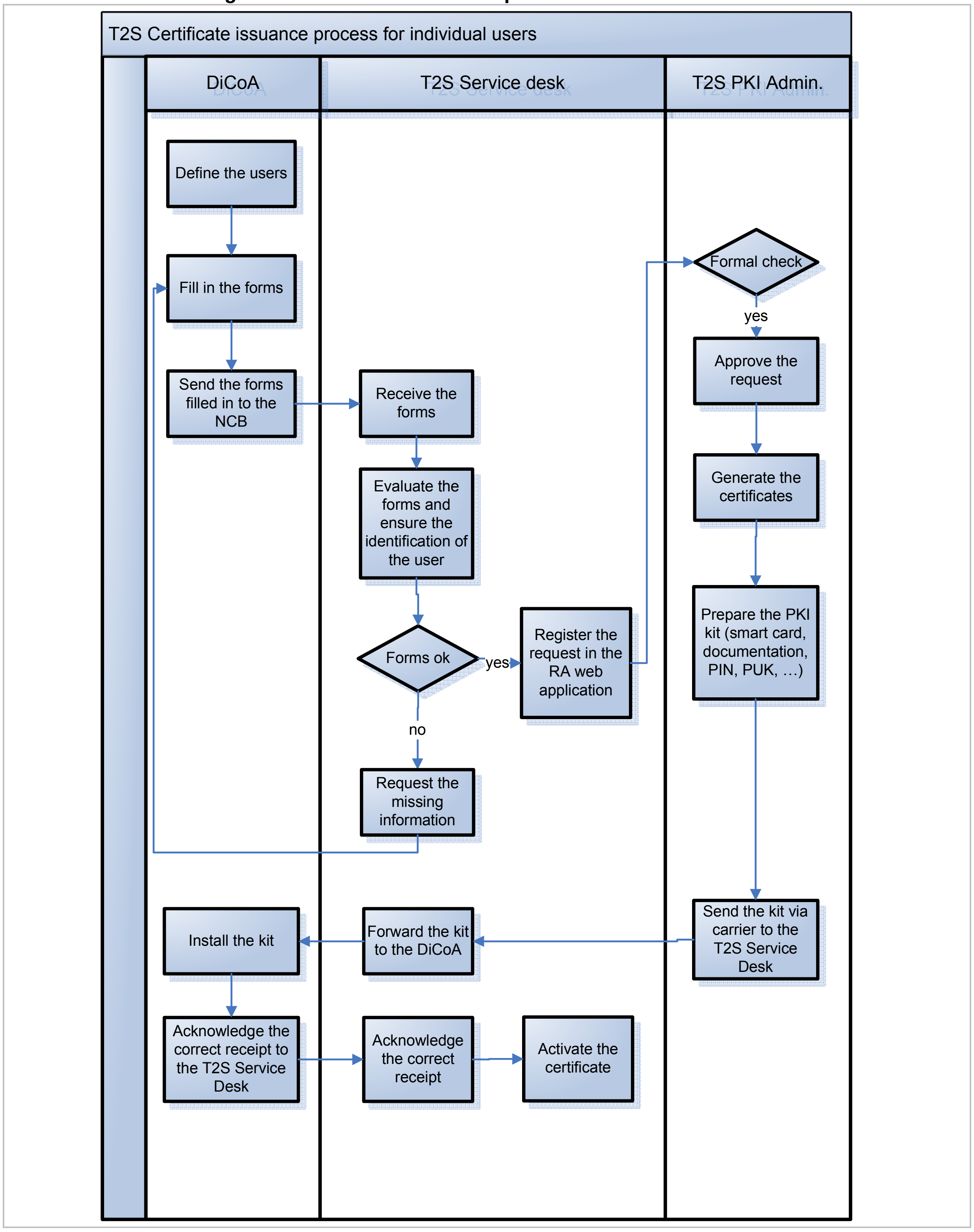
Regarding certificates for individual users, private and public keys are generated at the PKI site during the process of producing the smartcard and the certificate.

Regarding application certificates, private and public keys ("key pairs") are generated on the HSM device at the DiCoA site; the "T2S CA for Applications" will be responsible of generating the related certificate based on the Certificate Signing Request (PKCS#10 format) issued by the DiCoA.

The DiCoA shall identify a Security Officer that will be responsible to initiate the certificate request process and to receive information from the PKI Administrators.

The process of issuing a certificate for individual users is described in the following diagram:

Diagram 7: certificate issuance process for individual users

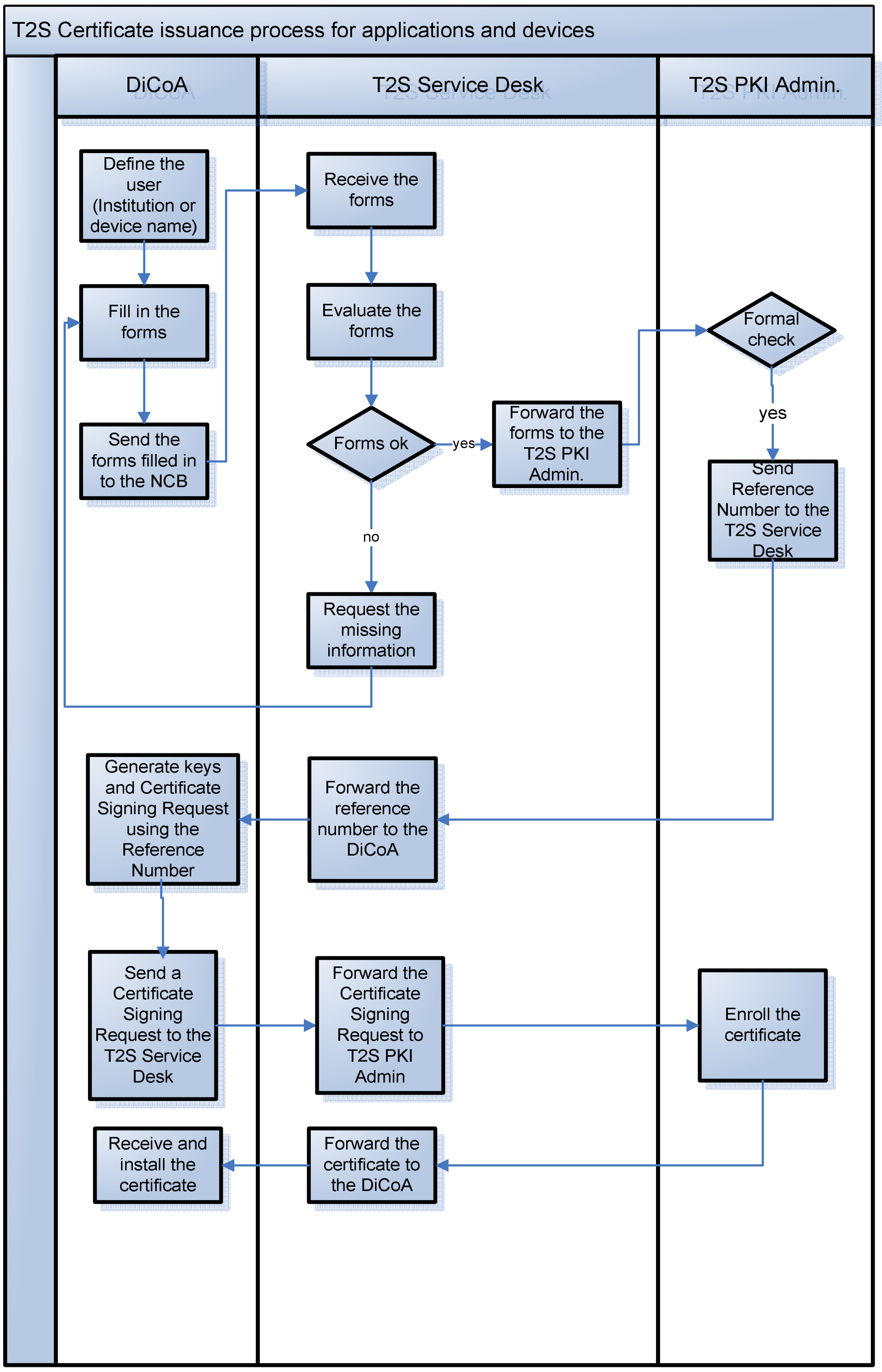

T2S Certificate issuance process for individual users
DiCoA
T2S Service desk
T2S PKI Admin.
Define the users
Fill in the forms
Send the forms filled in to the NCB
Receive the forms
Evaluate the forms and ensure the identification of the user
Forms ok
yes
no
Register the request in the RA web application
Request the missing information
Formal check
yes
Approve the request
Generate the certificates
Prepare the PKI kit (smart card, documentation, PIN, PUK, …)
Send the kit via carrier to the T2S Service Desk
Forward the kit to the DiCoA
Install the kit
Acknowledge the correct receipt to the T2S Service Desk
Acknowledge the correct receipt
Activate the certificate

The process of issuing a certificate for individual users envisages that

1. the user is identified by the T2S Service Desk (vis-à-vis identification in the premise of the NCB of the related Country) before accepting the request to generate the Certificate;
2. the digital keys are generated as part of the process to produce the smartcard/USB token, at the T2S PKI premises. The certificate is originally "suspended" (the serial number is inserted into the T2S PKI CRL) ;
3. The individual has to pick up the smartcard/USB token at the premises of the NCB of the related Country;
4. The certificate is activated (i.e. its serial number is removed from the CRL) after the user has acknowledged the reception of the smart card/USB token.

The process of issuing a certificate for applications and devices are described in the following diagram:

Diagram 8: Certificate issuance process for application and devices


T2S Certificate issuance process for applications and devices
DiCoA
T2S Service Desk
T2S PKI Admin.
Define the user (Institution or device name)
Fill in the forms
Send the forms filled in to the NCB
Receive the forms
Evaluate the forms
Forms ok
yes
no
Forward the forms to the T2S PKI Admin.
Formal check
yes
Send Reference Number to the T2S Service Desk
Request the missing information
Generate keys and Certificate Signing Request using the Reference Number
Forward the reference number to the DiCoA
Send a Certificate Signing Request to the T2S Service Desk
Forward the Certificate Signing Request to T2S PKI Admin
Enroll the certificate
Receive and install the certificate
Forward the certificate to the DiCoA

The process of issuing a certificate for digital keys that must be generated on a device (such as HSM) at the DiCoA premise envisages that

1. the DiCoA initiates a formal request by describing the usage of the certificate and the identification of the system or application that will use the certificate (including the DN to be inserted in the certificate)
2. T2S PKI Administrator sends back a reference number to be used during the process of generating the digital keys and the Certificate Signing Request file.
3. The DiCoA Security Officer sends the Certificate Signing Request to T2S PKI
4. T2S PKI Administrator sends the generated public certificate to DiCoA Security Officer

5.1.3. Digital signature management

The signature of the business content shall be in XAdES format; it can be generated by using either the digital keys for the signature that have been provided by the "T2S CA for Users" on cryptographic devices like smart cards or USB tokens or by Digital keys generated by the DiCoA on his own hardware Security module. In this case the HSM shall be compliant with FIPS 150 or EAL4+ specifications; certificates associated with such digital keys are issued by the "T2S CA for Applications".

The signature of DEP protocol messages will be made using digital certificates provided by the Applications Users Certificate on HSMs.

5.1.4. Non-repudiation of the exchanged data

In A2A, the non-repudiation of emission and receipt of exchanged data is ruled by the dep:Non-Repudiation flag in the technical header and it is implemented according to the following assumptions:

For incoming messages, when the dep:nonRepudiation flag is set, the technical envelope shall contain a digital signature. The digital signature proves that the message has been delivered by the DiCoA. T2S replies with a technical acknowledgement that contains a digital signature of its content; such a technical acknowledgement proves that the message was received by T2S.

For outgoing messages, if T2S sets the dep:nonRepudiation flag in the DEP technical header, the technical envelope contains a digital signature. Such a technical header proves that T2S delivered the message; the DiCoA shall reply with a technical acknowledgement that contains a digital signature of its content that proves to T2S that the message was received by the DiCoA systems.

According to W3C's XML Advanced Electronic Signature recommendations[7], the XAdES format satisfies the legal requirements for advanced electronic signatures as defined in the European Directive on

[7] XML Advanced Electronic Signatures (XAdES), W3C Note 20 February 2003, available at http://www.w3.org/TR/XAdES/.

electronic signatures. It provides basic authentication and integrity protection and can be created without accessing on-line (time-stamping) services.

When the signature is validated the status of the certificate at the arrival time shall be considered; no time stamp attribute attached to the signature (as in XAdES-T format) is used.

5.2. Handling of Messaging services

5.2.1. Real-time mode

The real time service is aimed at respecting the response time requirements.

Each request sent via real time service shall receive a response within 60 seconds.

In the case that no response is received within the 60 seconds, a timeout condition shall be raised to close the real-time session.

On the T2S side, if the request is correctly received and the response is going to be processed, the timeout condition is handled by a specific process named ''timeout management" described in depth in the section "5.3.2 Timeout management".

The process waiting for the response to a request needs to listen to the specific WMQ queues agreed during configuration phase. If the response size is over the limit of the selected channel, a specific process named ''oversize management" will handle the communication as described in the section ''5.2.4 Oversize management".

Currently there is no business case scenario that foresees a query sent by T2S to the DiCoA via this messaging service, so the DiCoA should not implement oversize and timeout management on the client side, but it should be able to correctly process the incoming messages provided by T2S related to the above mentioned specific processes.

5.2.2. Store-and-forward mode

The Dedicated Link connectivity is implemented between 2 actors (the DiCoA and T2S). In this scenario there is no additional actor that can store the messages to ensure delivery to the final receiver.

For this reason, the store-and-forward service is implemented in a DiCoA configuration inheriting the WMQ functionalities provided by server-server configuration.

Because automatically managed by the WMQ, the usage of this functionality provides the following advantages:

- one and only one delivery of messages to the remote WMQ server

- automatic message resend in case of connection problems, provided by the WMQ channel agent;
- the usage of transmission queues ensures that messages are stored locally before being sent to the remote WMQ, and are removed from the local queue only when the messages persist on the remote queue. Reconnection in case of failure of the channel is managed automatically by the WMQ channel agents that manages the synchronization process to check the status of the exchanged and committed messages;
- the channel (connection) availability means that the messaging service can be used without having to handle the DEP protocol commands to enable or disable the Store-and-forward traffic. The "EnableSnfTraffic" – "DisableSnfTraffic" DEP primitives have no sense in this configuration. To enable the SNF traffic, the relative MQ channel will be started and to disable the SNF traffic, it will be stopped.

Moreover as a possible exception respect to the DEP protocol description the usage of dep:DeliveryNotifiication flag can be avoided and substituted by verifying the reception of a Technical ACK generated by T2S to be sure that the message is correctly received by T2S. However a message with the dep:DeliveryNotification flag set in the ExchangeHeader will not be refused by T2S and will be treated following the DEP protocol;

In any case, the DiCoA client shall provide a retry mechanism based on the DEP Store and Forward protocol description that is:

- If a NAN is returned by T2S for a message or File sent via Snf service, the DiCoA shall retry sending the message up to 10 times every 10 minutes.
- If for 10 times the DiCoA receives NAN from T2S this means there is a persistent problem on the platform, so the message shall be marked as ''undelivered'' in the DiCoA site.
- A ''resending'' functionality shall be available at the DiCoA site to recover messages following the rules reported in the section ''5.2.5 re-transmission of messages ''

5.2.3. Timeout management

For real-time messages exchange, the DEP protocol imposes to handle the entire exchange within a specified limited time[8]. As soon as the timeout is expired the communication is interrupted and a ''timeout'' error is generated.

For the query/response message flow, this limitation can interrupt the communication even if the response is being producing, causing error message generation in a scenario that in reality is working properly.

To overcome this limit for the production of the response that takes longer that the timeout limitation, T2S applies an effective protocol.

[8] Timeout value can be subjected to change in the future. It is currently fixed to 60 seconds and includes the transport time.

It defines a timeout limit which anticipates that of the protocol. If the processing takes longer than the T2S timeout limit the transfer mode of the response changes from real-time to store and forward. The store and forward mode delivers all requested data properly.

The T2S timeout limit is considerably lower than that of the protocol one, to take in consideration the transport time.

The following sequence illustrates the timeout management protocol with an example of query/response flow:

1. the communication counterpart sends a query request in real-time mode to T2S. T2S starts a timer at query request reception time;
2. T2S processes the query request but the processing time exceeds the T2S timeout limit.
3. If T2S cannot respond to the query request within the timeout limit, the middleware sends an "Inbound Processing Rejection" admi.007.001.01 ReceiptAcknowledgement is sent as query response to the communication coutnerpart (sender) indicating that a T2S timeout has occurred but the request is being processed[9].
4. T2S continues to prepare the response. When the data is available, it is sent in store and forward mode to the communication counterpart according to the routing rule. Oversized responses are sent according to the default routing rule for the file channel (see below).

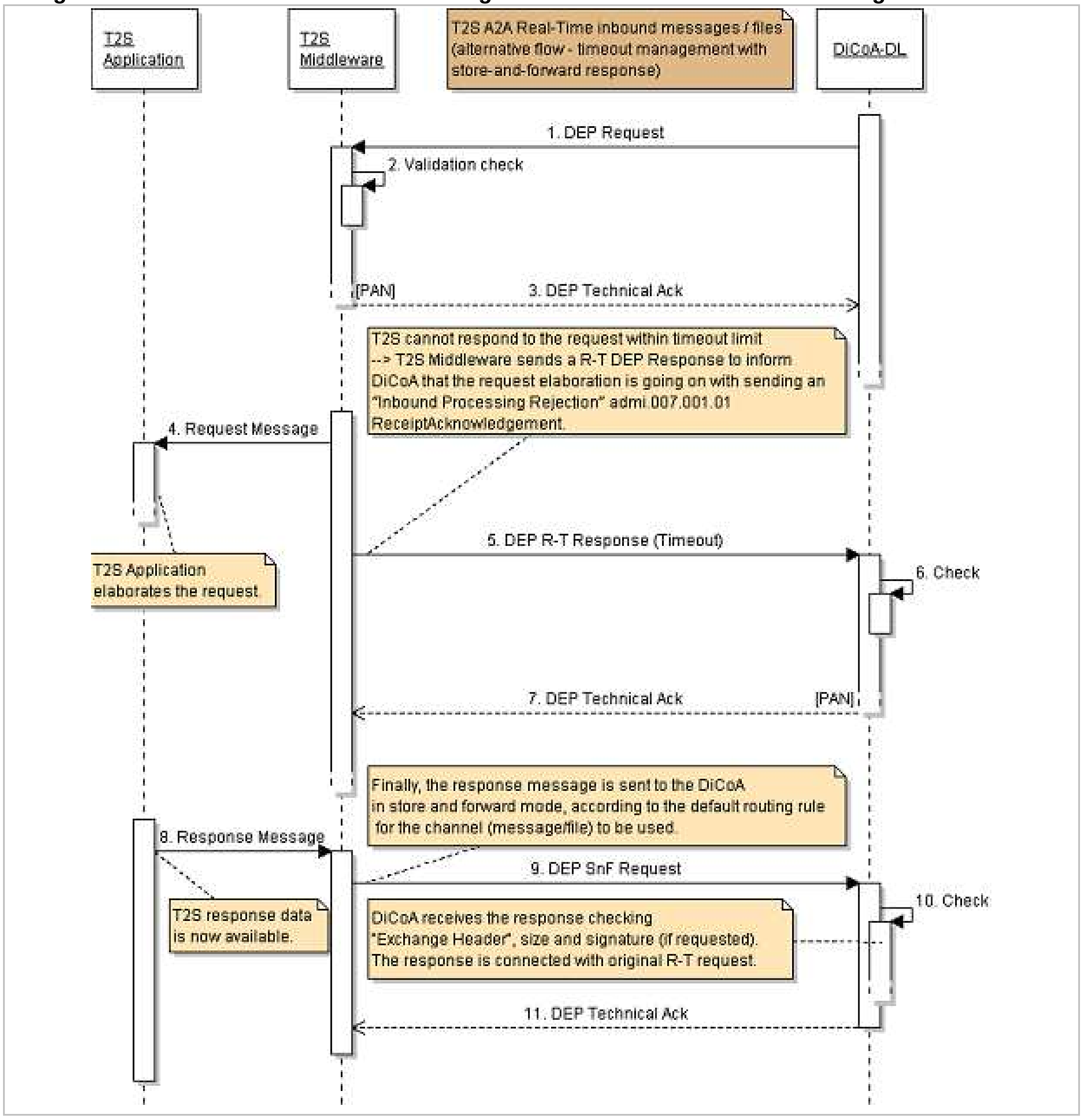
The DEP timeout value is fixed to 60 seconds.

The T2S timeout value is configurable. It is initially set to 40 seconds.

Timeout management will be implemented following the schema below.

[9] Text of the message will be ICAA001-T2S cannot respond to the query request within the timeout limit. File store and forward network service will be used.

Diagram 9: Real-Time T2S inbound message – Alternative SD – Timeout management


T2S Application
T2S Middleware
T2S A2A Real-Time inbound messages / files (alternative flow - timeout management with store-and-forward response)
DiCoA-DL
1. DEP Request
2. Validation check
[PAN]
3. DEP Technical Ack
T2S cannot respond to the request within timeout limit --> T2S Middleware sends a R-T DEP Response to inform DiCoA that the request elaboration is going on with sending an "Inbound Processing Rejection" admi.007.001.01 ReceiptAcknowledgement.
4. Request Message
T2S Application elaborates the request.
5. DEP R-T Response (Timeout)
6. Check
7. DEP Technical Ack
[PAN]
Finally, the response message is sent to the DiCoA in store and forward mode, according to the default routing rule for the channel (message/file) to be used.
8. Response Message
9. DEP SnF Request
10. Check
T2S response data is now available.
DiCoA receives the response checking "Exchange Header", size and signature (if requested). The response is connected with original R-T request.
11. DEP Technical Ack

5.2.4. Oversize Data management

DEP protocol is built to allow segregation of traffic and optimization of data exchange based on the size of the communications.

Messages are limited in size to 32KB and files to 32MB. Messages that exceed the size limitation are blocked to avoid that messaging services are used in incorrect way.

The real-time protocol it is normally expected to be used for query/response message flow and it is defined that response to a request is sent using the same messaging service used by the request.

It can happen that data produced by the application when producing response is bigger than the messaging service size limitation, and even in case of a correct response it could cause an error message due to mismatch between response size and messaging service size limitation.

Messages that may breach the size limit, have to be checked for their size before transmission, to avoid that messages are stopped.

To avoid message stopping for size limitation, T2S apply a protocol named ''oversize management".

The response that exceeds the real-time messaging service size is routed to the communication counterpart following the rules reported in the table below:

Table 9

REQUEST	**RESPONSE SIZE < 32 KB**	**RESPONSE 32 MB > SIZE > 32 KB**	**RESPONSE SIZE > 32 MB**
Message channel Real-time	Message channel Real-time	File channel Store and forward	No transmission
File channel Real-time	File channel Real-time	File channel Real-time	No transmission

The following sequence illustrates the oversize management protocol with an example of query/response flow:

1. The query request is sent in real-time mode via message channel.
2. if the response is too large for a transfer via the message channel the file Store and forward channel is used.
3. T2S sends an admi.007.001.01 ReceiptAcknowledgement in real-time mode to the communication counterpart (sender) indicating the change of the transfer mode[10].
4. The query response is sent in store and forward mode according to the default routing rule for the file Store and forward channel.

[10] Text of message is ICAA002-T2S cannot respond via message based network service due to size restriction. File store and forward network service will be used.

5. If the response is bigger than the File channel size limitation, the file is not sent and an admi.007.001.01 ReceiptAcknowledgement is sent via store and forward channel to the communication counterpart to alert that response is aborted due to size limitation[11].

Regarding the Store and Forward Communication (Reports, Notifications) the channel for the transmission of push messages have to be configured by the receiver via dedicated routing rules.

These have to follow the technical restrictions for the various channels, i. e. it is not possible to configure a rule for the message channel for messages larger than 32 kB, while a routing rule for the file channel for messages with a lower size than 32 kB would be valid.

If no routing rule is configured for a present communication, the default routing rules are applied. According to such default rules routing occurs via the message channel for all messages up to 32 kB and via the file channel for all larger messages.

If no default routing rules are present, the message is not routed to the network and an alarm is raised to the technical monitor to alert the operators to check the problem or alert the receiver to update the routing rules in the Static Data.

The oversize management will be implemented following the schemas below.

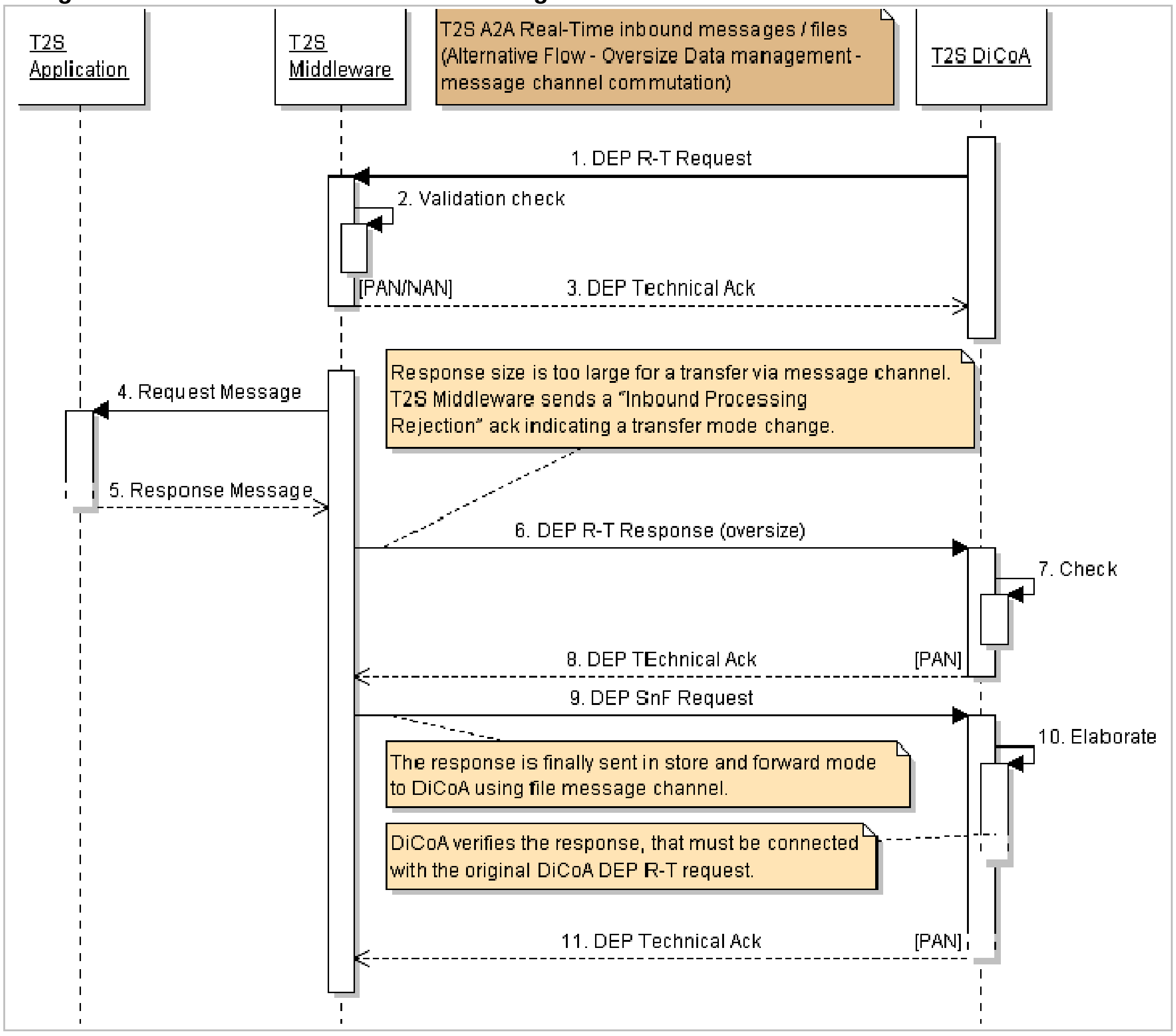
In the first scenario (Real Time message/file channel with response size < 32 KB), the size of the response is correct with the same channel that was used for the query request. So, T2S middleware sends the response message over the same channel, as modeled in previous Diagram 2: Real-Time T2S inbound message – SD of the main Use Case.

For file channel, this scenario applies with 32 MB > response size > 0 KB too.

[11] Text of message is `ICAA003-T2S cannot respond to the query due to 32MB size restriction`

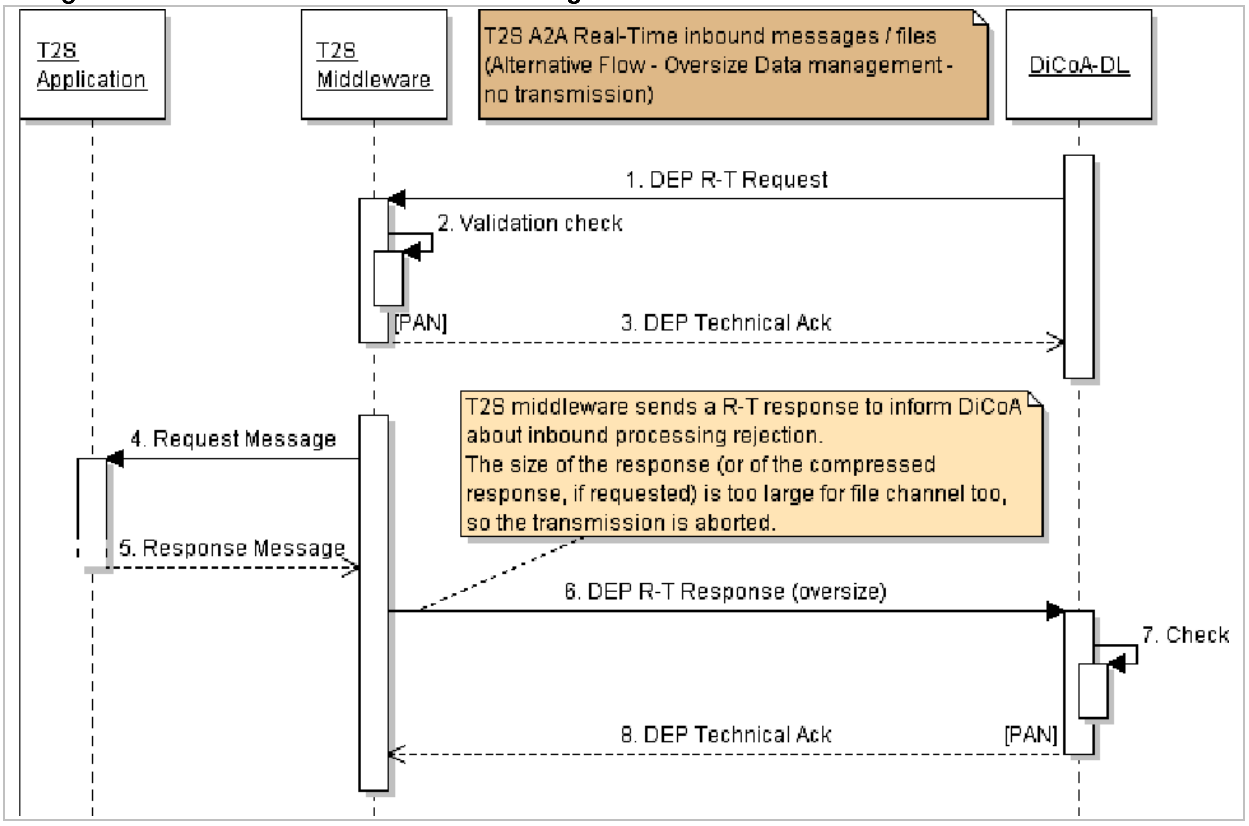
The second scenario is when the request is sent via the message channel and the size of the response is too large for a transfer via the message channel. In this case, T2S middleware sends the response in store-and-forward mode, using file channel.

Diagram 10: Real-Time T2S inbound message – Alternative SD – Oversize - channel transaction


T2S Application
T2S Middleware
T2S A2A Real-Time inbound messages / files (Alternative Flow - Oversize Data management - message channel commutation)
T2S DiCoA
1. DEP R-T Request
2. Validation check
[PAN/NAN]
3. DEP Technical Ack
Response size is too large for a transfer via message channel. T2S Middleware sends a "Inbound Processing Rejection" ack indicating a transfer mode change.
4. Request Message
5. Response Message
6. DEP R-T Response (oversize)
7. Check
8. DEP TEchnical Ack
[PAN]
9. DEP SnF Request
10. Elaborate
The response is finally sent in store and forward mode to DiCoA using file message channel.
DiCoA verifies the response, that must be connected with the original DiCoA DEP R-T request.
11. DEP Technical Ack
[PAN]

The third and final scenario is when response size > 32 MB; in this case, the size of the response is too large for a transfer via the file channel and so the transmission is aborted.

Diagram 11: Real-Time T2S inbound message – Alternative SD – Oversize - no transmission


T2S Application
T2S Middleware
T2S A2A Real-Time inbound messages / files (Alternative Flow - Oversize Data management - no transmission)
DiCoA-DL
1. DEP R-T Request
2. Validation check
[PAN]
3. DEP Technical Ack
T2S middleware sends a R-T response to inform DiCoA about inbound processing rejection.
The size of the response (or of the compressed response, if requested) is too large for file channel too, so the transmission is aborted.
4. Request Message
5. Response Message
6. DEP R-T Response (oversize)
7. Check
8. DEP Technical Ack
[PAN]

5.2.5. Re-transmission of messages and files in case of DiCoA (or network) unavailability.

In case of technical error (e.g service interruption due to failure of an infrastructural element), resending of messages takes place to be sure that nothing has being lost.

Resendig functionalities shall be provided by the DiCoA.

The Resending functionality is implemented in T2S. To be able to send again a single message or a group of messages the messages can be selected following the listed criteria:

- Sender
- Receiver
- Service used
- Message Identifier
- Time interval (date and time)
- Message type

- Direction (sent or received)

The messages are then re-sent out without the ''duplication flag''. Checks for duplication function are needed on the DiCoA's side in this case.

The DiCoAs are requested to implement similar functionalities to recover from any disaster recovery scenario.

6. Operational Management

6.1. Registration Process

6.2. Recovery Management

There is a basic recovery principle which applies to the Dedicated Link solution: on one side T2S must be able to recover the U2A (https) and A2A (WMQ/DEP) services, at any of the four available sites, with no changes from the DiCoA; on the other side the DiCoA must be able to recover the A2A (WMQ) service, at any available site, with no changes from T2S. The goal is to have a data center agnostic service: DiCoAs do not perceive which is the T2S active region, DiCoAs do not discern the swap of active Region (the so called rotation), all this is fully transparent to the DiCoAs, thus no configuration changes in the DiCoA systems are envisaged. To achieve this a DNS based solution is in place.

Each T2S data center is reachable via a specific IP subnets (DC_1 is reachable via IP $subnet_1$, DC_2 is reachable via IP $subnet_2$, DC_3 is reachable via IP $subnet_3$, DC_4 is reachable via IP $subnet_4$). Between the two T2S sites in the same region there is a layer 2 (L2) VLAN extension. Each data center runs IBM WebSphere WMQ and DNS services. These local DNS caching services are updated and are forwarders of a more internal DNS which “knows” on which T2S data center a certain service is running.

Example: DiCoA looking for T2S services

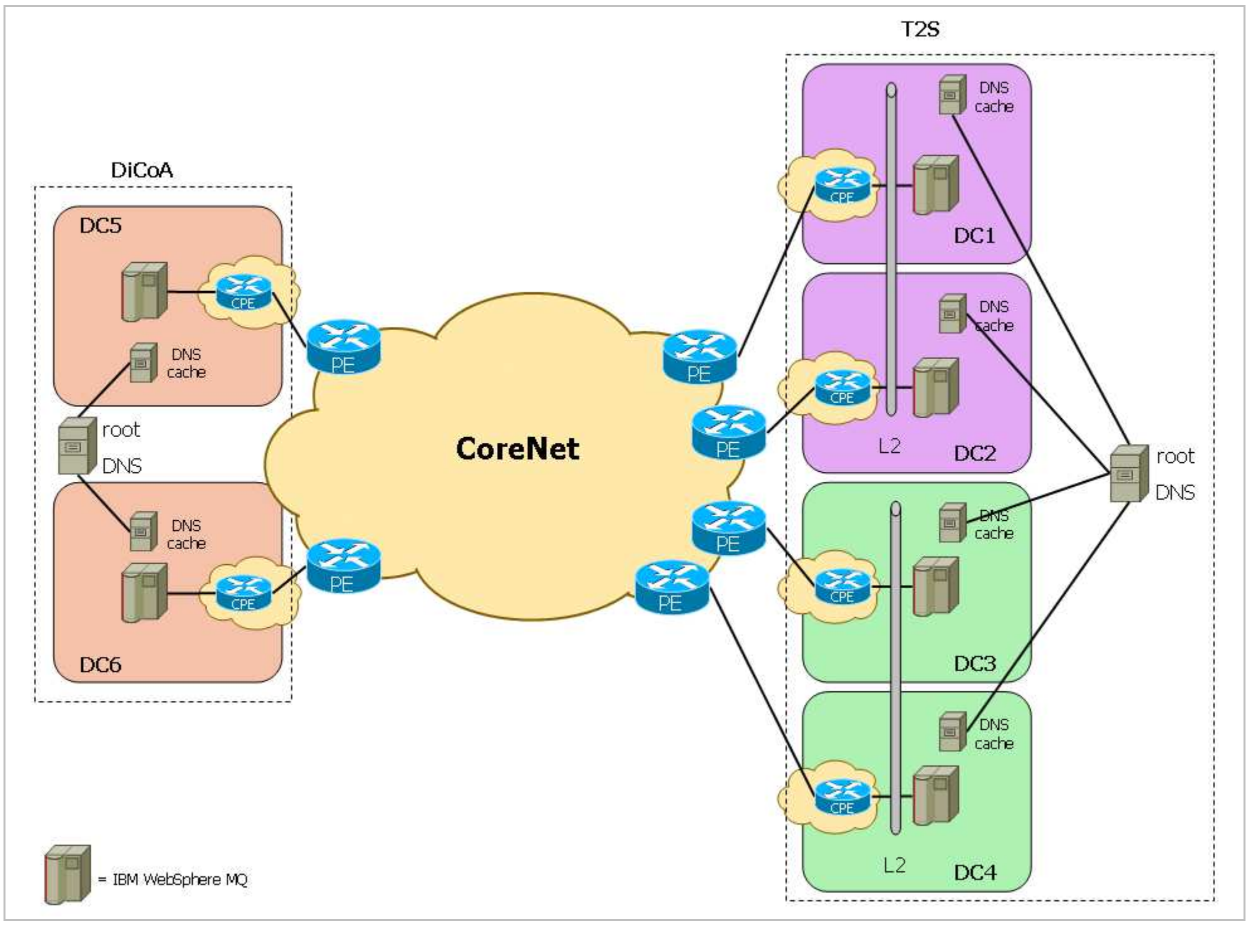
The DNS name servers implemented at all four T2S sites (DC_1, DC_2, DC_3, DC_4) are authoritative for the T2S domain (for example t2s.int). These name servers (for example $ns_{[1-4]}$.t2s.int) are updated by T2S root DNS servers located anywhere in the T2S core, and are queried by the DNS client located at any of the DiCoA sites (DC_5, DC_6).

Under normal operations a T2S service manager willing to run a specific T2S service (for example xyz.t2s.int) on a specific T2S data center (for example the IBM WebSphere WMQ running on DC_3), via the operation support team, updates the root DNS, which then updates the DNS caching name servers, thus the respective DNS records - describing where the service is active - are ready for queries.

The DiCoAs (either A2A or U2A) want to connect to the xyz.t2s.int service, the DiCoA’s DNS client points to all of the T2S name servers (authoritative for the t2s.int name resolution) and starts round robin queries for example from DC_5 to any of the four T2S DNS name servers. The name server at DC_1

(ns$_1$.t2s.int) replies that the host xyz.t2s.int is active at a specific DC$_3$ IP address and then the DiCoA can establish a TCP session to the WMQ service available at DC$_3$[12].

The following picture describes the solution:



Under recovery operations the T2S service manager might decide for whatever reason to run the specific T2S service on another T2S data center (for example DC$_4$), again via the operation support team the root DNS is updated with the most current information, it then updates the DNS caching name servers, which are again ready for queries. The DiCoA still wants to connect to the xyz.t2s.int service, starts the round robin queries, for example from DC$_5$, the name server at DC$_2$ (ns$_2$.t2s.int) replies that the host xyz.t2s.int is active at a specific DC$_4$ IP address and the DiCoA establishes a new TCP session to the WMQ service available at DC$_4$.

Example: T2S looking for DiCoA services

[12] The well-known port number for WebSphere WMQ is 1414. If a single queue manager is hosted, it is common for the queue manager to listen on TCP/IP port number 1414

The same solution described above symmetrically applies to the DiCoA (with the only exception of the L2 VLAN extension between the sites in the same region).

The DNS name servers implemented at the two (or more) DiCoA sites (DC_5, DC_6) are authoritative for the DiCoA domain (for example DiCoA.com). These name servers (for example $ns_{[5,6]}$.DiCoA.com) are updated by the DiCoA root DNS servers located anywhere in the DiCoA backbone, and are queried by the DNS client located at any of the T2S sites (DC_1, DC_2, DC_3, DC_4).

Under normal operations the DiCoA runs a specific DiCoA service (for example abc.DiCoA.com) on a specific DiCoA data center (for example the IBM WebSphere WMQ running on DC_6), in whatever suitable way, the information on the root DNS is updated, this is propagated to the DNS caching name servers which are then updated, eventually the respective DNS records - describing where the service is active - are ready for the T2S queries.

When T2S wants to connect to the abc.DiCoA.com service, T2S's DNS client points to all of the DiCoA name servers (authoritative for the DiCoA.com domain) and starts round robin queries for example from DC_3 to any of the DiCoA DNS name servers. The name server at DC_5 (ns_5.DiCoA.com) replies that the host abc.DiCoA.com is active at a specific DC_6 IP address and then T2S can establish a TCP session to the WMQ service available at DC_6.

Appendix1 - Data Exchange Protocol (DEP) and messaging services

T2S connectivity model interfaces DiCoAs using two different network connection modes:

- indirect connection (using VA-NSP);
- direct connection (using DL-NSP).

In order to manage the communication with a multiplicity of actors, with different network connection modes, T2S adopts an **ad hoc protocol** for **data exchange in A2A mode**. The **Data Exchange Protocol** (DEP) is used to exchange data between the T2S platform and the VA-NSP or the DiCoA connected via a CORENET channel. This protocol is developed on the WMQ application-to-application protocol, so to inherit some of the native functionalities provided by the WMQ product (as explained in section “DEP - MQMD message format”).

The aim of the DEP is to ensure the T2S network interface is independent from the DiCoAs’ choice to use a direct (DL-NSP) or an indirect (VA-NSP) network connection.

Appendix1.1 DEP communication services overview

The DEP implements, based on the T2S requirements, two different kinds of communication flow named real-time and store-and-forward services:

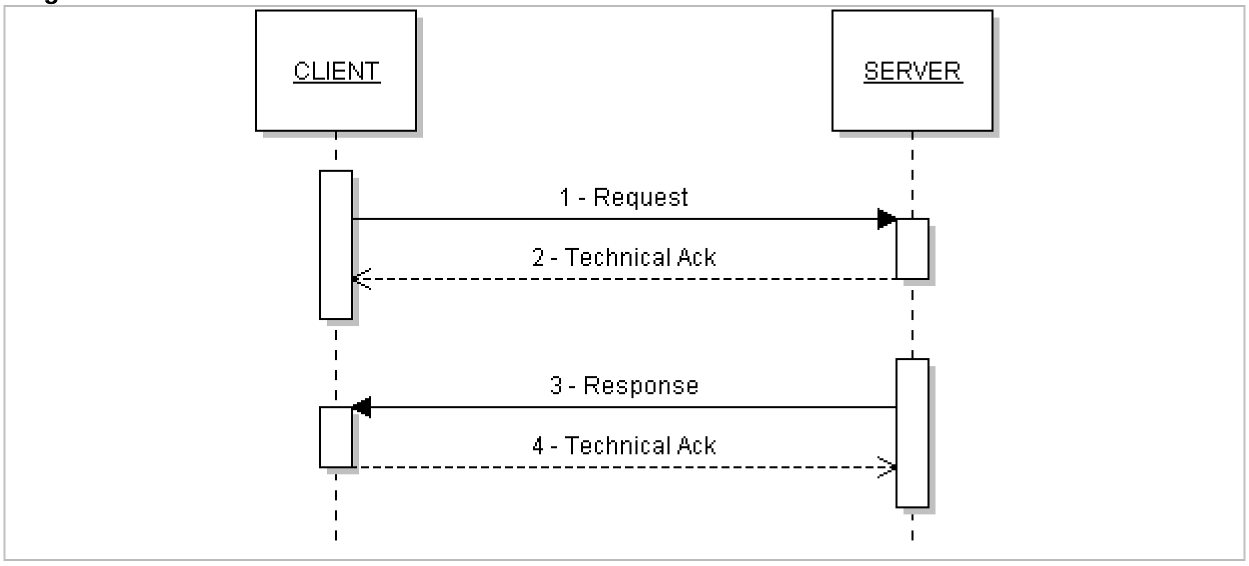
- the "real-time" service (message or file) requires that both parties, the sender and the receiver, are available at the same time to exchange messages or files. In case of unavailability of the receiver, **no retry** mechanism is available;
- the "store-and-forward" service (message or file) enables the sender to transmit messages or files even if the receiver is not available; the sender can be informed when the delivery of the data to the receiver has been successful.

Each of the above mentioned communication services is based on a client-server interaction.

In the **real-time** message/file exchange the communication is based on a request-response pattern. This means that for each request the client submits to the server, a response is expected to be sent from the server to the client.

The following picture describes the real-time exchange:

Figure 9: Real-Time communication service



1 – the client sends the Request

2 – the server confirms the Request has been received sending back a Technical-Ack

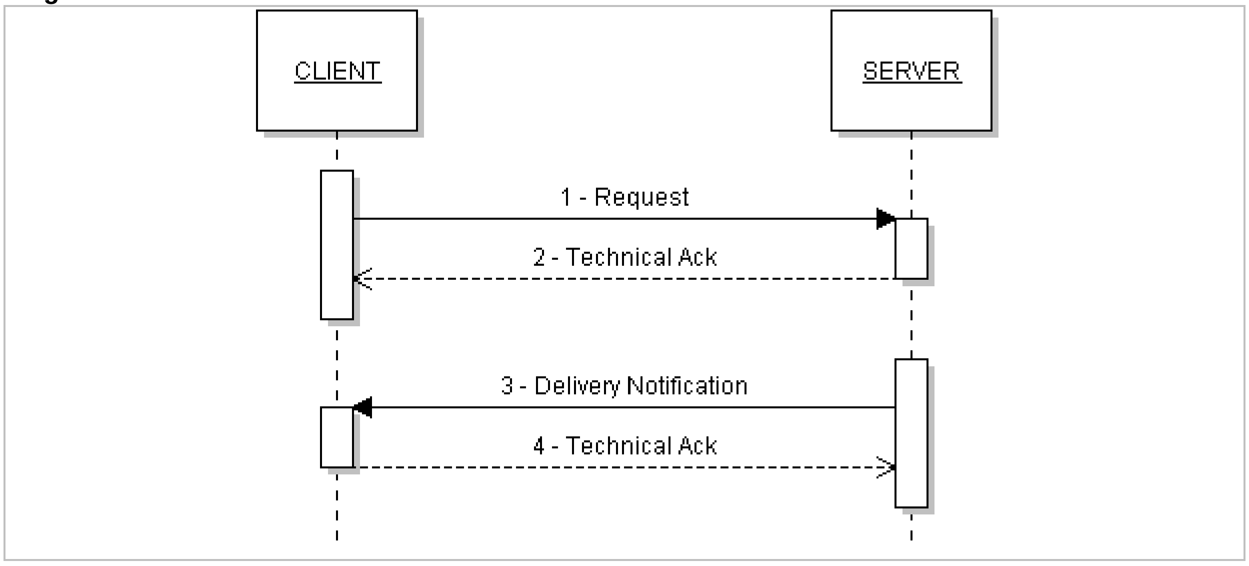
3 – the server sends the Response

4 – the client confirms the Response has been received sending back a Technical-Ack

This kind of communication is synchronous, i.e. the client expects a Response from the server to close the communication pattern or a specific time interval to abort it (in DEP protocol this value is 60 seconds).

In the **store-and-forward** message/file exchange, communication is based on a request-only pattern (in some message exchange patterns this is also named "In-Only", while the request-response scheme is named "In-Out"). This means a response isn't expected for each request the client submits to the server. The following picture describes the store-and-forward exchange:

Figure 10: Store-and-Forward communication service



1 – the client sends the Request

2 – the server confirms that the Request has been received sending back a Technical-Ack

As stated above, DEP can be used in case of direct (DL-NSP) or indirect (VA-NSP) network connection so it has been designed to permit both types of connection.

While for real-time message exchange the kind of connection (direct/indirect) doesn't affect the message pattern, in case of store-and-forward if the server is not the final destination of the message (indirect connection) the server is prompted to notify the client of the delivery to the final destination (via a DEP element in the ExchangeHeader).

So only when the client request contains the DEP element named dep:DeliveryNotification with a value different from NO (refer to the "DEP exchange header field descriptions" chapter for a description of allowed values for this field) the following steps are executed:

3 – the server sends a Delivery Notification to inform the client that the Request has been delivered to the final destination

4 – the client confirms the Delivery Notification has been received sending back a Technical-Ack

Appendix1.2 DEP - MQMD message format

Communication counterparties shall connect to the WebSphere WMQ (**WMQ**) architecture of the T2S platform in order to manage services available in A2A mode. For all counterparties, the T2S platform provides at least one **WMQ queue** for each of the following data flow types:

- real-time messages
- real-time files
- store-and-forward messages
- store-and-forward files

The T2S middleware and the counterparties manage the data exchange based on WMQ messages, that consist of a **Message Description** part (**MQMD**) and a **Message Text** part. WMQ RFH2 headers may exist in the WMQ messages but will be ignored by the T2S platform. The usage of other headers is not allowed.

As previously mentioned, the message structure of DEP uses standard WMQ messages; so, DEP uses IBM WebSphere WMQ as transport layer for its message primitives. The message text is in XML format.

Figure 11: WMQ data structure

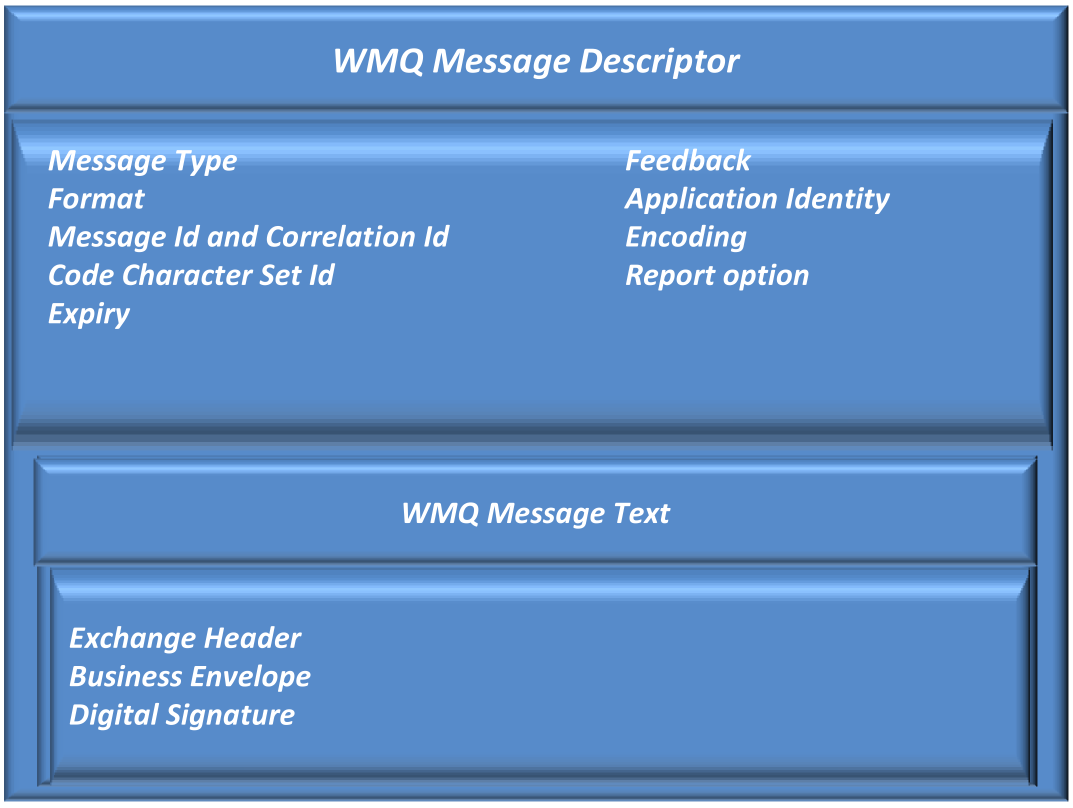


Figure 11 shows the WMQ format message structure:

- **WMQ message descriptor**: it contains all the data required to manage the message from an infrastructure point of view.

- **WMQ message text**: it is the information content of the message, formed according to the DEP structure (detailed in the following sections), i.e.:
  - **Exchange Header** (header of the DEP data structure);
  - **Business Envelope** (its composition in Business File Header and/or Business Application Header and business document is out-of-scope of this document);
  - The **digital signature of the technical sender** (T2S Platform or DEP counterparties) of the message. The signature of the Technical Sender is located in the DEP, while the signature of the Business Sender is located in the Business Application Header (or in the Business File Header in case of "multi-message"). This Technical Sender signature is present only if the "Non Repudiation" flag is set in the exchange header of the DEP data exchange.

Table 10 describes the list of WMQ message standard MQMD header fields, which sender and receiver have to manage when a message or a file is exchanged, and the contents of the "WMQ Message Text" part, in order to support the DEP message primitives.

Table 10: WMQ Data Structure

DATA SECTION	DESCRIPTION
WMQ Message Description	No particular header (e.g. RFH2) are foreseen. • **MQMD.MsgType**: request/reply/report/datagram values are allowed; • **MQMD.Format**: e.g. WMQFMT_NONE; • **MQMD.MsgId** and **CorrelationId**; • **MQMD.Encoding**; • **MQMD**.**ApplIdentity**; • **MQMD**.**Feedback;** • **MQMD.CodeCharacterSetId**; • **MQMD.Report** option: set to the value WMQRO_PAN+WMQRO_NAN; • **MQMD.Expiry**: this field will be used only for real-time traffic setting the value equal to the real-time time-out timeframe (e.g. 60 seconds). In this way it is possible to avoid unnecessary management of messages already expired.
WMQ Message Text	• **Exchange Header** section: contains all "service information" needed for the transport layer, exchanged between the DiCoA-DL or VA-NSP and the T2S Platform to manage messages and files flows; • **Business Envelope** for business layer: contains the Business Application Header or the File Application Header with document (or document set) section. • **Digital Signature** contains the signature at DEP level (signature at business level is, if present, inside the Business Envelope)

Appendix1.2.1 General Rules

The general rules summarized in table 2 should be applied to WMQ messages for the DEP. All other fields that are not specifically mentioned here should preserve their default values as defined in the WMQ API or as set as the defaults for the applied WMQ platform.

FIELD IN MQMD	GENERAL RULES	EXCEPTIONS AND FURTHER EXPLAINATIONS
StrucId	MQMD_STRUC_ID	
Version	MQMD_VERSION_1	MQMD_VERSION_2:· Version 2 of MQMD may be used. However, features that need MQMD version 2 are not supported (i.e. grouping or segmentation).
Report	MQRO_NONE	MQRO_PAN or MQRO_NAN for Technical ACK
MsgType	MQMT_DATAGRAM	The message type of all request and response messages will be MQMT_DATAGRAM. - For REPORT messages it will be MQMT_REPORT
Expiry	MQEI_UNLIMITED	The Expiry of real-time messages should be set to the equivalent of 60 seconds (i.e. the numerical value of 600).
Feedback		Set to the value 0 (zero) in the case a of PAN or a positive numeric value in the case of a NAN.
Encoding		
CodedCharSetId		
Format	MQFMT_NONE.	
Priority	Default value	WMQ T2S queues are defined with default delivery mode in T2S is FIFO and the default priority set to 5. Message priority is not honored unless specific agreement with connected counterparties. Priority can be set but to be honored by T2S in case of missing pre-agreement.
Persistence	Default value	WMQ queues in T2S are defined with default persistence set to YES. The messages hinherit the queue definition. Needs of deactivation of persistence need to be agreed with T2S.
MsgId		
CorrelId		
BackoutCount	0	
ReplyToQ	Blanks	The fields ReplyToQ should never be set and never be evaluated for answers. All messages will be directed to the message queues that match the nature of that message (i.e. qualified by real-time or Store-and-Forward, file or message; data or Ack).
ReplyToQMgr	Blanks	ReplyToQmgr should never be set and never be evaluated for answers. All messages will be directed to the Queue Manager configured in the communication path.
UserIdentifier		
AccountingToken		
ApplIdentityData	set to the system identification of the sending application (the counterparty's gateway hostname or the T2S platform hostname).	
PutApplType		
PutApplName		
PutDate	Date when message is sent	

PutTime	Time when message is sent	
ApplOriginData	Blanks	
GroupId		
MsgSeqNumber		
Offset		
MsgFlags		
OriginalLength		

Please note that these regulations might be changed or extended in future versions of DEP.

Appendix1.2.2 Technical Ack Messages

The DEP requires a **technical acknowledgment** message to be sent for each data exchange between the T2S platform and its communication counterparties. The technical ack is sent by the receiver of a DEP message to the sender of the original DEP message. This technical ack is necessary to confirm the completion of the data exchange.

This technical ack is a WebSphere WMQ report message with type PAN (Positive Application Notification) or NAN (Negative Application Notification). The receiving counterpart sends back this acknowledgment when it undertakes the received message (e.g. when it stores the message or it starts processing it).

The structure of the technical ack is as follows:

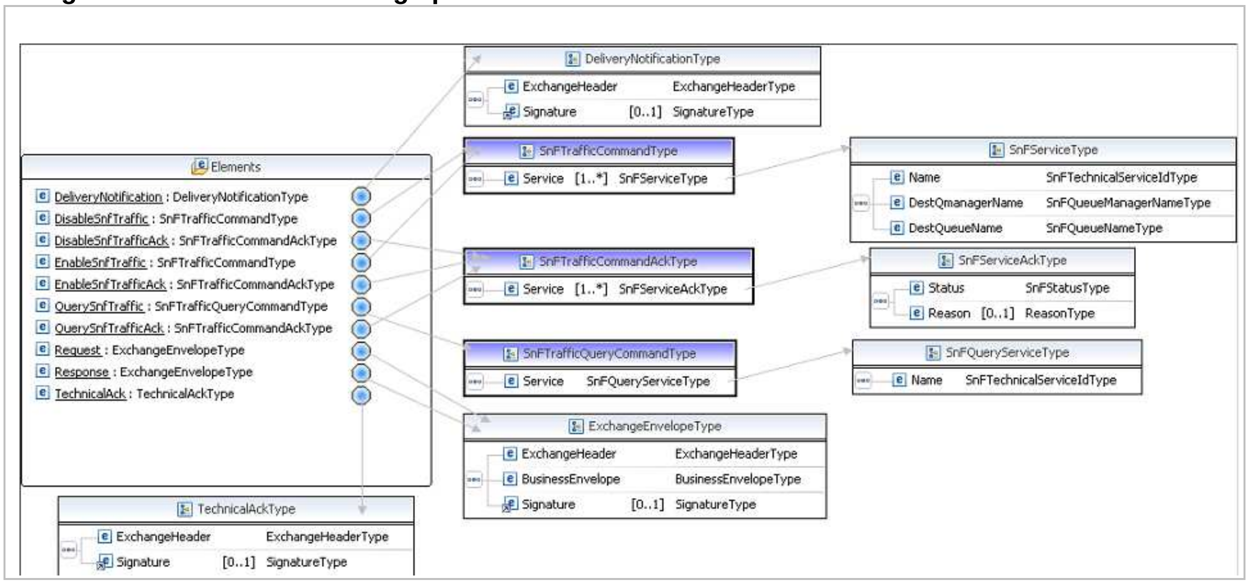
1. Technical Acks will get message type MQMT_REPORT.
2. The Feedback field of the MQMD will be set to the value 0 (zero) in case of PAN or to a positive numeric value in case of NAN.
3. The Application Identity Data field of the MQMD (ApplIdentityData) will be set to the system identification of the sending application (the counterparty’s gateway hostname or the T2S platform hostname).
4. The Correlation Id field of the MQMD section will be set to the "Message Id" (MQMD field MsgId) of the original message.
5. The Message Text part of the WMQ message returns the "Exchange Header" of the original message, updated as foreseen in the following message patterns description in case of a PAN. In case of a NAN the field "dep:ErrorDescription" returns an error message.

Refer to Appendix1.4.2-Technical ack/nak management section for additional information.

Appendix1.3 DEP message format

A valid DEP message is a well-formed XML document, as defined in the W3C specification, meeting some additional constraints expressed by an XML Schema Definition (XSD, ref. Appendix 1). Every message presents an XML declaration, which specifies the version of XML being used (e.g. *version="1.0"*), the character encoding (*encoding="UTF-8"*) and an XML element which defines the message primitive.

Diagram 12: Main DEP message primitives



DeliveryNotificationType
ExchangeHeader ExchangeHeaderType
Signature [0..1] SignatureType
SnFTrafficCommandType
Service [1..*] SnFServiceType
SnFServiceType
Name SnFTechnicalServiceIdType
DestQmanagerName SnFQueueManagerNameType
DestQueueName SnFQueueNameType
Elements
DeliveryNotification : DeliveryNotificationType
DisableSnfTraffic : SnFTrafficCommandType
DisableSnfTrafficAck : SnFTrafficCommandAckType
EnableSnfTraffic : SnFTrafficCommandType
EnableSnfTrafficAck : SnFTrafficCommandAckType
QuerySnfTraffic : SnFTrafficQueryCommandType
QuerySnfTrafficAck : SnFTrafficCommandAckType
Request : ExchangeEnvelopeType
Response : ExchangeEnvelopeType
TechnicalAck : TechnicalAckType
SnFTrafficCommandAckType
Service [1..*] SnFServiceAckType
SnFServiceAckType
Status SnFStatusType
Reason [0..1] ReasonType
SnFTrafficQueryCommandType
Service SnFQueryServiceType
SnFQueryServiceType
Name SnFTechnicalServiceIdType
ExchangeEnvelopeType
ExchangeHeader ExchangeHeaderType
BusinessEnvelope BusinessEnvelopeType
Signature [0..1] SignatureType
TechnicalAckType
ExchangeHeader ExchangeHeaderType
Signature [0..1] SignatureType

As shown in Diagram 12, the DEP specifies four message primitives, each with a proper XML element type definition:

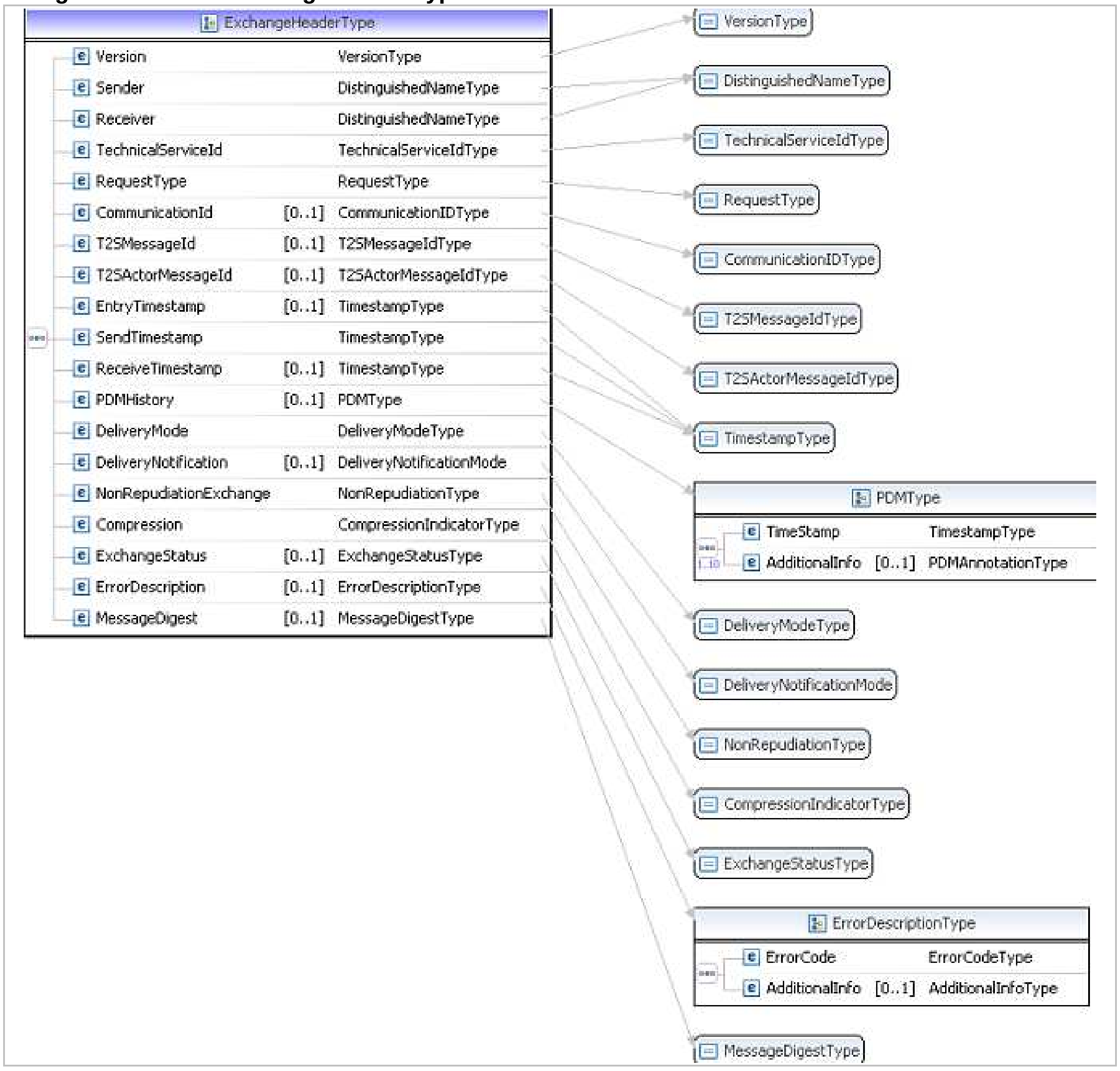
- A **Request** message: the sender uses this message type to send a message/file to a receiver. This kind of primitive is used both in real-time mode and in store-and-forward mode.
- A **Response** message: the sender uses this message type to answer a previously received request. This kind of primitive is used only in real-time mode.
- A **TechnicalAck** message: this acknowledgement is provided for each data exchange between the communication counterparties for the confirmation of the completion of the data exchange. This kind of primitive shall be used both in real-time mode and in store-and-forward mode. For technical sender non-repudiation functionality, the receiver must sign the Technical Ack and include the hash of the received message and the relevant timestamp in the ExchangeHeader.
- A **DeliveryNotification** message: in the store-and-forward mode this message is used to inform the DEP sender that a Request message has been delivered to the final destination. In case of indirect connection scenario, after 10 unsuccessful attempts, the server sends back to

the original sender a "Delivery Notification Failure" and suspends the sending of the store-and-forward messages/files to the T2S platform.

- An **EnableSnfTraffic** message: in case of store-and-forward mode in the indirect scenario this primitive is used by T2S to inform the NSP that it is ready to receive the store-and-forward traffic.
- An **EnableSnfTrafficAck** message: in case of store-and-forward mode in the indirect scenario this primitive is used by the NSP to reply to the T2S Platform about an EnableSnfTraffic request result.
- A **DisableSnfTraffic** message: in case of store-and-forward mode in the indirect scenario this primitive is used by T2S to inform the NSP that it is not ready to receive the store-and-forward traffic.
- A **DisableSnfTrafficAck** message: in case of store-and-forward mode in the indirect scenario this primitive is used by the NSP to reply to the T2S Platform about DisableSnfTraffic request result.
- A **QuerySnfTraffic** message: in case of store-and-forward mode in the indirect scenario this primitive is used by T2S to check the status of the store-and-forward traffic.
- A **QuerySnfTrafficAck** message: in case of store-and-forward mode in the indirect scenario this primitive is used by the NSP to reply to the T2S Platform about the status of the store-and-forward traffic.

The Exchange Header section (see Diagram 13) contains all the service information needed by the transport layer, exchanged between the DEP communication counterpart and the T2S platform to manage messages and files flow.

Diagram 13: DEP ExchangeHeader type


ExchangeHeaderType
Version VersionType
Sender DistinguishedNameType
Receiver DistinguishedNameType
TechnicalServiceId TechnicalServiceIdType
RequestType RequestType
CommunicationId [0..1] CommunicationIDType
T2SMessageId [0..1] T2SMessageIdType
T2SActorMessageId [0..1] T2SActorMessageIdType
EntryTimestamp [0..1] TimestampType
SendTimestamp TimestampType
ReceiveTimestamp [0..1] TimestampType
PDMHistory [0..1] PDMType
DeliveryMode DeliveryModeType
DeliveryNotification [0..1] DeliveryNotificationMode
NonRepudiationExchange NonRepudiationType
Compression CompressionIndicatorType
ExchangeStatus [0..1] ExchangeStatusType
ErrorDescription [0..1] ErrorDescriptionType
MessageDigest [0..1] MessageDigestType
VersionType
DistinguishedNameType
TechnicalServiceIdType
RequestType
CommunicationIDType
T2SMessageIdType
T2SActorMessageIdType
TimestampType
PDMType
TimeStamp TimestampType
AdditionalInfo [0..1] PDMAnnotationType
1..10
DeliveryModeType
DeliveryNotificationMode
NonRepudiationType
CompressionIndicatorType
ExchangeStatusType
ErrorDescriptionType
ErrorCode ErrorCodeType
AdditionalInfo [0..1] AdditionalInfoType
MessageDigestType

The BusinessEnvelope section contains business information. This part is not checked or modified by the NSP or by the T2S middleware and it is delivered unchanged to the receiver.

Appendix1.4 DEP exchange header fields description

As shown in Diagram 13, the ExchangeHeader section contains all the service information needed for the transport layer, exchanged between DEP communication counterparties to manage messages and files flows, in real-time or store-and-forward mode.

As specified in the XSD (XML Schema Definition) of the DEP Exchange Header, provided in "Exchange Header XSD and message examples", this section contains many mandatory or optional fields.

The DEP uses a technical header (ExchangeHeader) to convey technical information to the counterpart. This technical information is used for many purposes, i.e.:

- Addressing (dep:Sender and dep:Receiver);
- Selecting Message/File channel to use (dep:TechnicalServiceId);
- Message/File identifier (dep:T2SActorMessageId, dep:T2SMessageId);
- Timestamps (dep:SendTimestamp, dep:ReceiveTimestamp, dep:EntryTimestamp);
- Function's flags (dep:DeliveryNotification, dep:NonRepudiationExchange and dep:Compression);
- Message/File security (dep:MessageDigest);
- Message/File flow control (dep:ExchangeStatus, dep:ErrorDescription).

Table 11 includes an exhaustive list of the available tags and their descriptions, specifying allowed values and providing an example for the main tags.

Table 11: DEP ExchangeHeader Fields.

TAG NAME	TAG DESCRIPTION / ALLOWED VALUES	EXAMPLE
dep:Version *<mandatory tag>*	Version of Data Exchange Protocol. **Enumeration** with fixed value "**0.2**"	<dep:Version> 0.2 </dep:Version>

dep:Sender
<mandatory tag>
	Identification for T2S Technical Sender that sends the message.
	Restriction is set on base type "**string [100]**".
		<dep:Sender>
		cn=t2sappl1,
		o=t2sprod
		</dep:Sender>

dep:Receiver
<mandatory tag>
	Identification for T2S Technical Receiver that receives the message.
	Restriction is set on base type "**string [100]**".
		<dep:Receiver>
		cn=t2s-cust1,
		o=nsp-name1
		</dep:Receiver>

dep:TechnicalServiceID *<mandatory tag>*	Name of the service used to send messages and files, formed by the DEP counterpart name, the message pattern and the environment of reference. Specifying a message pattern, it's possible to manage a message or a file as a payload of the DEP message. **Message pattern** means the following: • MSGRT: **Real Time Message**; • MSGSNF: **Store & Forward Message**; • FILERT: **Real Time File**; • FILESNF: **Store & Forward File**. **Restriction** is set on base type "**string [60]**", with expression in the format: VA-NSP/DiCoA-DL Name+ "." + <msg-pattern> + "." + <environment> where <msg-pattern> is one of: MSGRT MSGSNF FILERT FILESNF and <environment> is one of: INTEG,IAC,EAC,UTEST,MIG1,MIG2,PROD	<dep:TechnicalServiceId> nsp-name1.MSGRT.PROD </dep:TechnicalServiceId>

dep:RequestType *<mandatory tag>*	Type of request, to classify message content. In case of different request types in the same BusinessEnvelope, the "T2SRequest" value shall be used as RequestType **Restriction** is set on base type "**string [100]**".	<dep:RequestType> T2SRequest </dep: RequestType >
dep:CommunicationID *<minOccurs="0">*	Unique message identifier assigned by the T2S counterpart (at DEP transport level)l **Restriction** is set on base type "**string [100]**".	<dep:CommunicationId> nsp-name1.gtw134567. 20100908185555.123456 </dep:CommunicationId>
dep:T2SMessageId *<minOccurs="0">*	Unique message identifier generated by T2S Platform **Restriction** is set on base type "**string [100]**".	<dep:T2SMessageId> T2S.MSGRT.NSPname1.2011 0101000000.000001 </dep:T2SMessageId>
dep:T2SActorMessageId *<minOccurs="0">*	Unique message identifier generated at T2S actor site **Restriction** is set on base type "**string [100]**".	<dep:T2SActorMessageId> T2SActorGateway1.20100908 175531.123456 </dep:T2SActorMessageId>
dep:EntryTimestamp *<minOccurs="0">*	Timestamp of the NSP's gateway reception, based on UTC time **Restriction** is set on base type "**dateTime**".	<dep:EntryTimestamp> 2011-01-01T00:00:00 </dep:EntryTimestamp>
dep:SendTimestamp *<mandatory tag>*	Timestamp of the sending of message, based on UTC time **Restriction** is set on base type "**dateTime**".	<dep:SendTimestamp> 2011-01-01T00:00:00 </dep:SendTimestamp>
dep:ReceiveTimestamp *<minOccurs="0">*	Timestamp of the receiving of message, based on UTC time **Restriction** is set on base type "**dateTime**".	<dep:ReceiveTimestamp> 2011-01-01T00:00:01 </dep:ReceiveTimestamp>
dep:PDMHistory *<minOccurs="0">*	Only for store-and-forward, Timestamp's list of the attempts of the delivery of the message, based on UTC time. This list contains a sequence of SendTimestamp entries. It also contains for each timestamp an optional AdditionalInfo. This is a **complex type** tag based on a sequence of maximum occurrences, each one containing two elements: • **TimeStamp**, a mandatory tag with base type **dateTime;** • **AdditionalInfo**, an optional tag with **restriction** set on base type "**string [100]**".	<dep:PDMHistory> <dep:TimeStamp> 2011-01-01T00:00:00 </dep:TimeStamp> <dep:TimeStamp> 2011-02-14T00:10:01 </dep:TimeStamp> <dep:AdditionalInfo> Annotation on 2th timestamp entry </dep:AdditionalInfo> </dep:PDMHistory>
dep:DeliveryMode *<mandatory tag>*	Identification of real time or store-and-forward exchange. **Enumeration** with possible values: • "**RT**" for Real-Time; • "**SF**" for Store-and-forward.	<dep:DeliveryMode> RT </dep:DeliveryMode>

dep:DeliveryNotification *<minOccurs="0">*	Delivery notification management; this field has to be set only in the case of **store-and-forward mode** for indirect connection. The following values are foreseen: • "**YES**": the delivery notification is requested always • "**FAIL**": the delivery notification is requested only in case of failure • "**NO**": the delivery notification is not requested (default value) **Restriction** is set on base type "**string**".	<dep:DeliveryNotification> FAIL </dep:DeliveryNotification>
dep: **NonRepudiationExchange** *<mandatory tag>*	Flag that indicates if the non-repudiation is requested or not **Enumeration** with possible values: **YES** or **NO**.	<dep:NonRepudiationExchange> NO </dep:NonRepudiationExchange>
dep:Compression *<mandatory tag>*	Flag that indicates the algorithm used to compress the payload or "NO" (if compression is not used) **Enumeration** with possible values "**NONE**" or "**ZIP**".	<dep:Compression> ZIP </dep:Compression>
dep:ExchangeStatus *<mandatory tag>*	Status of the exchange: "OK" in the case of a successful exchange "KO" in case of failure This element must be present in DEP technical ack messages and in Response messages of R-T (message and file) exchange. **Enumeration** with possible values: • "**OK**" in the case of successful exchange • "**KO**" in case of failure	<dep:ExchangeStatus> OK </dep:ExchangeStatus>
dep:ErrorDescription *<minOccurs="0">*	Description of the error occurred during the exchanging process (tag has to be set only if tag dep:ExchangeStatus has value "KO") This is a **complex type** tag based on two elements: • **ErrorCode**, a mandatory tag with base type **string** and a validation pattern "**T2S[0-9]{3}E**". • **AdditionalInfo**, an optional tag with **restriction** set on base type "**string [200]**".	<dep:ErrorDescription> <dep:ErrorCode> T2S040E </dep:ErrorCode> <dep:AdditionalInfo> Message expired. Receiver has not been connected for 14 days. </dep:AdditionalInfo> </dep:ErrorDescription>
dep:MessageDigest *<minOccurs="0">*	Used only in Technical Ack primitive when the NonRepudiationExchange flag has been set. The digest has to be calculated based on the received DEP Exchange Header and Business Envelope. **Restriction** is set on base type "**string [1024]**".	

In the DEP data can be exchanged as a message or a file. From a DEP point of view the distinction between a file or a message is based only on the size of the transported Business Envelope. There is no relationship between the message/file term used at DEP level and the message/file term used at business level.

The channel through which data is exchanged, both for messages and files, defines the maximum size of the Business Envelope part of the DEP message (size is calculated without considering the BusinessEnvelope tags). Size limits for each channel are summarized in Table 12.

Table 12: Size limits for the various channels.

	MINIMUM LENGTH	MAXIMUM LENGTH
Message channel	n.a.	32 KB
File channel	n.a.	32 MB

Appendix1.4.1 Non repudiation management

The non-repudiation feature of DEP is used to provide both sender and receiver of DEP messages with a guarantee that both the emission and the reception of such messages cannot be repudiated. Non-repudiation in DEP is based on the exchange of electronic signatures which include essential parts of the DEP message. Non-repudiation in DEP relies on the so-called technical or transport signature. DEP messages may also carry business signatures that only refer to the Business Envelope content of messages. Business signatures have no function with respect to DEP non-repudiation.

Signature management is based on the XML Advanced Electronic Signature (XAdES) standard. In particular, the DEP adopts the XAdES-BES (Basic Electronic Signature) format for signature of DEP message/file exchange.

The counterparties using DEP shall manage the non-repudiation flag on exchanging of incoming and outgoing messages/files. In the following is described the process that the T2S Platform and counterparties shall manage in case of non-repudiation (dep:NonRepudiationExchange=YES). The sender of a message will decide whether to enable non-repudiation or not on the basis of the business requirements for that message. This decision is out of scope of DEP.

If the non-repudiation is requested for a message/file:

- The sending part (e.g. T2S) shall sign the message and insert the electronic signature into the Signature element of the DEP request or response message.
- The receiving part (e.g. a counterparty) shall verify the validity of the signature and send back an error message (NAN Technical ack) if the check fails (i.e. Code T2S999E in case of other errors, appropriate error information is provided in th NAN), otherwise, the receiving part shall create a PAN technical ack.
- Sign the message and insert the electronic signature into the Signature element.
- The sending part shall check the validity of the signature added to the Technical Ack and store the message.

It is the responsibility of all counterparties to keep enough data of the messages (including its signatures) and information used during signature validation to provide evidence of the correct issuing and validation of signatures when required. The extent of such evidence and the time frame to keep it, is beyond the scope of DEP.

The technical signature shall be an XAdES-BES signature. It shall follow the manifest signature form the W3C XML Signature Syntax and Processing recommendation (http://www.w3.org/TR/xmldsig-core/, section 2.3).

The signature shall contain:

1. A single Reference in the SignedInfo that points to the Manifest.
2. A Manifest structure in its Object container. The Manifest itself will contain References as follows:
   - For Technical ack:
     1. A Reference with empty URI covering the technical Ack itself containing its DigestValue.
     2. One Reference covering the BusinessEnvelope of the message or file for which the technical ack was generated containing its DigestValue.
   - For Request/Response:
     1. A Reference with empty URI covering the Request/Response itself containing its DigestValue.

The creation of a signature requires that the signer first obtain the digests of all messages contents that should be included in the signature. As the final step, the signature structure shall be created and signed.

On the receiving side, the process of validation depends on the responsible counterparty. Like signing, validation will also be performed in two steps:

1. All receiving parties shall validate the signature as a fundamental step.
2. The validity of all contained digests shall be checked.

Parties that directly communicate using DEP are in possession of the complete DEP messages. It is their responsibility to check all digests contained in the signature.

Downstream recipients of the contained Business Envelope are not able to check all DEP message contents. However, it is their responsibility to check the validity of the digests of the affected Business Envelope.

The following sample shows the contents of a Technical ack signature:

```
<ds:Signature xmlns:ds="http://www.w3.org/2000/09/xmldsig#" Id="Signature-GS3PV">
 <ds:SignedInfo>
 <ds:CanonicalizationMethod Algorithm="http://www.w3.org/TR/2001/REC-xml-c14n-20010315" />
 <ds:SignatureMethod Algorithm="http://www.w3.org/2001/04/xmldsig-more#rsa-sha256" />
 <ds:Reference URI="#Manifest">
 <ds:Transforms>
  <ds:Transform Algorithm="http://www.w3.org/TR/2001/REC-xml-c14n-20010315" />
 </ds:Transforms>
 <ds:DigestMethod Algorithm="http://www.w3.org/2001/04/xmlenc#sha256"/>
 <ds:DigestValue>...</ds:DigestValue>
 </ds:Reference>
 </ds:SignedInfo>
 <ds:SignatureValue>...</ds:SignatureValue>
 <ds:KeyInfo>
 <ds:X509Data>
 <ds:X509Certificate>...</ds:X509Certificate>
 </ds:X509Data>
 </ds:KeyInfo>
 <Object xmlns="http://www.w3.org/2000/09/xmldsig#">
 <QualifyingProperties xmlns="http://uri.etsi.org/01903/v1.4.1#" Target="#Signature-GS3PV">
 <UnsignedProperties>
  <UnsignedSignatureProperties>
  <SignatureTimeStamp Id="SignatureTimeStamp">
   <CanonicalizationMethod xmlns="http://www.w3.org/2000/09/xmldsig#"
Algorithm="http://www.w3.org/TR/2001/REC-xml-c14n-20010315" />
   <EncapsulatedTimeStamp
Encoding="http://uri.etsi.org/01903/v1.2.2#DER">...
   </EncapsulatedTimeStamp>
  </SignatureTimeStamp>
  </UnsignedSignatureProperties>
 </UnsignedProperties>
 </QualifyingProperties>
 <Manifest Id="Manifest">
 <Reference URI="">
  <Transforms>
  <Transform
   Algorithm=http://www.w3.org/2000/09/xmldsig#enveloped-signature/>
  <Transform
   Algorithm="http://www.w3.org/TR/2001/12/REC-xml-c14n-20010315"/>
  </Transforms>
  <DigestMethod
  Algorithm="http://www.w3.org/2001/04/xmlenc#sha256"/>
  <DigestValue>...</DigestValue>
 </Reference>
 <Reference URI="BusinessEnvelope">
  <DigestMethod
  Algorithm="http://www.w3.org/2001/04/xmlenc#sha256"/>
 <DigestValue>...</DigestValue>
 </Reference>
 </Manifest>
 </Object>

</ds:Signature>
```

Appendix1.4.2 Technical ack/nak management

The receiver provides a Technical Ack for each data exchange with the sender, for confirmation of the data exchange completion.

The receiver manages the technical acknowledgement process as follows. The Technical Ack is a WebSphere WMQ report message with type PAN (Positive Application Notification) or NAN (Negative Application Notification). The receiving WebSphere WMQ application (e.g. the T2S middleware component) sends this report back when undertaking a message (i.e. when the message is stored or processed setting the dep:ReceiveTimestamp). Section Appendix1.3-DEP message format describes the structure of the Technical Ack.

The Technical Ack, for store-and-forward communication, shall be returned to the DEP sender within a time-frame of 10 minutes[13].

For real-time communication, no specific actions are required for timing issues, owing to the time-out management mechanism. For store-and-forward incoming messages, in case that the time-out for the Technical Ack is exceeded, the DEP sender re-sends the message including in the ExchangeHeader

[13] This value can be configured.

section the "dep:PDMHistory" element specifying the delivery time of the previous attempt(s) in the following format:

```
    <dep:PDMHistory>
<dep:TimeStamp>2011-01-01T00:00:00</dep:TimeStamp>
     <dep:TimeStamp>2011-02-14T00:10:01</dep:TimeStamp>
     <dep:AdditionalInfo>Annotation    on    2th    timestamp    entry</dep:AdditionalInfo>
    </dep:PDMHistory>
```

After 10 unsuccessful attempts, in case of indirect scenario, the NSP sends a Delivery Notification Failure back to the original sender and it suspends the sending of the store-and-forward messages/files to the T2S platform. An alarm is triggered in order to allow the NSP staff to inform the T2S Operator that a problem has occurred in the store-and-forward channel.

The T2S DEP counterparties and the T2S platform manage the negative message acknowledgement in all cases of error. The originator of the message receives a NAN. The "dep:ExchangeStatus" field is set to the value "KO" and the "dep:ErrorDescription" field is set according to the following table.

Table 13: T2S Error Coding

CODE	**ERROR OCCURRED**	**ERROR DESCRIPTION FIELD VALUE**
T2S010E	The message or file size is not in the allowed range	"Message or file size is not in the allowed size range"
T2S020E	One (or more) fields are not well formed	"Field xxxx not well formed"
T2S030E	One (or more) mandatory fields of Exchange Header are not present	"Field xxxx missing"
T2S040E	Timeout condition	"Timeout occurred"
T2S999E	All other errors	"ERROR occurred – Message/File exchange aborted"

Appendix2 - Exchange Header XSD and message examples

Appendix2.1 Exchange header XSD

```
<?xml version="1.0" encoding="UTF-8"?>
<schema targetNamespace="http://www.ecb.eu/t2s-0.2"
               xmlns="http://www.w3.org/2001/XMLSchema"
               xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
               xmlns:t2s="http://www.ecb.eu/t2s-0.2"
               elementFormDefault="qualified"
>

<import
               namespace="http://www.w3.org/2000/09/xmldsig#"
               schemaLocation="http://www.w3.org/TR/2002/REC-xmldsig-core-20020212/xmldsig-
core-schema.xsd"
/>


       <!-- SIMPLE TYPE DEFINITION -->
       <simpleType name="VersionType">
               <restriction base="string">
                       <enumeration value="0.2"/>
               </restriction>
       </simpleType>
       <simpleType name="DistinguishedNameType">
               <restriction base="string">
                       <minLength value="1"/>
                       <maxLength value="100"/>
               </restriction>
       </simpleType>
       <simpleType name="TechnicalServiceIdType">
               <restriction base="string">
                       <maxLength value="60"/>
                       <pattern
value=".+(MSGRT|MSGSNF|FILERT|FILESNF)\.(INTEG|IAC|EAC|UTEST|MIG1|MIG2|PROD)"/>
               </restriction>
       </simpleType>
       <simpleType name="SnFTechnicalServiceIdType">
               <restriction base="string">
                       <maxLength value="60"/>
                       <pattern
value=".+(MSGSNF|FILESNF)\.(INTEG|IAC|EAC|UTEST|MIG1|MIG2|PROD)"/>
               </restriction>
       </simpleType>
       <simpleType name="CommunicationIDType">
               <restriction base="string">
                       <minLength value="1"/>
                       <maxLength value="100"/>
               </restriction>
       </simpleType>
       <simpleType name="T2SMessageIdType">
               <restriction base="string">
                       <minLength value="1"/>
                       <maxLength value="100"/>
               </restriction>
       </simpleType>
       <simpleType name="DeliveryModeType">
               <restriction base="string">
                       <enumeration value="RT"/>
                       <enumeration value="SF"/>
               </restriction>
       </simpleType>
       <simpleType name="CompressionIndicatorType">
               <restriction base="string">
```

```
                <enumeration value="NONE"/>
                <enumeration value="ZIP"/>
        </restriction>
</simpleType>
<simpleType name="TimestampType">
        <restriction base="dateTime"/>
</simpleType>
<simpleType name="SnFQueueManagerNameType">
        <restriction base="string">
                <minLength value="1"/>
                <maxLength value="48"/>
        </restriction>
</simpleType>
<simpleType name="SnFQueueNameType">
        <restriction base="string">
                <minLength value="1"/>
                <maxLength value="48"/>
        </restriction>
</simpleType>
<simpleType name="SnFStatusType">
        <restriction base="string">
                <enumeration value="FAILED"/>
                <enumeration value="ACTIVATED"/>
                <enumeration value="DEACTIVATED"/>
        </restriction>
</simpleType>
<simpleType name="NonRepudiationType">
        <restriction base="string">
                <enumeration value="YES"/>
                <enumeration value="NO"/>
        </restriction>
</simpleType>
<simpleType name="ReasonType">
        <restriction base="string">
                <minLength value="1"/>
                <maxLength value="100"/>
        </restriction>
</simpleType>
<simpleType name="ErrorCodeType">
        <restriction base="string">
                <pattern value="T2S[0-9]{3}E"/>
        </restriction>
</simpleType>
<simpleType name="AdditionalInfoType">
        <restriction base="string">
                <minLength value="1"/>
                <maxLength value="200"/>
        </restriction>
</simpleType>
<simpleType name="T2SActorMessageIdType">
        <restriction base="string">
                <minLength value="1"/>
                <maxLength value="100"/>
        </restriction>
</simpleType>
<simpleType name="MessageDigestType">
        <restriction base="string">
                <minLength value="1"/>
                <maxLength value="1024"/>
        </restriction>
</simpleType>
<simpleType name="ExchangeStatusType">
        <restriction base="string">
                <enumeration value="OK"/>
                <enumeration value="KO"/>
        </restriction>
</simpleType>
<simpleType name="PDMAnnotationType">
        <restriction base="string">
                <minLength value="1"/>
                <maxLength value="100"/>
                </restriction>
        </simpleType>
        <simpleType name="DeliveryNotificationMode">
                <restriction base="string">
                        <enumeration value="YES"/>
                        <enumeration value="NO"/>
                        <enumeration value="FAIL"/>
                </restriction>
        </simpleType>
        <simpleType name="RequestType">
                <restriction base="string">
                        <minLength value="1"/>
                        <maxLength value="30"/>
                </restriction>
        </simpleType>



        <!-- COMPLEX TYPE DEFINITION -->
        <complexType name="SnFServiceType">
                <sequence>
                        <element name="Name" type="t2s:SnFTechnicalServiceIdType"/>
                        <element name="DestQmanagerName" type="t2s:SnFQueueManagerNameType"/>
                        <element name="DestQueueName" type="t2s:SnFQueueNameType"/>
                </sequence>
        </complexType>
        <complexType name="SnFQueryServiceType">
                <sequence>
                        <element name="Name" type="t2s:SnFTechnicalServiceIdType"/>
                </sequence>
        </complexType>
        <complexType name="SnFServiceAckType">
                <complexContent>
                        <extension base="t2s:SnFServiceType">
                                <sequence>
                                        <element name="Status" type="t2s:SnFStatusType"/>
                                        <element name="Reason" type="t2s:ReasonType"
minOccurs="0"/>
                                </sequence>
                        </extension>
                </complexContent>
        </complexType>
        <complexType name="SnFTrafficCommandType">
                <sequence>
                        <element name="Service" type="t2s:SnFServiceType"
maxOccurs="unbounded"/>
                </sequence>
        </complexType>
        <complexType name="SnFTrafficQueryCommandType">
                <sequence>
                        <element name="Service" type="t2s:SnFQueryServiceType"/>
                </sequence>
        </complexType>
        <complexType name="SnFTrafficCommandAckType">
                <sequence>
                        <element name="Service" type="t2s:SnFServiceAckType"
maxOccurs="unbounded"/>
                </sequence>
        </complexType>
        <complexType name="ErrorDescriptionType">
                <sequence>
                        <element name="ErrorCode" type="t2s:ErrorCodeType"/>
                        <element name="AdditionalInfo" type="t2s:AdditionalInfoType"
minOccurs="0"/>
                </sequence>
        </complexType>
        <complexType name="PDMType">
                <sequence minOccurs="1" maxOccurs="10">
                        <element name="TimeStamp" type="t2s:TimestampType"/>
                        <element name="AdditionalInfo" type="t2s:PDMAnnotationType"
minOccurs="0"/>
```

```
              </sequence>
       </complexType>
       <complexType name="ExchangeHeaderType">
              <sequence>
                     <element name="Version" type="t2s:VersionType">
                            <annotation>
                                   <documentation>Version of Data Exchange
Protocol</documentation>
                            </annotation>
                     </element>
                     <element name="Sender" type="t2s:DistinguishedNameType">
                            <annotation>
                                   <documentation>
                                          Identification for T2S Technical Sender that sends
the message
                                   </documentation>
                            </annotation>
                     </element>
                     <element name="Receiver" type="t2s:DistinguishedNameType">
                            <annotation>
                                   <documentation>
                                   Identification for T2S Technical Receiver that receives
the message
                                   </documentation>
                            </annotation>
                     </element>
                     <element name="TechnicalServiceId" type="t2s:TechnicalServiceIdType">
                            <annotation>
                                   <documentation>
                                          Name of the service used to send messages and
files
                                          VA-NSP/DiCoA-DL Name+ "." + &lt;msg-pattern&gt; +
"." + &lt;environment&gt;
                                          where &lt;msg-pattern&gt; is one of: MSGRT MSGSNF
FILERT FILESNF and &lt;environment&gt; is one of: INTEG,IAC,EAC,UTEST,MIG1,MIG2,PROD.
                                   </documentation>
                            </annotation>
                     </element>

                     <element name="RequestType" type="t2s:RequestType">
                            <annotation>
                                   <documentation>
                                          Type of the request, to classify message content.
                                          In case of different request types in the same
BusinessEnvelope, the "T2SRequest" value shall be used as RequestType
                                   </documentation>
                            </annotation>
                     </element>

                     <element name="CommunicationId" type="t2s:CommunicationIDType"
minOccurs="0">
                            <annotation>
                                   <documentation>
                                          Unique message identifier assigned by the T2S
counterpart (at DEP transport level)
                                   </documentation>
                            </annotation>
                     </element>
                     <element name="T2SMessageId" type="t2s:T2SMessageIdType" minOccurs="0">
                            <annotation>
                                   <documentation>
                                          Unique message identifier generated by T2S
Platform
                                   </documentation>
                            </annotation>
                     </element>
                     <element name="T2SActorMessageId" type="t2s:T2SActorMessageIdType"
minOccurs="0">
                            <annotation>
                                   <documentation>
```

```
                                                Unique message identifier generated at T2S actor
site
                                        </documentation>
                                </annotation>
                        </element>
                        <element name="EntryTimestamp" type="t2s:TimestampType" minOccurs="0">
                                <annotation>
                                        <documentation>
                                                Timestamp of the NSP's gateway reception, based on
UTC time
                                        </documentation>
                                </annotation>
                        </element>
                        <element name="SendTimestamp" type="t2s:TimestampType">
                                <annotation>
                                        <documentation>
                                                Timestamp of the sending of message, based on UTC
time
                                        </documentation>
                                </annotation>
                        </element>
                        <element name="ReceiveTimestamp" type="t2s:TimestampType" minOccurs="0">
                                <annotation>
                                        <documentation>
                                                Timestamp of the receiving of message, based on
UTC time
                                        </documentation>
                                </annotation>
                        </element>
                        <element name="PDMHistory" type="t2s:PDMType" minOccurs="0">
                                <annotation>
                                        <documentation>
                                        Timestamp's list of the attempting of the delivery of the
message, based on UTC time.
                                        This list contains a sequence of SendTimestamp entries.
                                        </documentation>
                                </annotation>
                        </element>
                        <element name="DeliveryMode" type="t2s:DeliveryModeType">
                                <annotation>
                                        <documentation>
                                        Identification of real time or store-and-forward exchange
                                        </documentation>
                                </annotation>
                        </element>
                        <element name="DeliveryNotification" type="t2s:DeliveryNotificationMode"
minOccurs="0">
                                <annotation>
                                        <documentation>
                                                Delivery notification management.
                                                This field has to be set only in the case of
store-and-forward mode.
                                                The     following values are foreseen:
                                                YES: the delivery notification is requested always
                                                FAIL: the delivery notification is requested only
in case of failure
                                                NO: the delivery notification is not requested
(this is the DEFAULT value)
                                        </documentation>
                                </annotation>
                        </element>
                        <element name="NonRepudiationExchange" type="t2s:NonRepudiationType">
                                <annotation>
                                        <documentation>
                                                Flag that indicates if the non-repudiation is
requested or not
                                        </documentation>
                                </annotation>
                        </element>
                        <element name="Compression" type="t2s:CompressionIndicatorType">
                                <annotation>
```

```
                                    <documentation>
                                    Flag that indicates the algorithm used to compress the
payload or "NONE" (if compression is not used)
                                    </documentation>
                              </annotation>
                        </element>
                        <element name="ExchangeStatus" type="t2s:ExchangeStatusType"
minOccurs="0">
                              <annotation>
                                    <documentation>
                                    Status of the exchange: "OK" in the case of a successful
exchange "KO" in case of failure
                                    This element must be present in DEP technical ack
messages and in Response messages of R-T (message and file) exchange.
                                    </documentation>
                              </annotation>
                        </element>
                        <element name="ErrorDescription" type="t2s:ErrorDescriptionType"
minOccurs="0">
                              <annotation>
                                    <documentation>
                                    Description of the error occurred during the exchanging
                                    </documentation>
                              </annotation>
                        </element>
                        <element name="MessageDigest" type="t2s:MessageDigestType"
minOccurs="0">
                              <annotation>
                                    <documentation>
                                    Digest of the Message/File exchanged (The digest has to
be applied to the DEP Exchange Header and to the Business Envelope)
                                    This element is used only in Technical Ack primitive,
when DEP:NonRepudiationExchange flag has been set.
                                    The digest has to be based on the received DEP Exchange
Header and Business Envelope.
                                    </documentation>
                              </annotation>
                        </element>
                  </sequence>
            </complexType>


            <complexType name="BusinessEnvelopeType">
                  <complexContent>
                        <extension base="anyType"/>
                  </complexContent>
            </complexType>


            <complexType name="ExchangeEnvelopeType">
                  <sequence>
                        <element name="ExchangeHeader" type="t2s:ExchangeHeaderType"/>
                        <element name="BusinessEnvelope" type="t2s:BusinessEnvelopeType"/>
                        <element ref="ds:Signature" minOccurs="0"/>
                  </sequence>
            </complexType>
            <complexType name="TechnicalAckType">
                  <sequence>
                        <element name="ExchangeHeader" type="t2s:ExchangeHeaderType"/>
                        <element ref="ds:Signature" minOccurs="0"/>
                  </sequence>
            </complexType>
            <complexType name="DeliveryNotificationType">
                  <sequence>
                        <element name="ExchangeHeader" type="t2s:ExchangeHeaderType"/>
                        <element ref="ds:Signature" minOccurs="0"/>
                  </sequence>
            </complexType>
```

```
       <!-- ELEMENT TYPE DEFINITION -->
       <element name="Request" type="t2s:ExchangeEnvelopeType"/>
       <element name="Response" type="t2s:ExchangeEnvelopeType"/>
       <element name="TechnicalAck" type="t2s:TechnicalAckType"/>
       <element name="DeliveryNotification" type="t2s:DeliveryNotificationType"/>
       <element name="EnableSnfTraffic" type="t2s:SnFTrafficCommandType"/>
       <element name="DisableSnfTraffic" type="t2s:SnFTrafficCommandType"/>
       <element name="QuerySnfTraffic" type="t2s:SnFTrafficQueryCommandType"/>
       <element name="EnableSnfTrafficAck" type="t2s:SnFTrafficCommandAckType"/>
       <element name="DisableSnfTrafficAck" type="t2s:SnFTrafficCommandAckType"/>
       <element name="QuerySnfTrafficAck" type="t2s:SnFTrafficCommandAckType"/>

</schema>
```

Appendix2.2 Message Examples