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5G Safety - Phase 1 Industrial survey, sub-phase IR.2

Studies and conceptual design for 5G PPDR architectural concepts

Result IR.5 activity T.2.3. 5G PPDR Architectural Concepts

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1. Abstract

The document *IR.5: Studies and Conceptual Design of Architectural 5G PPDR Concepts* is the result of *T.2.3 Architectural 5G PPDR Concepts* task within the first phase of industrial research implementation, within *IR.2 Studies and Conceptual Design*. The purpose of this set of activities is preparing outline plan for services and network architecture based on 5G PPDR concepts. Starting point for 5G PPDR studies on network architecture and services and the determination of concepts were on one side results of a preliminary study on 5G and legacy special-purpose technologies, and on other side the innovative use cases introducing state of the art services for critical communications. Research has led to the proposal of concepts that will form the basis for end-end critical communications solutions and innovative services for dispatcher functions, which will be offered as a service (Network as a Service - NaaS, Dispatcher as a Service - DpaaS). Mission critical services MCX contained in dispatcher services and related applications are discussed in document IR.6, which describes the 5G PPDR platform-independent services and applications.

PPDR networks and services should allow appropriate support for the following activities:

- daily routine operations conducted by governmental services such as police, army, fire brigade, emergency rescue and civil defence;
- planned large-scale events that require additional staff and additional resources, activities, carried out by private security organisations in addition to governmental services;
- unexpected incidents and natural disasters of greater or lesser magnitude which require rapid reaction and recovery. Even in such cases, with in advance planned measures which also include the systematic training of all involved stakeholders, faster and above all more efficient reaction in case of unforeseen events can be achieved.

PPDR radio communications are by definition (Resolution 646, Rev. WRC-15) divided into:

- radio communications used by agencies and organizations responsible for the maintenance of law and order, protection of life and property and emergency situations (PP - Public Protection);
- radio communications used by agencies and organizations dealing with a serious disruption of the functioning of society, posing a significant widespread threat to human life, health, property or the environment, whether caused by accident, natural phenomena or human activity, and whether developing suddenly or as a result of complex, long-term processes (DR - Disaster Relief).

PPDR services supported by TETRA and DMR technologies are limited to voice services and minimal set of data services which have limited data transfer capabilities looking from today's perspective and do not support more recent services and applications which require significantly higher data throughput. Existing PPDR technologies have been specially developed for specific user categories and not for a wide use in mobile communications. Digital Single Market strategy prepared by European Commission has taken the initiative to develop PPDR services based on standardised and proven technologies for mobile networks. For operation of broadband PPDR (BB-PPDR) networks the use of networks compliant with 3GPP standards is envisaged, since these networks are well established and globally widespread. 3GPP networks also have clearly defined development path to the next, even more capable generations of mobile networks. Uniform technology offers many advantages. It allows sharing of existing broadband infrastructure for the needs of PPDR organisations and at the same time allows the emergence of PPDR services market. This new approach requires a mental changeover and enables new business models for building up and managing PPDR networks and PPDR services provisioning.

Presented architectural solutions and concepts will allow the identification and comprehensive support to national policies on PPDR networks and services, which will include a comprehensive plan for network and services operation in normal conditions, their use in disaster relief and in restore to normal operation phase. Existing broadband wireless network, in particular the upcoming 5G network, will meet all the requirements and needs of PPDR users. These requirements are the highest possible availability and accessibility of networks and services, network security, use of limited range of services also in the case when the network is not available and compliance with regulatory requirements.

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Architecture of heterogeneous networks and services and the proposed concepts encourage the sharing of network infrastructure and enable interoperability in emergency situations regardless of the network, network operator or technology. In doing so, the concepts support organisational hierarchy by clearly distributed roles and responsibilities of participating stakeholders.

The following starting points are relevant for the networks architectural concepts: PPDR frequency spectrum, communication scenarios for efficient operation functioning, coverage and capacity, reliability of operations, priority access and quality of service, interoperability and compatibility, security and privacy, and platform-independent services and applications.

Depending on the ownership and maintenance of specific network levels (infrastructure, IP CAN access network and core network), and depending on the use of technologies there are several architectural concepts which we have addressed:

- state BB-PPDR network,
- contractually dedicated BB-PPDR network,
- public network,
- public network with specific requirements for BB-PPDR services,
- hybrid solution with partially dedicated network where the division between the dedicated and the public network is carried out in several ways:
    - geographic split between dedicated and public network,
    - MVNO for BB-PPDR users using a public access radio network,
    - MVNO for BB-PPDR users using geographically separate radio access network,
    - MVNO for BB-PPDR users with the radio access network in a dedicated BB-PPDR radio spectrum.

We performed basic technical analysis taking into account the available frequency spectrum for each considered architectural concept. We examined the influence of various architectural options on the feasibility of user scenarios in the experimental development phase. When defining architectural models for services and applications we took in account:

- general 5G network architecture,
- standard protocols between network elements,
- functional requirements for mission critical systems and for audit trail,
- integration of existing DMR and TETRA systems via available interfaces of those systems,
- quality of service requirements in heterogeneous networks in such way that future upgrades of functionalities will not substantially interfere with the overall architecture of the solution,
- independence of graphical component regarding the services provided by the component DPaaS,
- architectural model components for MCX clients and application server, as defined by the 3GPP standards,
- integration of communication technologies for 112 applications for citizens with a component DPaaS,
- independence of different business models that are being examined in the context of the project 5G Safety,
- segmentation into components, providing domain-specific services and components that provide support services and
- integration of security components with no direct impact on the business logic components for domain services.

In addition, we took into account the distributed network architecture with standard PEMEA protocol to which national 112 applications for citizens converge, in accordance with the EENA initiative.

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PEMEA protocol represents the current architecture development of 112 applications for citizens; it solves problems due to non-standardized approach of individual national applications and hence their incompatibility and ensures operation when roaming abroad. Architecture with a central server is being presented, as well as architecture of existing national mobile applications for 112 data calls and management of PEMEA standard based systems.

These individual architectural concepts were also validated according to the results of studies on technologies, use cases and business models.

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