

HMF ACCESSNET®-MCX



MISSION-CRITICAL BROADBAND COMMUNICATION 3GPP STANDARD (MCX)

HMF Smart Solutions GmbH
FEBRUARY 2026

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Fundamentals & origin of the standard 3GPP MCX

01



„WHAT IS MCX?“

3GPP defines MCX (Mission Critical Services) as

- a set of standardized, high-reliability, broadband communication applications
- designed for public safety, utilities and enterprise
- use over 4G LTE and 5G networks

Three core services:

- Mission Critical Push-To-Talk (**MCPTT**)
- Mission Critical Data (**MCDATA**)
- Mission Critical Video (**MCVideo**)

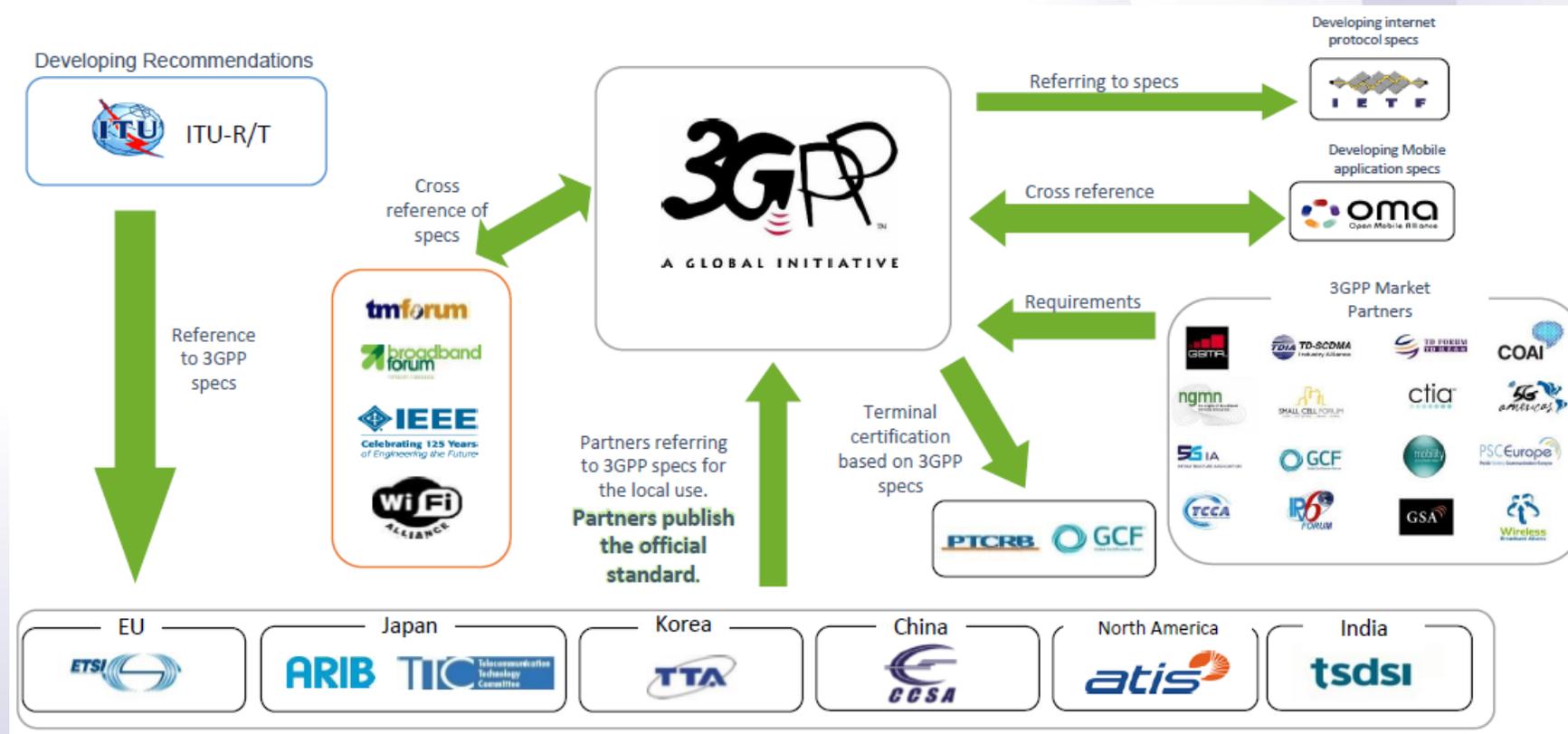
ensuring secure voice, data, and video transmission.



„WHO DEFINED MCX?“ - ROLE OF 3GPP

3rd Generation Partnership Project (3GPP)

- Global collaboration of telecom standards development organizations



„WHO DEFINED MCX?“ - ROLE OF 3GPP

Standardization was initiated in 2013

- Initiated by public safety departments of Korea, USA, UK, France, Germany, Netherlands, TCCA, ETSI, ATIS, TTA

3GPP identified as the home for global MCX standards

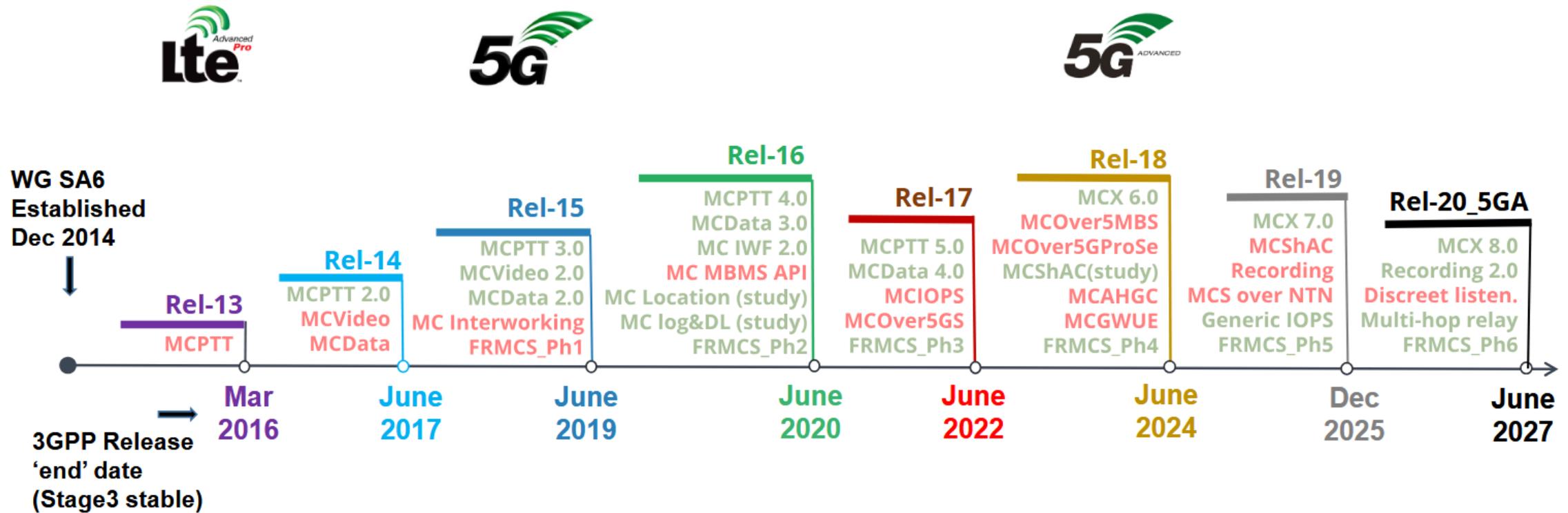
- Over 600 user requirements were developed with inputs from TETRA, P25 and mobile broadband industry
- New Working Group dedicated for Mission Critical Applications (SA6)

First global MCPTT standard published in 2016 (Rel-13)

- Rel-12 as precondition
 - Quality of Service Class Identifiers (QCI)
 - Proximity Services (ProSe/D2D)
 - Group Communication System Enablers (GCSE)

„WHO DEFINED MCX?“ - ROLE OF 3GPP

11 years of MCX standardization



„WHO USES MCX?“

Public Safety org's (PSS) / Public Protection & Disaster Relief (PPDR)

- Police
- Fire brigades & rescue services
- Ambulances
- Civil protection

Government entities, communities

Utilities (electricity, gas, water)

Public transport (Metro, buses, trams, rail, airports, sea ports, ...)

Road services

Other critical infrastructure organizations (also: org's required in crisis)

WHY STANDARDS? 1/2

Tasks in Public Safety (Public Protection & Disaster Relief, PPDR) as well as operating critical infrastructures require communication

-> communication requires interworking

-> interworking requires interoperability

-> interoperability requires standards

WHY STANDARDS? 2/2

End users

- Independence from individual manufacturers
- Continuous competition
- Wide range of compatible devices – Free choice
- Replacement during life cycle
- Continuous product innovation(s)

Manufacturers

- Larger sales markets
- Longer lifetime of markets
- Motivation for long-term investments

TECHNOLOGY CANDIDATES LTE™ & 5G™ ?

3GPP standards basically seem suitable...

- Excellent spectrum efficiency
- Quality of Service (QoS)
- Low latency
- Operation frequencies < 1 GHz
- Enough bandwidth for real-time video

3GPP standard for Mission-Critical services (MCX) further addresses ...

- Group communication
- Priorities & pre-emption
- Direct Mode (Device-to-Device, D2D)
- Security (e.g. End-to-End Encryption, E2EE)

OPEN STANDARDS & TESTING

Only open standards lead to full interoperability

Only testing ensure compliance to open standards

ETSI MCX Plugtests

- First plugtest event was in 2017
- 9th MCX plugtests were held in February 2025
- Informal, hands-on events to test interoperability
- Result: ETSI Plugtest report



Global Certification Forum

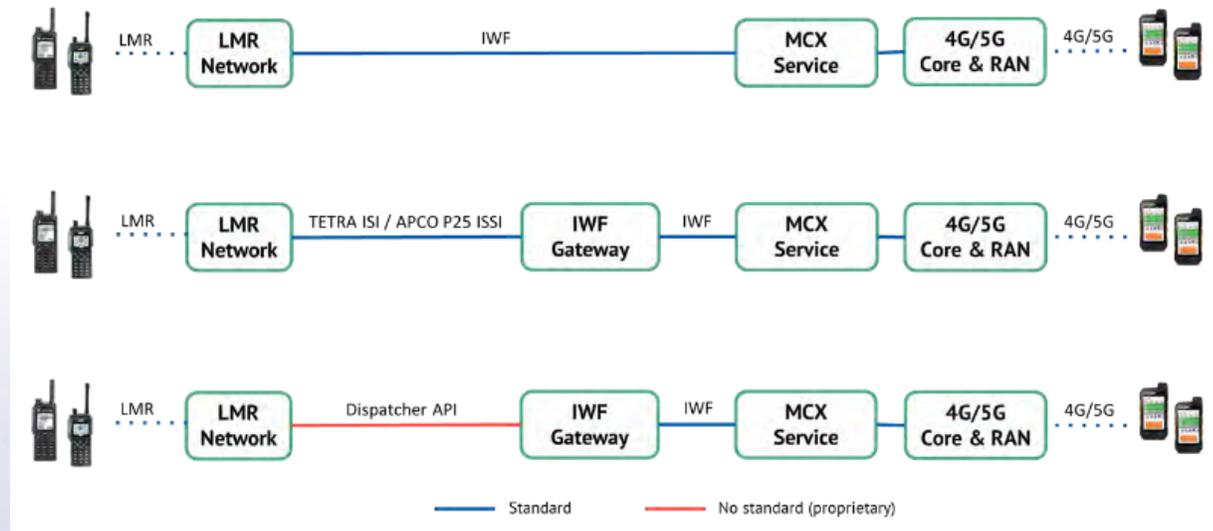
- Formal certification by accredited laboratories
- MCX certification program started in June 2024
- Result: Product certificate



INTERWORKING FUNCTION (IWF)

Interworking of TETRA networks with 3GPP MCX

- The Interworking Function (IWF) is a key component of the 3GPP MCX architecture that enables interoperability between TETRA systems and MCX
- IWF specifications introduced in Rel-15 and continuously refined through Rel-18
- IWF adoption by both MCX and TETRA vendors has lagged*



MARKET VOLUMES

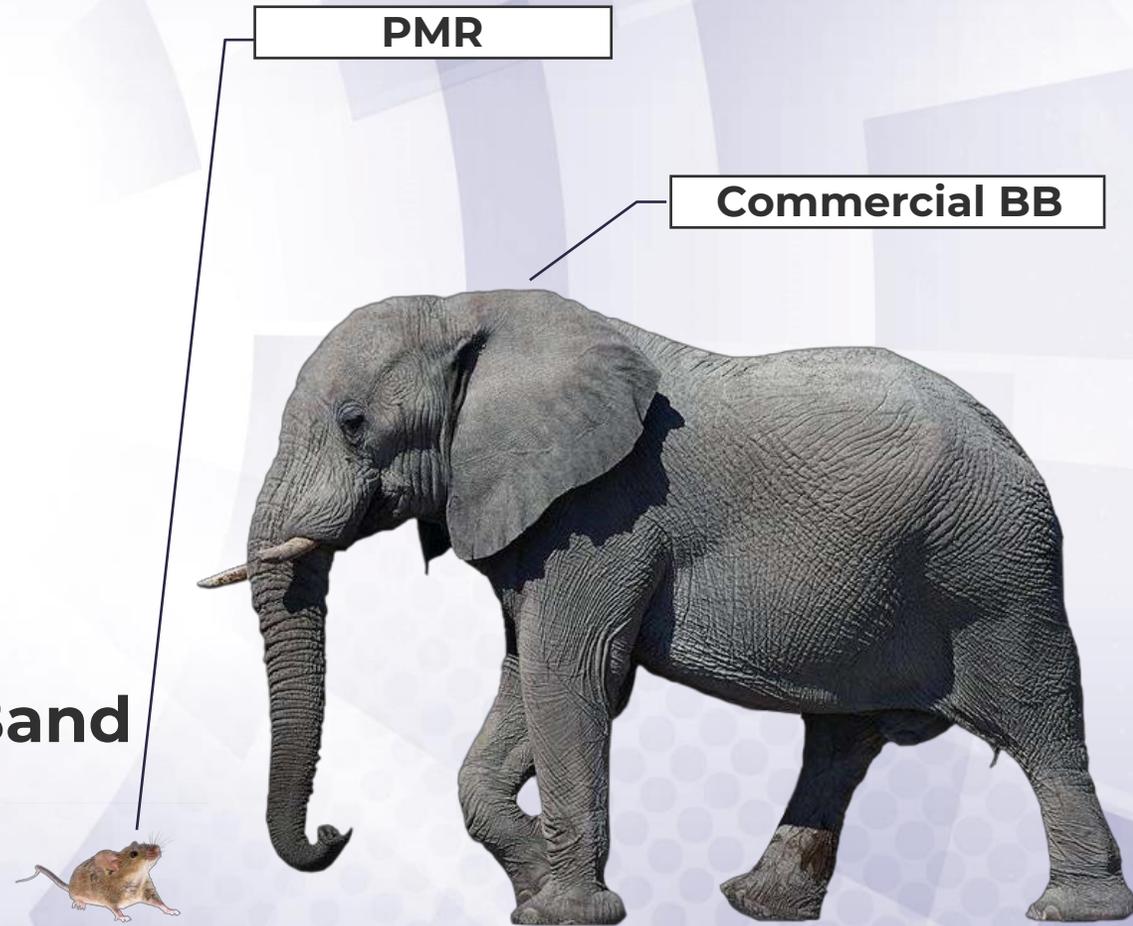
Commercial Broad Band

- LTE / 5G available almost worldwide
- ~ 1 billion LTE devices sold per year
- ~ 8,6 billion LTE devices (2025)

Mission-Critical Narrow Band (PMR)

- ~ 6 million TETRA devices worldwide
- TETRA is ~ 30% of the digital PMR market

PMR is <1% of the commercial Broad Band



FUTURE OF TETRA?



TETRA 2 / TEDS

TEA SET B & TAA2

1995

2005

2022



UMTS



1990

2004

2010

2019

MOVING FROM TETRA TO 5G?



TETRA 2 / TEDS

1995

2005



1990

UMTS

2004



2010



2019

Mission Critical Enablers

02



QoS, PRIORITIES & PRE-EMPTION (QPP)

Quality of Service (QoS)

- Network capability to guarantee grade of service; uses parameters like e.g. Packet Priority, Delay Budget, Packet Error Loss

Priorities

- Controls the access to network resources for users during higher load situations

Pre-emption

- Mechanism to take over resources from other users / cancel active sessions of lower priority in case of lack of free resources

Resource allocation

- static (on registration)
- dynamic (per session/call; Rx interface)
- according to policies (user, app, type of service, etc.)

QoS, PRIORITIES & PRE-EMPTION (QPP)

QoS – an analogy

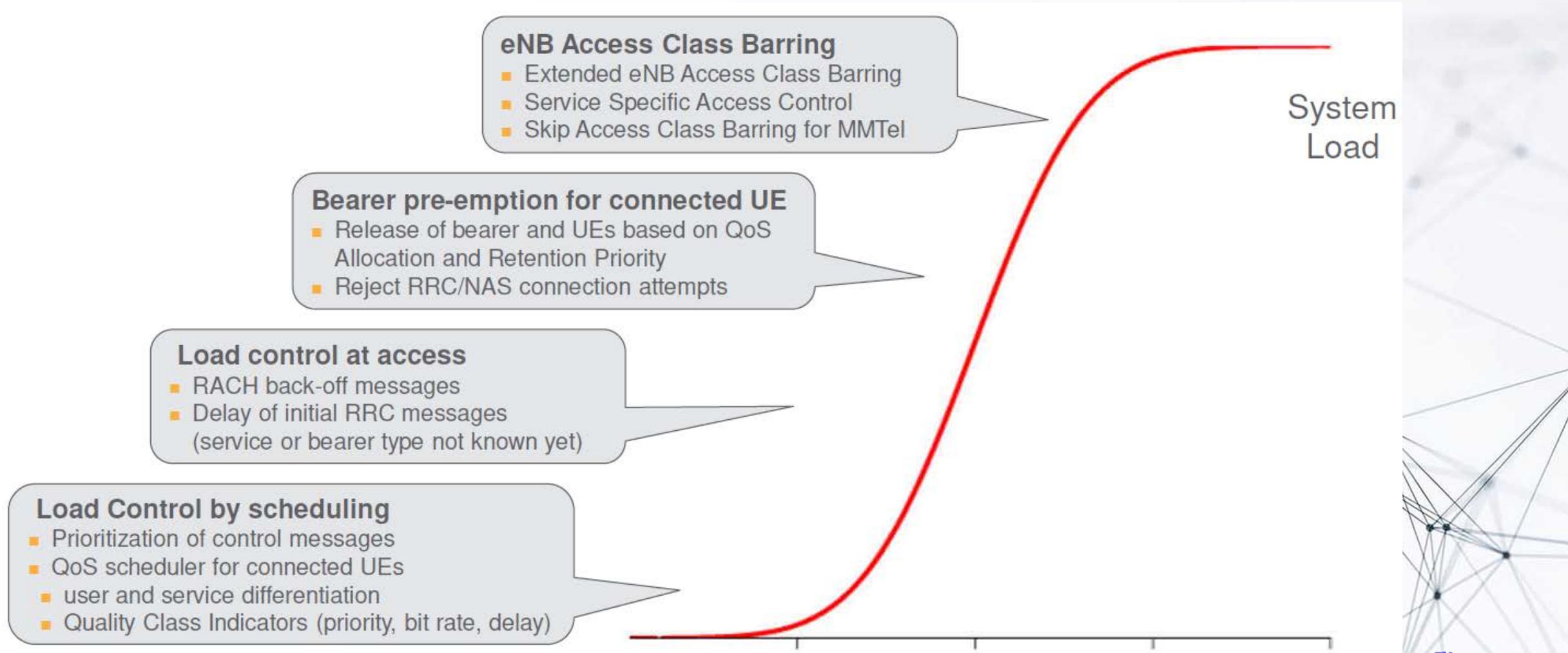


Priority & Pre-emption

Quality of Service



QoS, PRIORITIES & PRE-EMPTION (QPP)



MCX SERVICE QUALITY & KPIs

Service Connection KPI	Design Target
KPI 1: MCPTT Access Time Not include the time for MCPTT user affiliating to the group Not include confirmations from receiving users	<300 ms
KPI 2: E-to-E MCPTT Access Time Including the time for MCPTT user affiliating to the group Including confirmations from receiving users when applicable	<1000 ms
KPI 3: Mouth-to-ear Latency	<300 ms
KPI 4: Late Call Entry Time without application layer encryption	<150 ms
KPI 4: Late Call Entry Time with application layer encryption	<350 ms
Audio / Voice Quality KPI	MOS-LQO
KPI 1: MCPTT call within one MCS system	>3.0
KPI 2: MCPTT call involved interworking with other system	>2.7

LTE/5G BEARER & QoS BEARER

Bearer

- Uniquely identifies a packet flow between user equipment (UE) and network
- Same packet-forwarding treatment for packets mapped to same bearer
- Decision to modify/establish dedicated bearer by network (QoS)

Default Bearer

- Assigned by default; immediate use; throughout „lifetime“ of connection
- Best effort service, like www (e.g. email, FTP, HTTP, etc.)

Dedicated Bearer

- Optionally assigned on need for better QoS (services, SW applications)
- Temporarily assigned, can be released by network any time

LTE/5G BEARER & QoS BEARER

QCI	Resource Type	Priority Level	Packet Delay Budget	Packet Error Loss Rate	Example Services
1	GBR	2	100 ms	10^{-2}	Conversational Voice
2		4	150 ms	10^{-3}	Conversational Video (Live Streaming)
3		3	50 ms	10^{-3}	Real Time Gaming, V2X messages; Electricity distribution - medium voltage; Process automation - monitoring
4		5	300 ms	10^{-6}	Non-Conversational Video (Buffered Streaming)
65		0.7	75 ms	10^{-2}	Mission Critical user plane Push To Talk voice (e.g., MCPTT)
66		2	100 ms	10^{-2}	Non-Mission-Critical user plane Push To Talk voice
67		1.5	100 ms	10^{-3}	Mission Critical Video user plane
75		2.5	50 ms	10^{-2}	V2X messages
71		5.6	150ms	10^{-6}	"Live" Uplink Streaming
72		5.6	300ms	10^{-4}	"Live" Uplink Streaming
73		5.6	300ms	10^{-8}	"Live" Uplink Streaming
74		5.6	500ms	10^{-8}	"Live" Uplink Streaming
76		5.6	500ms	10^{-4}	"Live" Uplink Streaming
5	Non-GBR	1	100 ms	10^{-6}	IMS Signalling
6		6	300 m	10^{-6}	Video (Buffered Streaming); TCP-based (e.g., www, e-mail, chat, ftp, p2p file sharing, progressive video, etc.)
7		7	100 ms	10^{-3}	Voice, Video (Live Streaming), Interactive Gaming
8		8	300 ms	10^{-6}	Video (Buffered Streaming); TCP-based (e.g., www, e-mail, chat, ftp, p2p file sharing, progressive video, etc.)
9		9			
69		0.5	60 ms	10^{-6}	Mission Critical delay sensitive signalling (e.g., MC-PTT signalling, MC Video signalling)
70		5.5	200 ms	10^{-6}	Mission Critical Data (e.g. example services are the same as QCI 6/8/9)
79		6.5	50 ms	10^{-2}	V2X messages
80		6.8	10 ms	10^{-6}	Low latency eMBB applications (TCP/UDP-based); Augmented Reality

LTE/5G BEARER & QoS BEARER

Mission Critical QCI

Rel-12 defined the QCI entries for Mission Critical Services

QCI	Type	Priority	Max. Packet Delay	Max. Packet Error	Service
65	GBR	0.7	75 ms	1%	MCPTT
67		1.5	100 ms	0,1%	MCVideo
69	Non-GBR	0.5	60 ms	0,0001%	MC Signalling
70		5.5	200 ms	0,0001%	MC Data

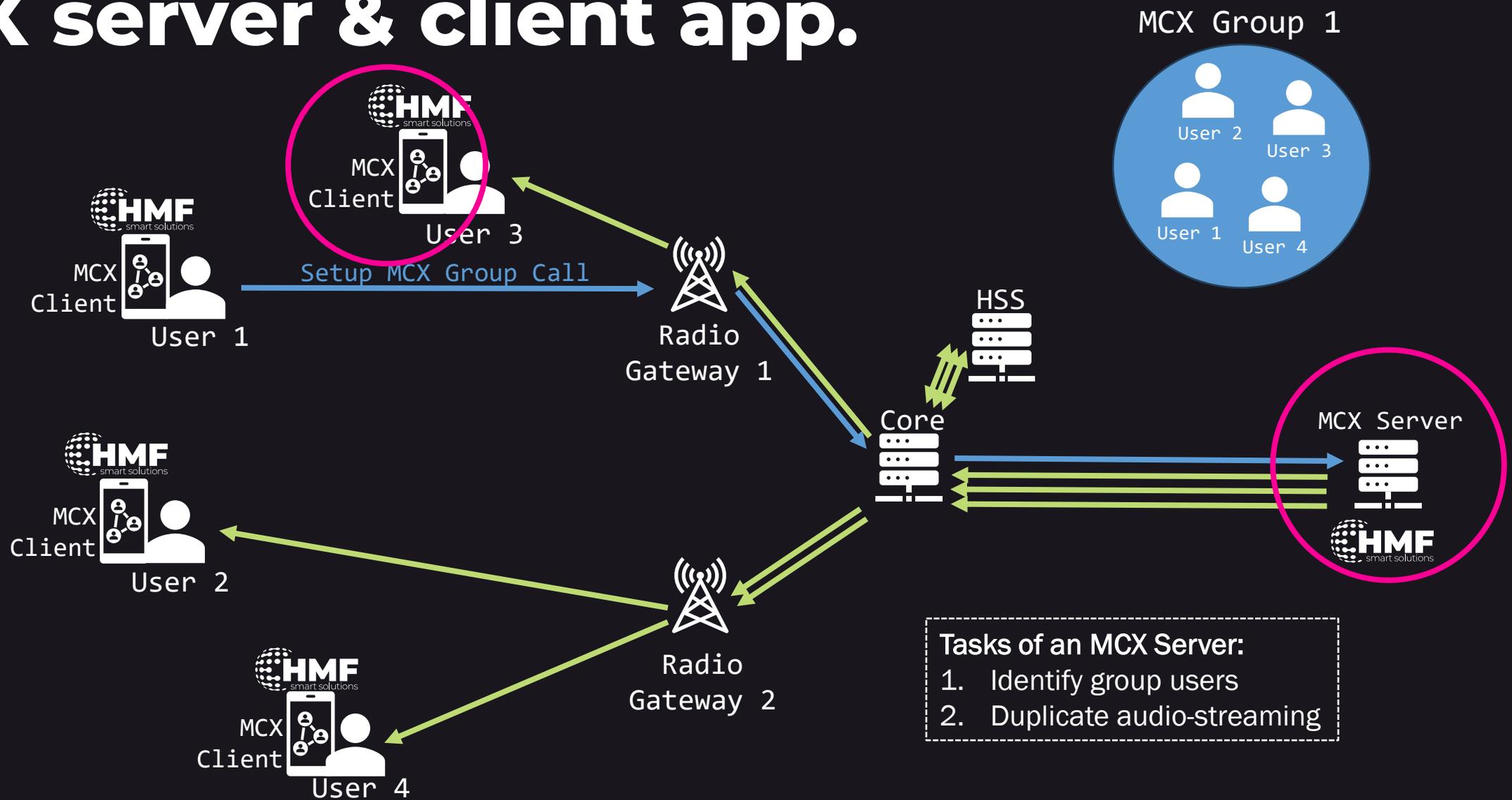
Realisation

MCX App asks at the EPC for dedicated Bearers to serve MCX services. The QCI of the bearers are related to its MCX service:

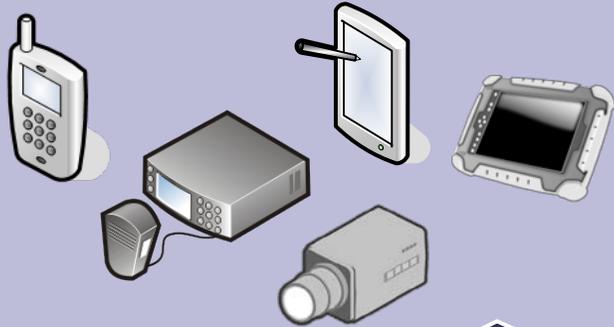


Prioritizing of MCX data within Client, RAN and Core (EPC)

MCX server & client app.

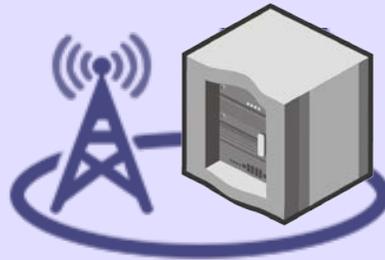


MISSION CRITICAL SYSTEM



Mission-critical devices

(robust, easy-to-use, physical control elements / keys, direct communication (D2D))



Mission-critical networks

(available, reliable, secure)



Mission-critical services & SW applications

(vertical-specific & task-related, voice & data, group communication, priorities)

ACCESSNET-MCX – Functional scope

03



MISSION-CRITICAL SERVICES (MCX)



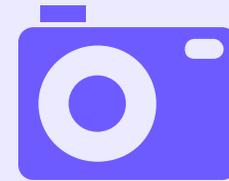
MCPTT

Mission-Critical
Push-To-Talk



MCDATA

Mission-Critical
Data



MCVIDEO

Mission-Critical
Video

MISSION-CRITICAL VOICE: MCPTT

PTT group call (voice)

- Emergency group call
- Priority group call (also pre-emptive)
- Broadcast call
- *Late Entry*
- Call types: pre-arranged, on-demand chat
- Dynamic talkgroups & other special variants

PTT private call (voice)

- Emergency private/individual call

Others, vertical-specific application (Roadmap)



MISSION-CRITICAL DATA: MCDATA

Short Data Service (SDS) / Messaging

- Individual & group-addressed
- SDS / text messages with emergency priority

Status

Geo localization / Position data transfer

File transfer

Streaming, IP connections (Roadmap)



MISSION-CRITICAL VIDEO: MCVIDEO

PTT group call (video)

- Emergency video group call
- Priority video group call
- Video broadcast call *

PTT private call (video) *

- Emergency video private/individual call

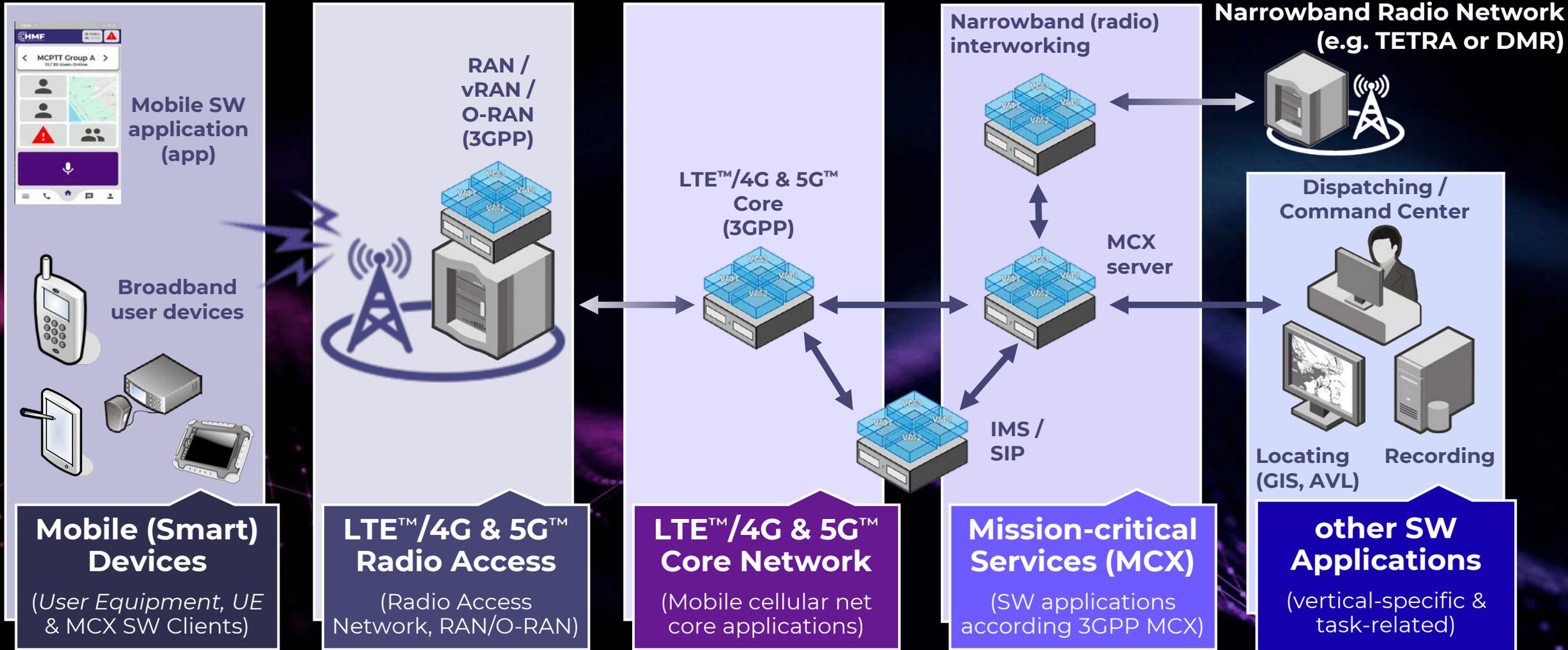
Private video call (full-duplex)

Ambient Viewing Call *

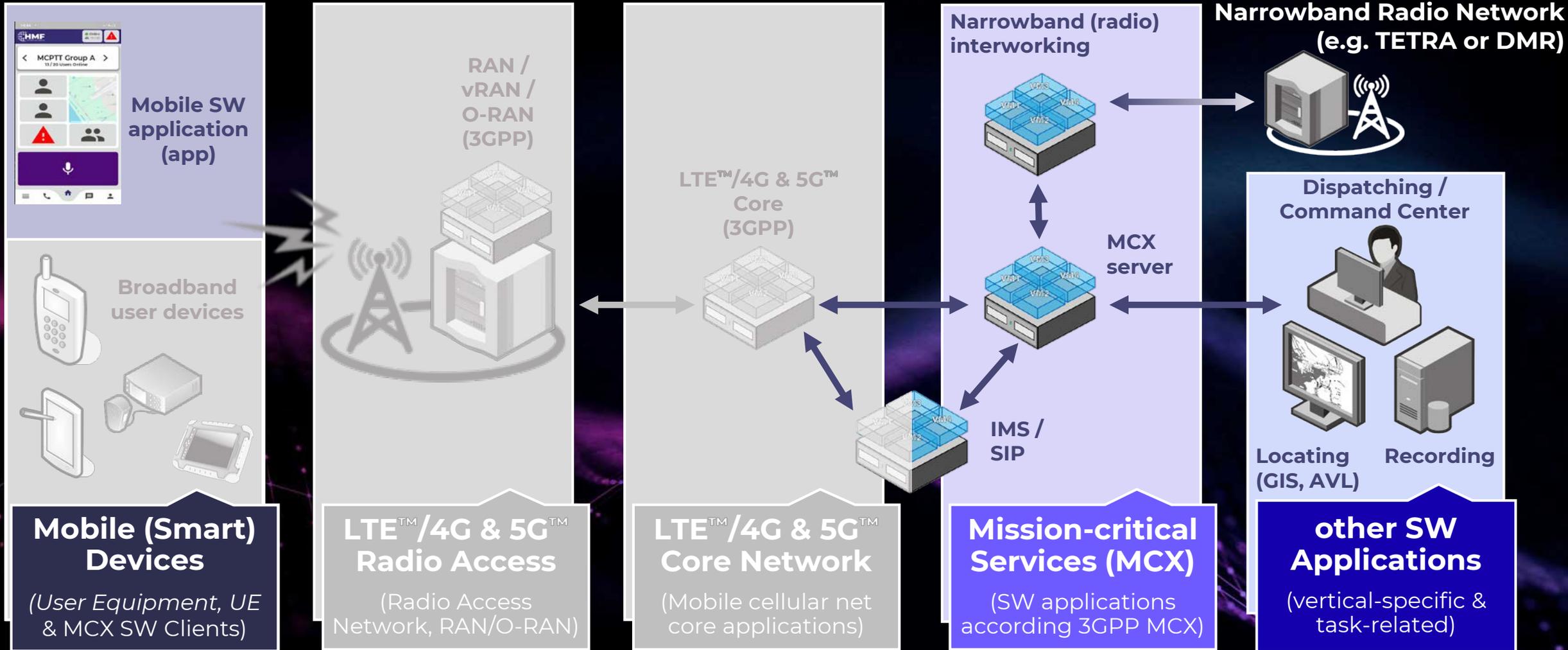
Video push & Video pull *



MCX IN LTE™ & 5G™ ARCHITECTURE GEN.



MCX IN LTE™/4G & 5G™: HMF PRODUCTS



HMF MCX – DEVICE PLATFORMS

Android™-operated devices

- Smartphones
- Rugged PTT devices (e.g. PoC radios) & hybrid technology devices (e.g. Hytera PTC series)
- Intrinsically safe (IS) devices for hardest environments (e.g. ATEX, UL913)
- Tablets, bodycams
- Vehicle-mounted devices

iOS- & iPadOS-operated devices (Roadmap)

PC platforms with web browser (Roadmap)

- e.g. Google Chrome™, Firefox™



HMF MCX – WRAP-UP & OVERVIEW

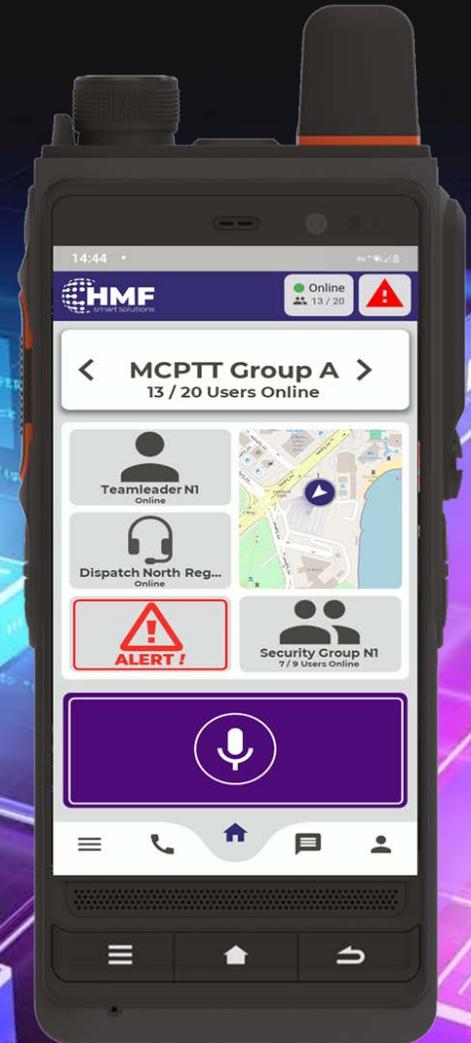
MISSION-CRITICAL SERVICES (MCX)

- 3GPP - worldwide standard
- Mission-critical PTT/voice, PTT/video & high-speed data
- Trunking communications
- Multimedia dispatch, recording & locating options
- Public & private LTE™ & 5G™ networks

App with multiple OS platform support

State-of-the-art cybersecurity & hardening – certified

Highest system availability



Benefits of the HMF MCX solution

04



HMF MCX USP's – TECHNICAL #1

True own SW development – Made in Germany

- Optimum control over SW stack, roadmap & SW maintenance

Compliance to latest complete 3GPP release

- 3GPP R17 as basis, 3GPP R18 for LMR/narrowband gateway

“One-click-deployment” by SW orchestration

- Consequent use of state-of-the-art virtualization / orchestration / containerization tools & frameworks
- Also “one-click-SW-updates”
- Seamless SW updates (no downtime)



HMF MCX USP's – TECHNICAL #2

Multiple deployment modes

- Hosting options: Public cloud, private cloud (“tenant cloud”), data center (“server park”), on-premise
- Redundancy designs: 1+1, geo-redundant 1+1, quorum

Highest cyber security / IT security

- Latest & most-relevant cyber security frameworks incl. IEC62443, NIS2, OWASP, ISO27001 / ISMS, SDL
- 2-factor authentication (2FA), single-sign-on (SSO)

Highly customizable app GUI/MMI

- Layout of app GUI/MMI adaptable to customer needs & workflows – Optimum usability



HMF MCX USP's - COMPANY EXPERIENCE

Projects worldwide in several market verticals

- Public safety & governmental, airports, seaports, construction, public operators

24/7 Support, SL3/SLA support, network operation

- Direct contact to engineers – no call center
- Optionally true network operation (remote; N.O.C.)

True & proven long-term lifecycle SW support

Secure development & project implementation by ISO 27001 certification

- Information Security Management System (ISMS)



MIGRATION & INVESTMENT PROTECTION

Investment in 4G/5G™ technology

Legacy narrowband systems for securing business operations

Coexistence & connection of networks

- De-coupled time-wise & cost-wise

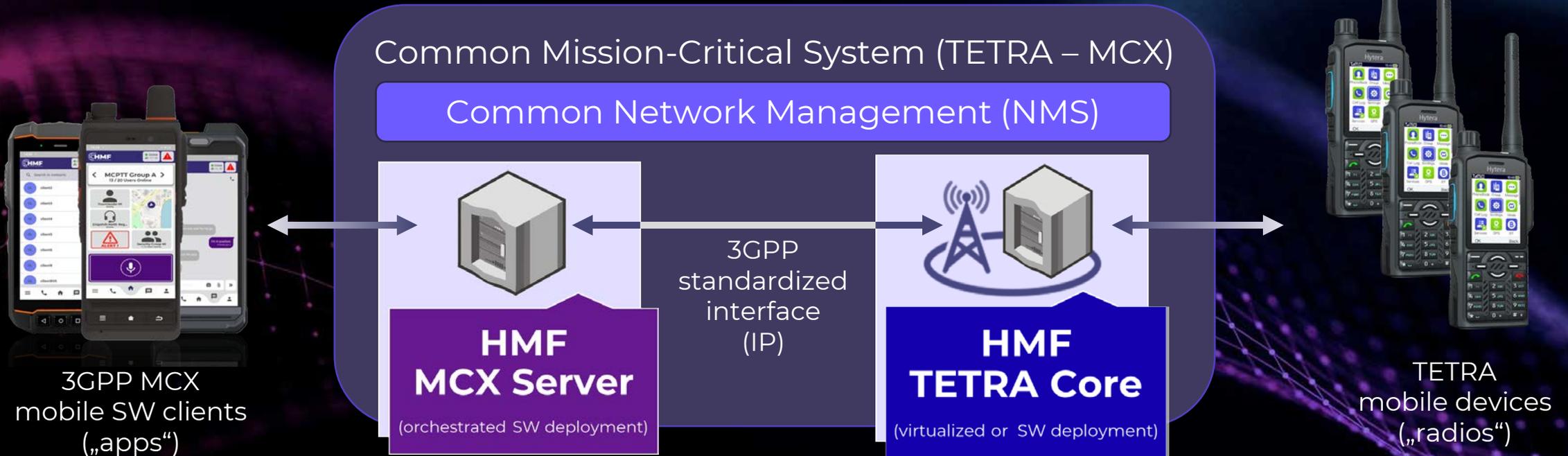
Use of „bridge technologies“

- Push-To-Talk (PTT) over Cellular (PoC)
- Hybrid devices



TETRA + MCX VIA STANDARD INTERFACE

- Native integration - one common HMF product
- Supports latest MCX standard & cloud-based architectures
- Mission- & business-critical scenarios - TETRA & MCX complementing each other
- Scalable & reliable (redundancy options)
- Integrated NMS



MCX INTEROPERABILITY



HMF successfully participating on 7th, 8th & 9th MCX Plugtests™ by ETSI



SECURITY – HMF CERTIFICATIONS



- ISO 27001-certified



- Information Security Management System (ISMS)
 - based on BSI* compendium (IT protection compendium)



- NIS2 Directive EU legislation on cyber security



- IEC62443-certification

- Software R&D according IEC62443 Part 4-1

- Secure product development life-cycle (SDL)
- Secure design
- Secure implementation (incl. coding guidelines)

- OWASP security guidelines (Open Web Application Security Project)

***Federal Office for Information Security in Germany**

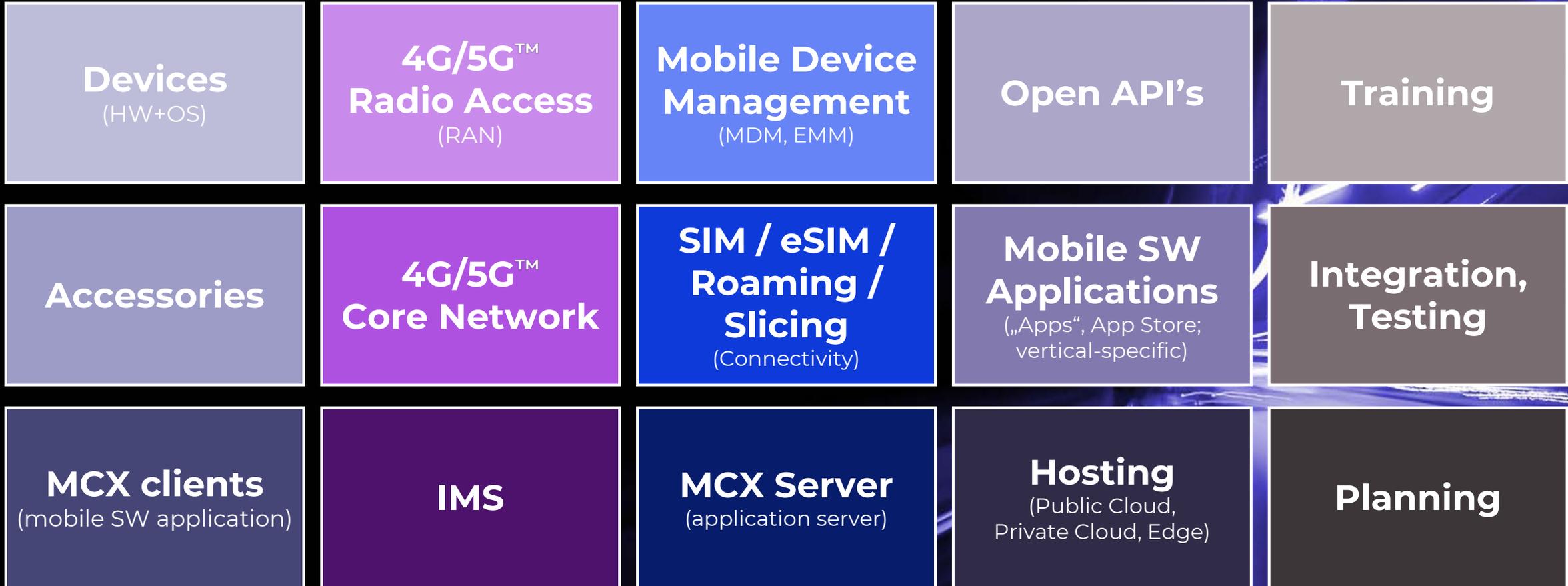


HMF MCX Solution Eco System

05



MISSION-CRITICAL ECO SYSTEM (MCX)



PTT/POC/MCX DEVICES: HYTERA BRAND, EXAMPLES/SELECTION

Broadband Cellular



P50
IP68
2G, 3G, LTE™,
Wi-Fi®

P50 Pro
IP68
2G, 3G, LTE™,
Wi-Fi®, NFC

P60
IP68
2G, 3G, LTE™,
Wi-Fi®, NFC

PNC460
IP68
2G, 3G, LTE™,
Wi-Fi®, BT®, NFC

PNC460U
UL913, IP68
2G, 3G, LTE™,
Wi-Fi®, BT®, NFC

PNC560
3GPP QCI's
IP68
2G, 3G, LTE™, 5G™
Wi-Fi®, BT®, NFC

PNC660
3GPP QCI's
IP68, Security
2G, 3G, LTE™, 5G™
Wi-Fi®, BT®, NFC

PDM680
3GPP QCI's
IP68
DMR 340-470MHz
2G, 3G, LTE™, 5G™
Wi-Fi®, BT®, NFC

PTC680
TETRA+LTE™
IP68
TETRA 350-475MHz
GSM, LTE™,
Wi-Fi®, BT®, NFC

Hybrid +DMR/TETRA



DEVICES ALREADY TESTED BY HMF (WHITELIST)

Many more available

Rugged



Crosscall Core-Z5
3GPP QCI's
IP68
2G, 3G, LTE™, 5G™
Wi-Fi®, BT®, NFC

Samsung Xcover6 Pro
IP68
2G, 3G, LTE™, 5G™
Wi-Fi®, BT®, NFC

Nokia XR20 Enterprise Ed.
IP68
2G, 3G, LTE™, 5G™
Wi-Fi®, BT®, NFC

Telox/TELO TE620G
3GPP QCI's
IP68
2G, 3G, LTE™, 5G™
Wi-Fi®, BT®, NFC

RugGear RG725/750
3GPP QCI's
IP68
2G, 3G, LTE™
Wi-Fi®, BT®, NFC

RugGear RG440
3GPP QCI's
IP68
2G, 3G, LTE™, 5G™
Wi-Fi®, BT®, NEC

ATEX / IS
Zone 1/21
Zone 2/22



3GPP-compliant QCI support for Mission-Critical Services (MCX)



i.safe MOBILE IS440.1
3GPP QCI's
IP68
LTE™, 5G™
Wi-Fi®, BT®, NFC

i.safe MOBILE IS540.1/2
3GPP QCI's
IP68
2G, 3G, LTE™, 5G™
Wi-Fi®, BT®, NFC



DEVICES ALREADY TESTED BY HMF (WHITELIST)

- i.safe MOBILE IS440.1 
- i.safe MOBILE IS540.1 
- Pepperl & Fuchs Smart-Ex 03 
- RugGear RG440
- RugGear RG540
- RugGear RG750 / RG725
- RugGear RG530 / RG540
- RugGear RG880i
- Samsung Xcover 6 & 6 Pro
- Samsung Xcover 7 & 7 Pro
- Samsung Galaxy S23 (Ultra)
- Samsung Galaxy S24 (Ultra)
- Hytera P50 & P50 Pro
- Hytera P60
- Hytera PNC660
- Hytera PNC560
- Hytera PNC460(U)
- Telox TE620G / TE650
- Telox TE800
- Sonim XP10
- Crosscall CORE-Z5
- Nokia XR20 (Enterprise Edition)
- Apple iPhone 14



Single Client Dispatcher



AIO Dispatch Desktop



AIO Dispatch Console

ACCESSNET®-T IP



TETRA Devices

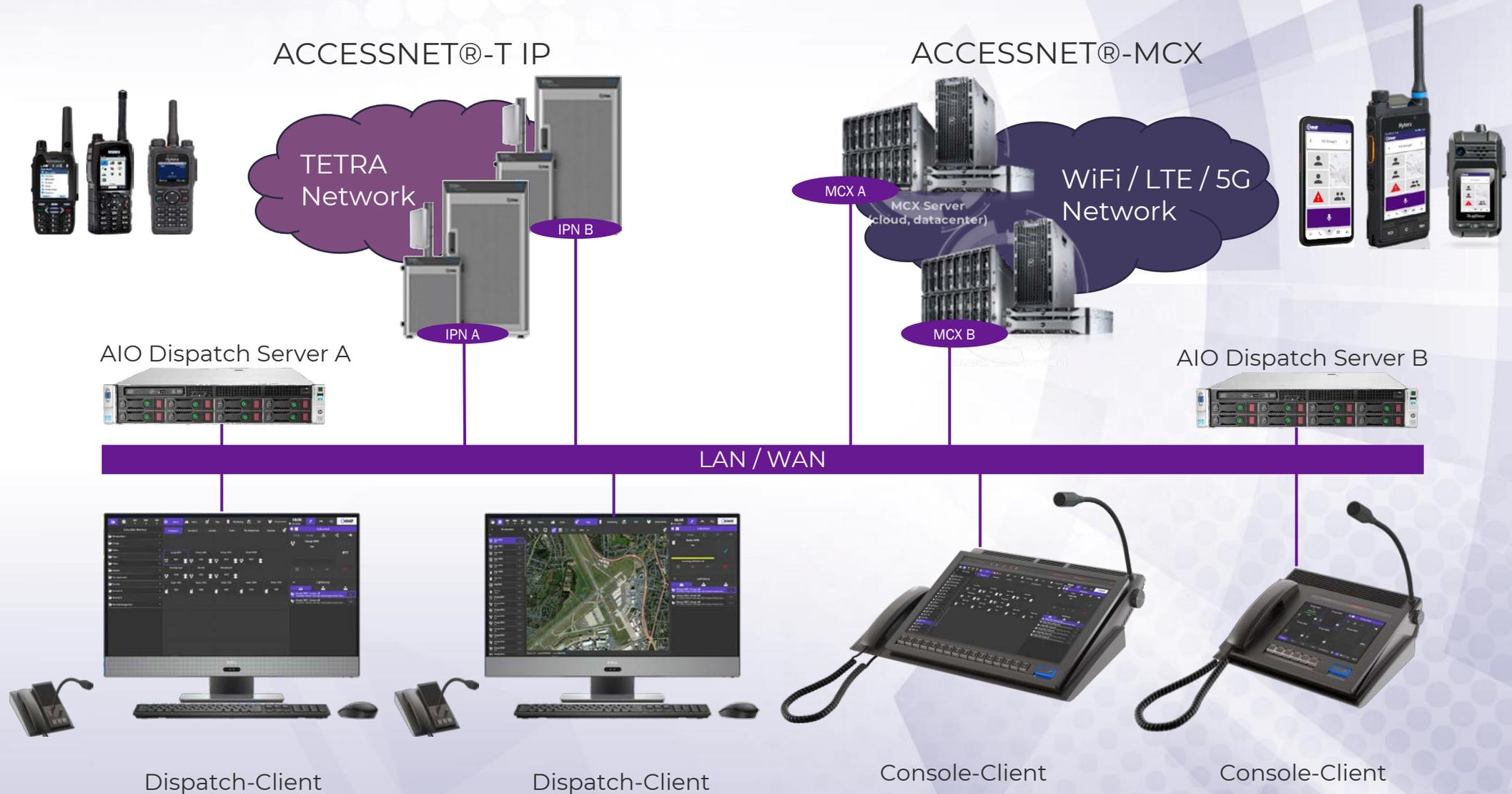
LAN / WAN

ACCESSNET®-MCX

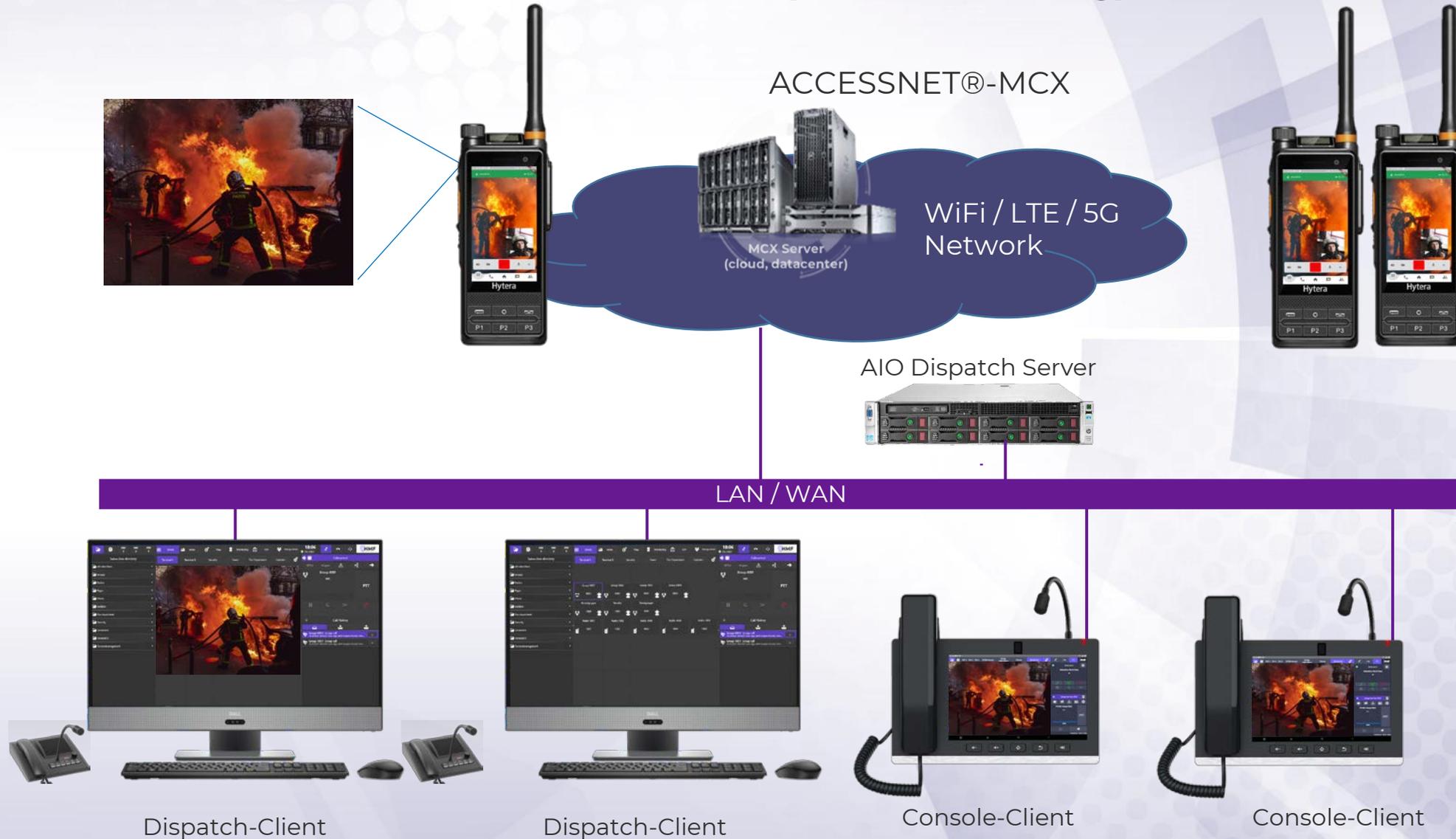


MCX Devices

Multi Client Dispatcher (redundant)



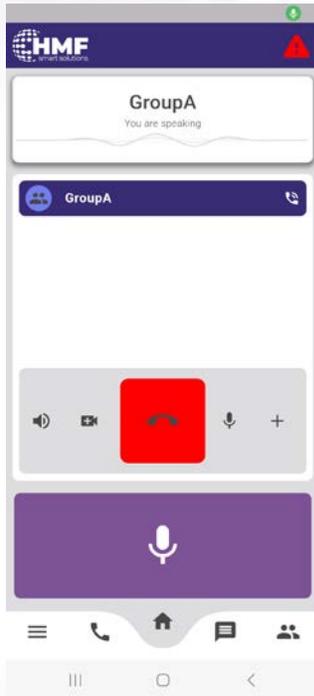
AIO PushToVideo (Video-Streaming)



MCX Client App



Main Menu



Voice call



Video call

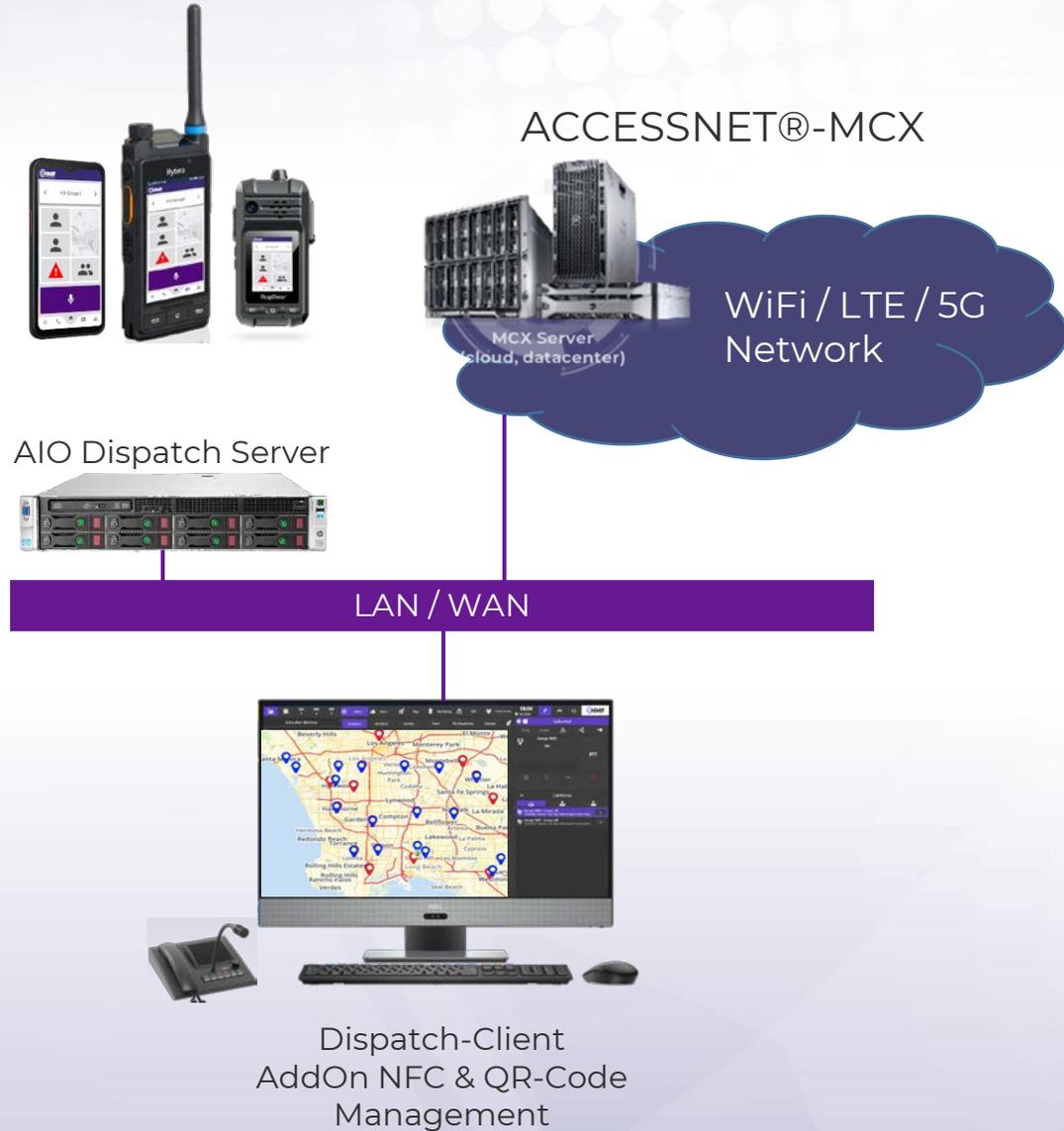
Initiate & receive MCX voice calls

- Group call (semi-duplex, point-to-multipoint)
- Chat group call (semi-duplex, point-to-multipoint)
- Imminent peril group call
- Group affiliation/de-affiliation | Talkgroup activation
- Talkgroup scanning (call activity scanning)
- Group broadcast call (point-to-multipoint, no talkback)
- Multi Talker

Initiate & receive MCX Video calls

- Full-duplex video private call
- Semi-duplex video group call
- Video pull
- Video push
- Video upload
- Video forwarding

AIO NFC & QR-Code Management

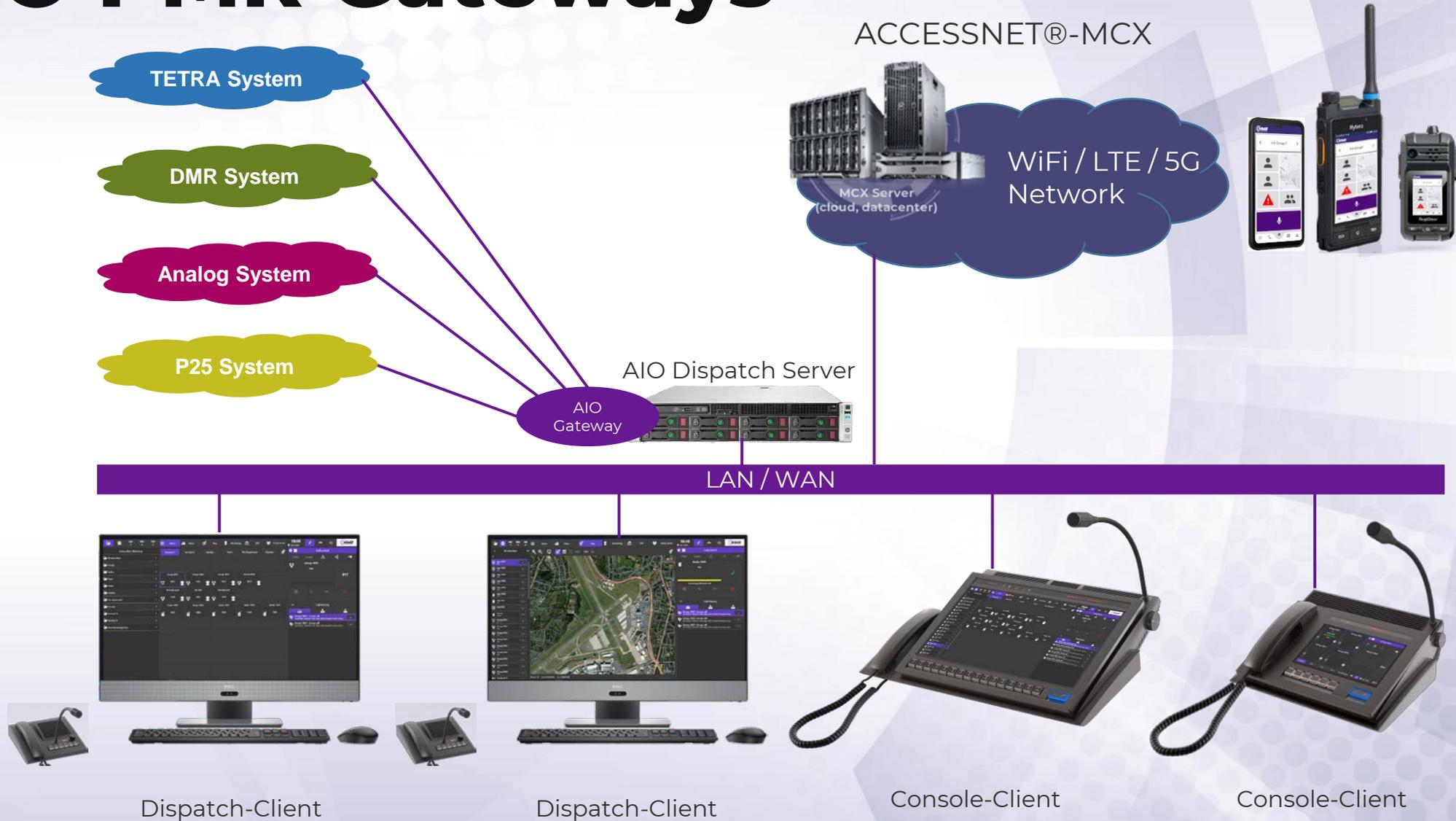


NFC Management System

- NFC – Tags / QR-Codes
- Geolocation / Status messages
- Equipment Management
- ID Management
- Time Management

MCX CoPilot APP

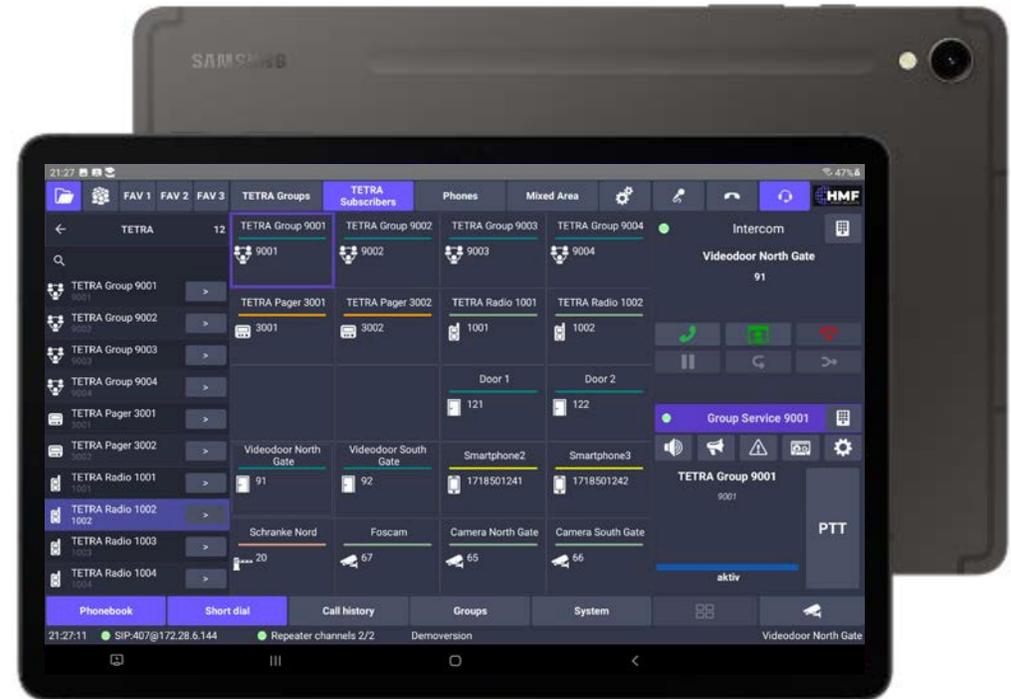
AIO PMR Gateways



AIO Dispatch Tablet App (Android & iOS)

Performance characteristics

- Radio console and SIP-Phone
- 10" Android 11,12,13,14 Tablet
- 10" +12" iPad
- Line connected (LAN/WAN) via AIO-Server
- Bluetooth headsets
- Individual/Group call
- PSTN/PABX SIP call
- Emergency calls
- SDS and status messages
- Door Intercom with video
- Camera integration

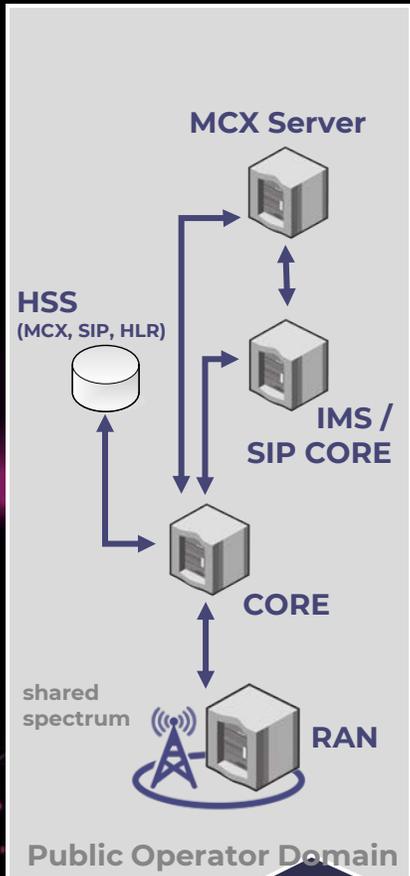


MCX Deployment & Integration with Cellular Networks

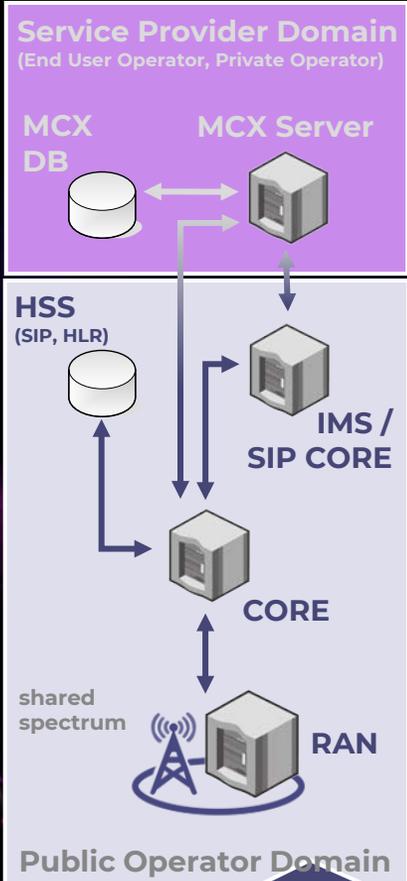
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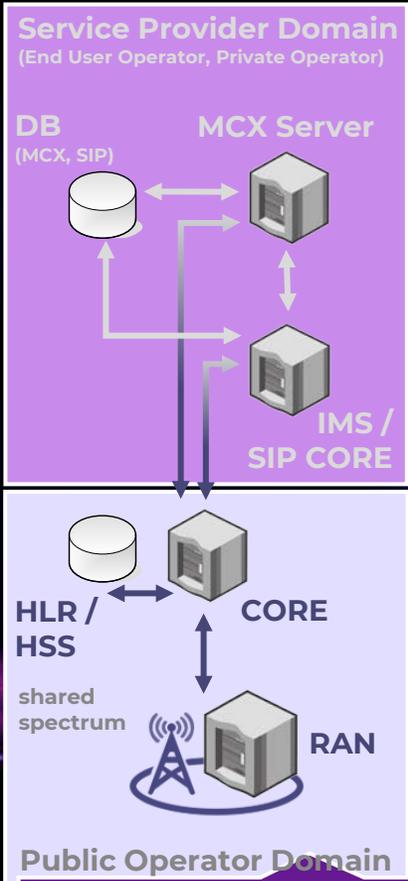
VARIANTS NET ARCHITECTURE („Deployment“)



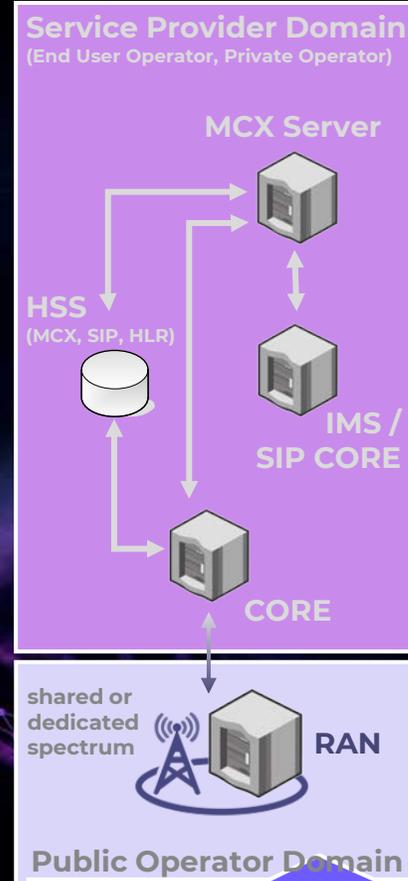
Scenario #1:
Public service MCX
(Fully hosted by MNO)



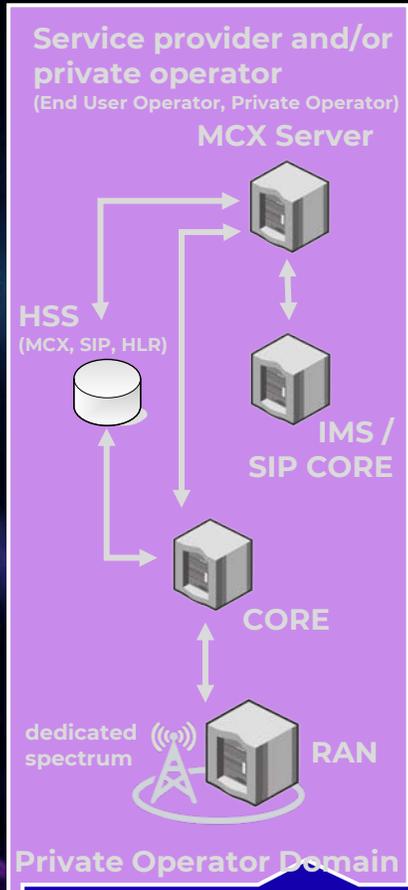
Scenario #2:
MCX services by
dedicated
MC service provider



Scenario #3:
„MVNO light“
(MC service provider
hosts MCX & IMS/SIP)



Scenario #4:
„MVNO full“



Scenario #5:
Fully private /
Non-Public Network
(by user organization)

**HMF as turn-key provider of
mission-critical communication**

07



MISSION-CRITICAL SERVICES (MCX) - HMF as turn-key provider of mission-critical communication

HMF BUSINESS ACTIVITIES

Turn-key solutions – vertical-specific

- Technologies, systems, devices, services

Managed Services

- Plan → Implement → Operate → Optimize

3GPP MCX ... *made in Germany*

MISSION-CRITICAL SERVICES (MCX) - HMF as turn-key provider of mission-critical communication

HMF BUSINESS ACTIVITIES - SOLUTIONS

MARKET VERTICALS

Private industry / Private 4G/5G™
Public Safety (PSS) & PPDR
Municipality / Smart city
Energy, utilities, mining, Oil&Gas
Logistics / transport

TECHNOLOGIES

3GPP Mission-Critical Services (MCX)
ETSI TETRA
3GPP LTE™/4G & 5G™
mioty® / IoT / mission-critical IoT



Radio terminals / UE's
Bodycams
Data modems
Sensors, Actors

Plan
Implement
Operate
Optimize

MOBILE DEVICES

MANAGED SERVICES

DISCLAIMER

This presentation contains simplifications. Therefore, it must not be considered as a specification of products, systems or solutions. The contents of this document are subject to revision without notice due to ongoing progress in methodology, design and manufacturing.

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