***S**ervice*
***O**verview*

SO 200-01

Version 2.2.0

14 Dec 2023

Source: TCCA Critical Communications Broadband Group (CCBG) – Task Force TETRA IWF
Keywords: TETRA, MCX, IWF, SO

TCCA

Service Overview (SO)

TETRA-MCX Interworking (TETRA IWF)

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1 General

1.1 Audience of this Document

This document is intended for:

A) Operators who plan to deploy 3GPP broadband Mission Critical Services (MCX) alongside existing PPDR Land Mobile Radio (LMR) network(s) and require an interconnection between the two systems. The duration of parallel LMR/MCX operation will vary according to different operators' strategies.

B) Vendors with a SwMI integrated native Interworking functionality / open standards interworking functionality planned or under development to facilitate services between the LMR/TETRA network and Mission Critical services.

C) End users/ organizations, to see the challenges and benefits of using the standardized features to interconnect between LMR and 3GPP services, helping to scope and define the integration and transition options towards co-existence between different system architectures.

1.2 Purpose of this Document

This document describes in more detail the relation between the interworking functionality and the TETRA SwMI from the perspective of operators and users. The focus is on the usage during transition and what the expected features needed from this perspective are. It sets aside the needed basic functionality for interworking like voice calls, data messages and designates priorities in a clear overview of 1) must-have, 2) nice to have and 3) not prioritized in this service overview for the standardized IWF features. The added use cases in chapter 5 are reflections from operators and considers how the IWF can be managed during operation. The current version of the SO for distribution in the CCBG IWF working group has been made possible thanks to Steven Wyckaert, Harald Ludwig, Philipp Hasbach and Tero Pesonen. For the resolution update I thank Tim Clark and Kit Kilgour for reading and finetuning the text leading up to version 1.4.

1.3 Abbreviations

For the purposes of this report, the following abbreviations apply:

AI	Air Interface
CCBG	Critical Communications Broadband Group
INT	Interconnection as standard to connect between MCX servers
ISI	Inter System Interface / TETRA
ISSI	Inter- RF Subsystem Interface (ISSI) Gateway / P25
IWF	Interworking Function e g 100% native interworking
IWF OS	Interworking function on open standards
KMF	Key Management Facility
LMR	Land Mobile Radio (traditional hand-held radio or mobile 2-way radios)
MCX	Mission Critical services (PTT, DATA and Video combined)
Migration	Local presence in visited system and participating in the visited system /MCX servers
MS	Mobile Subscriber
PPDR	Public Protection & Disaster Relief
Roaming	Foreign presence of MS/UE in visited infrastructure to connect back to Home system
SO	Service Overview
SwMI	Switching and Management Infrastructure
TCCA	The Critical Communications Association
TEA	TETRA Encryption Algorithms

TETRA	TErrestrial Trunked RAdio
Transition	Introduction of the 3GPP system architecture for Mission Critical users, the process of new deployment to replace current PPDR
UE	User Equipment
V+D	Voice and Data

1.4 References

For the purposes of this report the following references apply:

[1] ETSI TS 100 392-19-2 V1.1.1 (2019-03), Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 19: Interworking between TETRA and Broadband systems; Sub-part 2: Format for the transport of TETRA speech over mission critical broadband systems

[2] 3GPP TS 22.280, Mission Critical Services Common Requirements (MCCoRe); Stage 1

[3] 3GPP TS 22.179, Mission Critical Push to Talk (MCPTT); Stage 1

[4] 3GPP TS 22.282, Mission Critical (MC) Data Services

[5] 3GPP TS 23.283, Mission Critical Communication Interworking with Land Mobile Radio Systems; Stage 2

[6] 3GPP TS 29.379, Mission Critical Push To Talk (MCPTT) call control interworking with Land Mobile Radio (LMR) systems; Stage-3

[7] 3GPP TS 29.380, Mission Critical Push To Talk (MCPTT) media plane control interworking with Land Mobile Radio (LMR) systems; Stage 3

[8] 3GPP TS 29.582, Mission Critical Data (MCData) interworking with Land Mobile Radio (LMR) systems; Stage 3

[9] 3GPP TS 33.180, Security of the Mission Critical (MC) service

[10] ETSI EN 300 392-3-15 V1.2.1 (2020-04), Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 15: Transport layer independent Additional Network Feature, Mobility Management (ANF-ISIMM)

[11] ETSI EN 300 392-3-14 V1.2.1 (2020-04), Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 14: Transport layer independent Additional Network Feature Short Data Service (ANF-ISISDS

[12] ETSI EN 300 392-3-13 V1.2.1 (2020-04), Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 13: Transport layer independent Additional Network Feature Group Call (ANF-ISIGC)

[13] ETSI EN 300 392-3-12 V1.2.1 (2020-04), Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 12: Transport layer independent Additional Network Feature Individual Call (ANF-ISIIC)

[14] ETSI EN 300 392-3-11 V1.2.1 (2020-04), Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 11: General design, SIP/IP

[15] ETSI EN 300 392-3-10 V1.2.1 (2020-04), Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 10: General design, PSS1 over E.1

[16] ETSI EN 300 392-3-9 V1.2.1 (2020-04), Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 9: Transport layer independent, General design

[17] ETSI EN 300 392-3-8 V1.4.1 (2020-04), Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 8: Generic Speech Format Implementation

2 Introduction

Amidst all new development within the 3GPP and mission critical broadband features emerging, some national TETRA network operators and users are investigating and preparing to adopt the new Mission Critical technologies.

To facilitate this adoption, and to enable communication between users on each system, a connection between the two types of technology is needed to facilitate V+D services from LMR/TETRA to user groups on the MCPTT or MCDATA servers[1]. A means to provide this bridging functionality is under development by ETSI to standardize into a logical Interworking function (IWF), located within the TETRA SwMI. In this document, reflections are given on what is in the drafts for IWF functionality and put into an operational perspective how a part of the TETRA operators and users might want to use an interworking functionality soon for pilots, proof of concepts, migration, hybrid deployment and, at a later stage, the transition towards Mission Critical Broadband Services. The document outlines four implementation scenarios that could be applicable for the operators and user organisations. Duration and deployment as such are not detailed into plans per nation, user or operator, but in case the IWF functionality is to be used, it needs to be tested, rolled out, used, and packed together for an integration with MCX services.

In Figure 1 below the relation between the standards and documents is visually presented based on the TETRA standard.

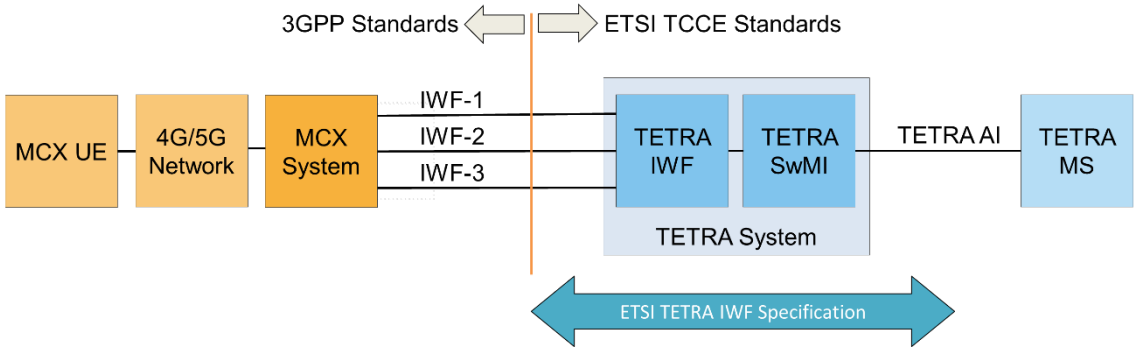

Figure 1: TETRA-MCX Connection via IWF

The three main connections are defined in three IWF connections:

- IWF-1 is an interworking between the LMR voice services with the MCPTT server.
- IWF-2 handles the data messages such as SDS and status messages from LMR with the MCData server.
- IWF-3 is taking care of handling and addressing between the user groups, access to group keys, the user access rights, and other services that are not handled in the streams of IWF-1 and IWF-2.

[1] This applies when the core systems are to be connected and exchange of information between the services is planned. When an organisation is planning a deployment without systems connected, end users may have two devices during service hours to communicate with each other. This scenario is a big bang with two devices (MS and UE) handled for a short period to communicate with others on both networks, depending on assignments.

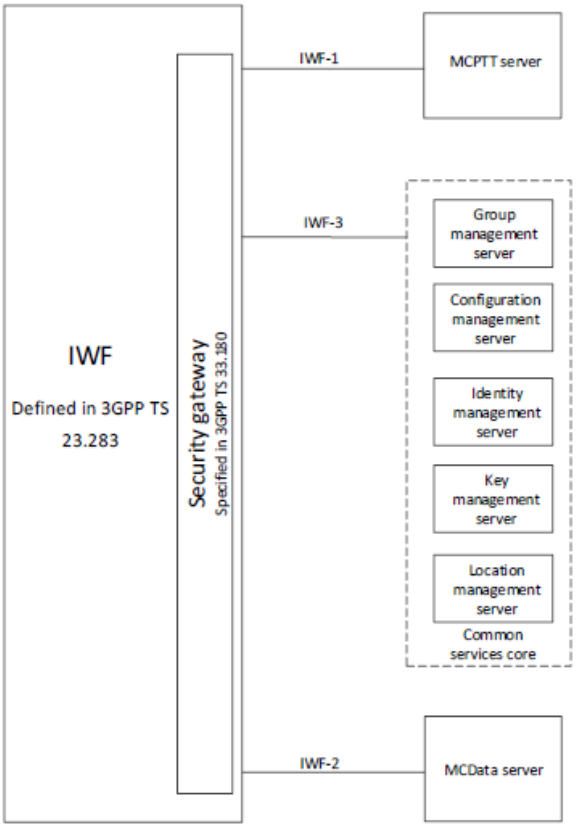

Figure 2: 3GPP IWF-x Reference Points

NOTE 1: only the group management server is applicable for the IWF-3 stream.

3 IWF Phases and Timeline

Since 2021, several parties and stakeholders have been discussing if an Interworking function is to be made available in the market so it can be used for the communication between the existing LMR systems and the 3GPP MCX services. As Mission Critical Broadband technologies are deployed, the requirement for interworking with existing narrowband systems is becoming increasingly important.

From an Operator perspective there could be several phases in the Interworking function deployment cycle. An abstraction of what this may look like in generic terms is presented to clarify the use case during the period the IWF functionality could be in use from an operator process or end user life cycle point of view. This is by no means a 100% complete representation but reflects logical generic phases (or lifecycle approach) operators could or will pass during deployment of the IWF functionality in the transition to more MCX services being deployed in the PPDR ecosystem besides LMR systems. It provides perspective on the stages and phases, where timelines for deployment are different per operator and user groups, depending on many external factors that are involved with the network migration and service transition from a TETRA network to Mission Critical broad band services.

The phases will be part of planning the national migration projects and will have variable durations, hence these phases indicate the business and use case for the IWF function. The only period quite well defined is that migration itself could be as short as possible and when for purposes of continuity, end user needs or obligations, a hybrid period is foreseen with possible more functions functionality added to the IWF capability due to the longer deployment scenario for communication between systems. The most difficult phase to consider for now with most of the operators and users working on how to get the national projects

started or while already in this first phase, is to define if there is an IWF functionality available on the short term as an instrument to facilitate the national projects to connect to the new – either to be purchased or already purchased – MCX application servers from 3GPP systems to validate a form of standardised communication with interworking functionality between users on the LMR system with MCX services

The four main phases (which have overlaps) can be categorised in a logical structure:

3.1 Phases

3.1.1 Pre- IWF Planning Phase

The pre-migration phase defines the outlines for the migration and deployment. This phase includes defining the (inter-)national project deliveries for the MCX services, requests for information, definitions on use cases, pilots, test setup, user configurations and establishment on a small scale as the proof of concept before rollout. What are the available options in the market for LMR operators and users to facilitate per today and near future in the core infrastructure or command and control centres to connect both systems? What is the preferred scenario to start migration and deploy the different architectures to keep the PPDR networks in operation during transition? Here, the possible solutions are validated as strategies to make plans on how to migrate, be it one network or are there many network connections to take care off. The basic features to have available in and across LMR and MCX to be able to provide the critical communications in a time of transition are considered in this phase.

3.1.2 Interworking roll-out Phase

This phase is the scale up of the agreed connections to maintain during migration. It is the deployment phase where there is a functioning IWF between the LMR and MCX systems to guarantee business as usual for critical communication for and with the end users in both the systems. It will be dependent on the particular user, operator, or network how long this phase will be, depending on many factors that will be part of the national migration plan and roll out affected by budgets, expectations, end user agreements, investments and maturity of deployment of the future technologies. The needed interworking functionality could be in a range from basic simple communication between systems (like only voice and group communications) to more sophisticated deployment and include more features and handling all identified functionality from the interworking function depending on transition plan for the system it applies.

3.1.3 Interworking Phase

A hybrid phase where both solutions need to coexist, interwork and gradually moving end users from the LMR system over to the new ecosystem on the MCX servers that will be used as the new PPDR system. Again, this phase will be coloured by national rollout plans and timelines and could define the extend of functionalities required from the old and new network and the IWF in between. This could span between the absolute needed minimum (equals the services of the LMR) up to what new features need to be in place from day one on the MCX platforms with the first end users on the system that were not possible in the LMR system. These requirements may vary per national scenario. Hence the usage of IWF functionality could differ in deployment per operator, like some need the basic interworking, while others need the 100% specified IWF by ETSI.

3.1.4 Retirement Phase

If an operator is considering replacing an existing LMR or TETRA network with MCX, an optional Retirement Phase can be added.

This phase is the downsizing and dismantling of the IWF functionality and the LMR /TETRA system since the majority of the PPDR user are migrated over to the MCX services. In some scenarios the LMR network could be in cold stand by as back up or be dismantled completely. In this phase, national and operator services will also be defined, varying between as soon as possible dismantling and up to keeping a skeleton LMR system at hand as national fall-back for an agreed period.

With all planning ongoing for migration to a next generation infrastructure and ecosystem, most of the major LMR operators will go through these phases, while IWF is an instrument when making this transition from LMR to MCX.

These 4 phases are identified as applicable to a number of operators in Europe that participated in earlier discussing during 2022 on what could be a workable scenario for the transition of the PPDR. Although valid as logical transition phases, there are exceptions to this and not all providers and operators will follow these phases.

Based on a forecast of European operators, it is foreseen to have a need for the IWF functionality as a purchasable product or service platform during the pre – IWF phase so the functionalities can be tested and validated during dedicated events such as the ETSI MCX plug tests. The IWF was added to the 7th plug test event hosted in Malaga in November 2022 for the first time. A standardized and preferable certified TETRA IWF solution supporting the basic set of voice and data services from LMR / TETRA should be available in the market to facilitate the transition so operators and network owners can start dimensioning future scenarios of making a transition from LMR to MCX. Operators that are moving forward share plans and scenarios often like at the Critical Communications World congress and publish requests for information to have a market consultation on what is possible in the future to make the transition to the Mission Critical services.

4 Functional Requirements outgoing from TETRA including Inter System Interface

4.1 Introduction to requirement priorities

Functional requirements for the IWF can be divided in what is an absolute must, nice to have or even not needed and as such out of scope. The beginning of this chapter provides a high-level structuring of what is needed to setup an interconnection and interworking between the two systems, based on expectations and discussion held with Operator and users. During the writing of this service overview, the ETSI agreed TETRA IWF document TS 100 – 392 -19-1 was not formally finalized and publicly available.

The must have or basic features working across the interworking functionality should ideally be the same as provided in the current LMR system. The reasoning behind this is that when both systems, connected via IWF, present the same common Voice and Data services, user groups affiliated on both systems are capable of communication between and across both systems, based on the features of the TETRA / LMR system. The features as below are defined for the Interworking features between a TETRA SwMI towards a connected MCX server. The features and the assigned priorities are the product of discussions inside the working group that helped shaping this Service Overview. Assigned priorities apply to all implementations as described in chapter 7. The reasoning is to provide more detail on what is needed and how operators look at the interworking functionalities to facilitate future developments with the PPDR networks to make communication possible between TETRA and MCX services.

Feature TETRA V+D and Inter System Interface	Note
Users attached to talk group /groups per system (affiliated per system)	
group calls including regrouping / patching per system	
individual / private calls across both systems	
emergency call (group and individual both supported)	Vendor dependent
short data messages (to group and individual, across systems)	Vendor dependent
(tactical) status messages	Vendor dependent

Feature TETRA V+D and Inter System Interface	Note
transmission control (prioritisation, interrupt and queuing (where supported)	Vendor dependent
encrypted communication (e2ee encrypted speech and data; transport of key management messages).	National KMF

Table 1: Feature TETRA V+D and Inter System Interface

The Inter System Interface (ISI) is defined within the TETRA standard and cross-connect to other TETRA networks, defining the protocols that are working across TETRA systems of different vendors (and hence implementations of the standard that differ per vendor). Migrated users will of course behave and have access to specific vendor features in a TETRA SwMI where the MS is registered but are at the same time capable of using this set of features from the visited SwMI to communicate back to the Home SwMI.

The Air Interface Migration (AIM)[2] belongs to the ISI but is as such not applicable for the IWF functionality since no physical MS and UE will register as visitors in each other's networks. For the IWF it is foreseen as an option to have E2EE between the two systems to secure the interworking calls between both systems with a transport key for the calls spanning both systems. Based on the complexity it might involve, the option to have E2EE between both standards is decided to be of low priority from the viewpoint of this SO[3]. In the current setup for most LMR TETRA networks, in case there is E2EE in use, there is a national database and Key management centre where the keys are managed, maintained, and distributed in a way applicable for the specific PPDR network. Per today with ISI deployment, the E2EE keys are not shared between different network user groups, only updates with SDS-transported key management updates are shared across systems for a homogenous group that belongs to the national KMF. Such an approach could be maintained in a national hybrid TETRA / broadband network.

In the Table 1, the basic Voice and Data features from LMR (TETRA + ISI) to MCX that are expected to work across the two standards are listed, based on the basic TETRA and ISI features that are available while migrating from a Home system to a Visited system in TETRA. The ISI defines a basic set of voice and data services that should work for users from SwMI A and B while making calls across the systems or when they are active in the V SwMI as visitors. This is a valid reference point for working across systems in Scandinavia where 3 TETRA SwMI/ PPDR networks are connected by ISI in Finland, Sweden and Norway.

Although not impossible but given the documented preconditions for implementing an E2EE service between the two standards over IWF between heterogenous devices, this feature has been assigned the lowest priority in the delivery of functionalities for the IWF. It should be clear that 3GPP and TETRA interworking specifications enable TETRA KMMs to be distributed through an IWF in accordance with TETRA protocols.

4.2 IWF Features

High level Feature MCPTT Server over IWF-1	Priority 1	Priority 2	Priority 3
Private Voice Call		X	

[2] AIM contains the TETRA MS registering on a Visited SwMI and signalling its information to the SwMI because it is physically leaving its Home system. There is no physical migration with IWF.
[3] The reference is here to the assumptions and architectural preconditions for key management as stated in chapter 5 in the ETSI TS 123 283 v17.3.0 from 2022-05. The possible implementation of these assumptions and architectural preconditions for key management in the ETSI TS 123 283 v17.3.0 are from this service overview weighted and evaluated as complex and a challenge to implement as a feature for IWF.

High level Feature MCPTT Server over IWF-1	Priority 1	Priority 2	Priority 3
Group Voice Call • pre-arranged, chat • Floor Control • Commencement mode	X		
Emergency Group Voice Call • pre-arranged, chat • Floor Control • Commencement mode	X		
E2EE voice calls (optional per operator)	X		
Emergency Private Voice Call		X	
Group Re-Grouping		X	
Group Affiliation	X		

Table 2: High Level Feature MCPTT Server over IWF-1

The absolute minimum of supported services to connect over IWF are the features that belong to IWF-1 MCPTT, including all the voice calls that are done in a group, 1:1 or the emergency call. In the LMR system, this is the most frequent type of voice service and must be available to work between the two standards. In Table 2 the IWF features between TETRA and MCX over IWF are highlighted.

The priority 1, 2 or 3 designates the operator perspective on needed (priority 1), nice to have (priority 2) and not prioritized (priority 3). A special case is for E2EE voice calls which are not needed by all interworking functions deployments but could be needed for a use case. So, if the use case for E2EE applies for an operator requesting this functionality, it is priority 1.

It is understood that in 3GPP releases 15 and higher, with new added features like the different stages and phases for an ongoing emergency call that work differently in 3GPP than in LMR, the status changes of an ongoing emergency call are not to affect the interworking functionality. IWF is expected to handle the Emergency call on the initiated alarm and should, in case of an upgrade or downgrade in the MCX server, stay at the same initiated stage for the emergency call until cleared in either one of the systems.

The priority 2 cases in Table 2 are assigned based on the current LMR deployment where some operators have Individual Emergency calls as a service and some do not.

For group combining and regrouping the priority 2 is given based on the conceptual understanding that any group in the LMR system is capable of regrouping or recombining in the LMR infrastructure, depending on the assigned properties for the identity of the groups. Hence here it is understood as a static link in the IWF where the legacy talk group is mapped towards an MCX group. So, in case of regrouping from the MCX side, the changed properties are added for the new group combination in the IWF that is connected to the LMR group. So, while predefined group to Talk Group linking is already possible, re grouping would be a nice to have.

High level feature MCDATA Server over IWF-2	Priority 1	Priority 2	Priority 3
Status Messages	X		
Short Data Messages	X		

High level feature MCDATA Server over IWF-2	Priority 1	Priority 2	Priority 3
Location Information			X
Emergency Alert	X		
End-to-End Encrypted keys & Data			X

Table 3: High Level Feature MCDATA Server over IWF-2

It is not foreseen for the location information to be necessary to share across systems, while the primary location information (in the LMR) from the MS is broadcasted in an SDS with a protocol to a dedicated location server. The seen use case is a one-way direction, either only from LMR to MCX or to a third-party server. At the same time, the UE in the MCX domain will update the designated location server. Sharing of location information data in a pool of MS and UE is handled from the originating source to the location server, which could result in two streams of updates, be it in LMR or MCX. It is not foreseen to share location updates from a UE to a MS positioning server or from a MS to an MCX location server. In case the UE handles more and different formats, and in case there is no third-party location server that handles both messages, it needs to be looked into on what is needed to share between the systems and their respectively dedicated location servers. It could be a dual feed from LMR and from MCX into an external third-party location service. This priority could vary between operator and their use cases. Currently location is not in scope for the IWF. For TETRA there is LIP (location information protocol) where the contained information might be made available to be handled by a third party or the location server used by the operator. If there is a need to exchange location information over IWF, this can be developed to facilitate the information exchange.

Another specific SDS markup is Callout, which in the small form can pass as SDS over IWF and the message can be delivered in the attached group users. For the big Callout feature as in use in Norway a specific Callout TIP to handle the functionality is being made available. It is outside the scope of this SO to elaborate on deployment and use cases for Callout over IWF since the TIP and SO are defining the usage per system hence the service description on how to deploy in MCData is made to capture this and work out the usage of additional media, formats and activation inside the Callout message.

For the priority 3 on the end-to-end encryption, the evaluation to assign priority 3 is in the translation and decoding of the protocols needed within a broadband MC client. However, if TETRA E2EE is used for SDS interworking then TEA equipment is in this case not needed at the IWF.

High Level feature information exchange over common service core IWF-3	Priority 1	Priority 2	Priority 3
Group administration server	X		
Configuration Management server		X	
Identity Management server	X		
Key Management server		X	
Location management server			X

Table 4: High Level Feature information exchange over common service core IWF-3

The group administration server is foreseen to be the needed element to configure, maintain and handle all logical combinations of users and groups being mapped for interworking between the two systems. The IWF function has the active role to do the ID mapping between the LMR ID (xSSI) and the assigned MCX

IDs. In addition, it must be able to configure and maintain additional mapping and translation between identities as used in LMR and MCX[4].

The remaining management servers are added from the MCX side to handle properties, capabilities capacities, identities and key material up into the IWF. It is too early to state to what extent this is needed or nice to have, but for the group administration server the handling will result in on which groups are mapped towards the LMR side from MCX and hence this is the absolute minimum that is needed to make the interworking possible.

5 Operational Use cases and requirements

Not all operators will have the same operational requirements so some of the foreseeable issues are listed here as use case demonstrations that may occur. It is a consideration on how operators will handle the deployment of the IWF besides the functionality to map voice and data services between the two platforms. The topics addressed in this chapter are to give directions on future implementations of the IWF and interworking functionalities as in connections over ISI and the control room API.

5.1 Dimensioning

5.1.1 Users

For the enlisted users to be provisioned from the LMR system on the IWF to be visible in the MCX server, a logical interface is needed that minimizes the effort of operators. When possible, dynamic assignments on ranges of allowed or approved users per groups should be approved dynamically. In case static data is to be used, the databases should be able to connect via an API towards the HLR of the SwMI where a selected set can be transferred to the IWF or a standard interface like an export or feed of data in .xml, .csv or a similar format can be enlisted. In case users from either system need to be identified as part of the caller ID, a separate mapping needs to be in place to make additional ID's available in both systems. It could be the case due to the deployed ID ranges in the LMR system (a fleetmap number plan with designated blocks to identify user organisations) an alternative range needs to be made available[5].

5.1.2 Talk Groups

Per operator, the number of talk groups that needs to be interconnected can vary. There could be a difference between the total number of defined groups versus the total number of simultaneously used groups over the IWF. Not all configured Talk groups will be simultaneously used, so this has an effect on how to use licences and capacity. Hence note a difference between provisioned or configured LMR groups connected and the number of simultaneous groups in use, like the capacity needed to support simultaneously ongoing group calls over the IWF. In this perspective, the capacity would be dynamically used and will not be needed to be over dimensioned. Flexibility, like a mapping over a selection of groups to Talk groups when both are in use, will create more dynamic usage of connections between the IWF and the MCX server. This compared to the static group linking as with the ISI gateway configuration, the preference for IWF connections related to configuration and capacity is to assign capacity and resources when connections are made between the systems (like an active linked TG to Group when in use that dissolves when no users are in the groups on either side). In theory, all available or provisioned Talk groups should be able to be made accessible in the IWF to connect when used (like when there is a UE in the group that corresponds with the LMR group and there is a MS registered there). If this was a pre-defined matrix of all provisioned TG in the LMR that potentially could be interworked with the MCX groups, it would make the IWF connection matrix or database very easy to maintain. In any case if activity like affiliation in

[4] 3GPP TS 28 283 for release 18 & 17, in both version the chapter 8.1 states the " The IWF can perform the identity mapping between an MCPTT system or MCDATA system and an LMR system during exchange of signalling and media messages." This is understood as dynamic and while interworking calls are ongoing.
[5] A range that could be used is the VASSI range in TETRA, reserved by 15.000.000 -15.999.999

the TG or presence in a Group or taking the floor could trigger an automatic mapping of interworking between both groups, this would increase the user friendliness of the IWF

5.1.3 Simultaneous Calls and IWF system limitations

Depending on configuration, bandwidth, licences in the SwMI or any other reason that could result in a limiting factor on the number of active simultaneous calls, it should be made clear if there is one. As operators our expectation is that in the logical manifestation of the IWF as a solution, the form and process providing the interworking between systems is scalable in logical units or even a cloud solution. In case there is a limit within the functionality or logic of setting up simultaneous calls, there should be a scalable option to increase the number of calls. This is related to the migration of users from LMR to MCX, where in the beginning and the end of the transition the total number of calls is different than at the height of the migration. The database or matrix that correlates the simultaneous ongoing calls should be flexible in this regard. If there are limitations on computable power, licenses, SIP connections in any form, a vendor should make this clear in the specifications for their IWF implementation.

5.1.4 Call connections and setups

From an operator point of view, setting up calls based on any predefined schedule or matrix of allowed call patterns between the two systems, once the mapping is made, should be as automatic as possible. When either party starts the call and the groups are listed as IWF group, the calls are to be automatically setup and connected once there are registered members in the talk group or group. In case there are logical or physical limitations, the IWF is scalable like N+1 or the active used linked IWF group combinations are present, the ones not in use are dormant or not actively used, but once a MS in the Talk group or a UE in the group is registered and affiliated, the IWF for this combination is to be active.

5.2 Administration & Management

5.2.1 User IDs Management

Adding the mapping or linking between xSSI and MCX IDs on the IWF is to be made possible individually per record as well as adding in bulk in case from either TETRA or MCX server a mapping needs to be made. Provisioning on the IWF for mappings should be made dynamic and in ranges to apply, not 1:1 registration. This should be like dynamic Visitor Alias SSI assignment as known from some ISI TETRA deployments. The ability for a single MCX identity to represent all the TETRA users in a single talk group may be required by some operators.

5.2.2 Group IDs Management

The mapping or linking between Talk Groups (GSSI) and Group IDs should be simply accessible and easy to alter. An integrated, easy to deploy GUI is preferred.

5.2.3 ID Translation Table Management

The ID translation table is to be able to be altered and easily exported for changes. Changes in the ID translation can be logged and exported in acceptable industry formats (CSV, XML).

5.2.4 Connection options and locations

In the enclosed scenarios for the IWF the common use case is to have 1 LMR system connected with IWF to 1 operator's MCX servers for national integration to realise communication between both systems. However, the development and integration should be open to have multiple IWF connected to several external MCX Servers. In case of a national transition this would be the main use case, but not the only one. It could be that the LMR system is to connect to several external MCX servers via one or many IWF functions. Hence it should be possible to either host several MCX servers outgoing over the IWF or the IWF is to be scalable to connect to several MC Application servers. In case the LMR system supports ISI, every ISI connection slot that is in the ISI Gateway can be used to an IWF over ISI and thereafter connect with

an MCX server. In case of a 100% IWF that is inside the SwMI, integration within the SwMI architecture as deployed seems a logical place the IWF. In case of using the ISI standard, the ISI gateway inside the SwMI could be the external connection point to connect interworking functionalities with the MCX servers outside the physical location of the SwMI. The TETRA ISI Gateway will in this case look at the IWF/MCX Server as another connected external network and communicate over ISI out of the TETRA network. In this last case, the IWF function can be placed physically remote from the SwMI and can have per definition more IWF functions connected based on the applicable number of ISI licenses in the SwMI. The architecture will need to take into account the location and need for a gateway carrying out the functions of a 3GPP security gateway.

5.2.5 Access to the IWF

In case the IWF is a part of the SwMI or LMR environment, requirements to access the IWF and being allowed to configure the content of the tables and IDs is part of access procedures where the IWF server will require usernames and passwords to log on to the IWF. The physical hardware integrated on site or remotely, possibly even as a cloud server, should be secured and protected by available firewalls against non-authorized intrusions. Accessibility and status are to be representable in an OSS layer with forwarding alarms, events and system logs for maintenance and cyber security. The management of the IWF should have a minimum set off alarms and events that can be added to existing platforms in use for operational support services as common used in the operating and maintenance of the SwMI.

5.2.6 Integration of the IWF

The functionality delivered by the IWF is situated close or even inside the logical functions of the SwMI. This interface is not part yet of the product portfolio of many TETRA suppliers. Inside the LMR systems, the functionality as described by IWF is still in the development phase. The counterpart for the IWF is specified in 3GPP and made available, so the interface to connect needs to be developed based on the TETRA standard to make the interconnection to the external MCX server. The TETRA standard has a myriad of implementations that vary per vendor and yet has a high grade of interoperability between deployments by different vendors. Having the interoperability as achieved with TETRA and the ISI, should guide the development and implementation of the IWF too. Operators should be able to integrate any vendor independent IWF functionality to integrate with their SwMI because the communication and call handling between the SwMI and the IWF is to be interoperable. It is not foreseen that this type of integration should lead to adaptions and enhancements of the TETRA standard.

6 For further study

6.1 End-to-end encryption across the IWF

The end-to-end encryption across the IWF between the LMR and MCX server is for now outside the scope until TS 100 - 392-19-1 TETRA IWF is published. After publication, an assessment can be made to validate if E2EE across IWF is a priority or not. Development as mentioned above is not prioritized for now.

7 Implementation Options

This section describes the different options on how the LMR and MCX system can be connected. The listed implementation options are not providing the same functionalities but can be applicable to different scenarios, for different timelines and deployments depending on the user needs, the deployed TETRA infrastructure, the foreseen transition scenarios and any other means to create and maintain communication between different networks during a transitional phase. With the native implementation and the defined priorities, most functions specified for the IWF will be available. The added two alternative implementations could provide what is needed for a time period during the transition and are not covering the complete specification. The fourth implementation is listed because these are available but are not standardised as such that these implementations work per definition with other vendors.

7.1 Native IWF (implementation option 1)

The IWF implementation as per standard

Figure 3: Native IWF (implementation option 1)

The IWF is a function providing a set of call features and is logically connected or integrated by access and protocols in the TETRA SwMI domain which needs to be made available for a cross connect to Broadband systems (MCX). In this case the implementation option is most likely handled by the SwMI vendor, where the IWF can be integrated in the total suite of services and architecture as deployed in the configuration of the network.

This is in any case the only possible solution based on the current standardisation activities. There is not much information from all TETRA vendors available on how and when IWF is to be on the roadmap or scheduled for implementation and deployment in current TETRA networks (vendor specific and/or to other TETRA vendors).

The implementation and providing the listed facilities will give the best integration possible between the TETRA network and the MCX services, providing the known features for how TETRA networks are configured and used today.

To find each other to set up calls across the system, call identifiers and unique numbers are applied to identify users registered in both systems to make the call or group calls possible.

Status messages as such are not mentioned here, but they are part of the MCData set and considered to be delivered across the systems (sometimes renamed operational or tactical status messages).

The location management server is listed as a separate function. This is understood as for LIP handling across the systems. However, if it is information on cell registration to be exchanged, it could be considered not a high priority to share across IWF because this kind of information can be handled in the networks and as record handled in the available end points (be it in call detail records handling or positioning servers (in case of SDS)).

7.2 Interworking functionality via ISI (implementation option 2)

The IWF on the standardized ISI interface, interworking functionality provided over the ISI implementation

Figure 4: Interworking via ISI (implementation option 2)

Based on the available documentation and discussion within the CCBG IWF group, some operators have – due to timelines – challenges to migrate the implemented ISI connections. In Scandinavia, Finland, Sweden and Norway have cross border communication over TETRA in place and investigate, if in some case the ISI can be connected to the IWF functionality if the neighbour country is already migrated to MCX systems while the other is still on TETRA. The national rollouts for migration are not aligned and probably

will be a challenge to align hence it could be an option to extend the ISI connections with interworking functionalities to connect to foreign broadband systems and dedicated MC Application servers.

The ISI phases 1, 2 and 3 are available in a standardised service from several TETRA vendors and the basic functionalities for voice and data services between ISI and the future IWF are alike. In addition to designing and developing a clear TETRA IWF, the idea added to the service overview is to investigate the ISI to IWF connection so there can be a solution based on ISI because inside TETRA this interface is developed and in use. It also makes it possible to move the IWF outside the direct SwMI via the ISI connection.

The ISI is a TETRA specified interface that provides a defined cross connect to other TETRA networks. Where ISI provides this for TETRA, the IWF shall provide this to external 3GPP systems. Both ISI over IP and E1 are applicable. Enhancements to the ISI standard are not foreseen to be necessary. The SwMI will over the ISI GW connect to an external network and as such see the interworking functionality over ISI as a connected external network. Any exchange of group membership and other administrative configuration details will be handled separately. Next to the national migration case from TETRA to Broadband, this option could service the Scandinavian and other cases by connecting (international) external MCX platforms in case the national network is still on TETRA.

7.3 IWF via API (implementation option 3)

Figure 5: Interworking via API (implementation option 3)

IWF via API could serve as a means to connect other than via the SwMI and use the Application protocols as in use by Control Rooms. Some vendors have investigated this option and it could be an alternative in case the IWF as described for the first two implementation options does not work.

This option may provide a scalable le solution per Control room, per agency, providing a bridge between TETRA and the MC Application server. An agreement on usage of the APIs is a pre-condition for development.

7.4 Proprietary interworking functionality MCX (implementation option 4)

The IWF as a proprietary interworking functionality MCX provided by some vendors as a solution interconnect MCX services established with the LMR / TETRA SwMI systems. This proprietary solution is not what is desired as an implementation in this Service Overview and not seen as a valid interworking deployment.

To choose this implementation option is not wrong or faulty, but if chosen operators and users should be aware of the risks of following a binding to a specific vendor while the specification work is still ongoing for 3GPP MC releases and there will be commercial impacts and limitations on what can be interoperable between proprietary platforms and the market due to the deployed solution where in house and third-party software and hardware may impact the provided services.

Figure 6: Proprietary interworking functionality MCX (implementation option 4)

8 Conclusion

Any plans on achieving () mission critical interconnections in the future should consider that all deployments should at least be compatible and interoperable with the 3GPP standards and specifications as being drawn up to make it possible to interconnect national systems in the future. Unfortunately, proprietary is not equal to open standards or agreed standards hence other parties supporting the standard can face challenges to connect and have interoperability between equipment and services.

This service overview has from the user and operator side listed the reasons to develop an IWF or interworking functionalities to have stable and reliable communication between two different types of networks, so it could bridge operational services while organisations and operators are in transition and public safety voice and data services are provided via hybrid solutions.

By looking at the bare minimum of what is needed from an operator perspective, this service overview has a defined business case described and outlines a scalable feature set on what is absolutely needed up to what can operators do without. Transitions are always challenging the same as network migrations, so whatever can be achieved to support this, is welcome.

Since there is currently no 100% IWF under development at least based on the latest information from the TETRA Industry Group, interworking functionalities over ISI or the ICCS API look like best practice alternatives to bridge the challenges to have communication between different standards and systems.

TCCA supports standardisation, open standards and interoperability and with describing the IWF and interworking functions our aim is to continue on future development of this feature.

Document History

Date	Version	Comment
9 May 2022	0.1	Initial draft
23 Dec 2022	1.0	Initial version for TCCA internal review
14 Dec 2023	2.2.0	Editorial amendments, Finalization for publication.