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Reconfigurable Radio Systems (RRS); Radio Equipment (RE) reconfiguration use cases

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Reconfigurable Radio Systems (RRS).

Modal verbs terminology

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Introduction

The present document provides use cases for radio equipment reconfiguration through software. It extends the use cases defined in ETSI TR 103 062 [i.7] for mobile device reconfiguration to the more generic framework of radio equipment reconfiguration.

1 Scope

The scope of the present document is to define use cases for radio equipment reconfiguration through software.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI EN 302 969 (V1.2.1): "Reconfigurable Radio Systems (RRS); Radio Reconfiguration related Requirements for Mobile Devices".

[i.2] ETSI EN 303 095 (V1.2.1): "Reconfigurable Radio Systems (RRS); Radio Reconfiguration related Architecture for Mobile Devices".

[i.3] ETSI EN 303 146-1 (V1.2.1): "Reconfigurable Radio Systems (RRS); Mobile Device Information Models and Protocols; Part 1: Multiradio Interface (MURI)".

[i.4] ETSI EN 303 146-2 (V1.2.1): "Reconfigurable Radio Systems (RRS); Mobile Device (MD) information models and protocols; Part 2: Reconfigurable Radio Frequency Interface (RRFI)".

[i.5] ETSI EN 303 146-3 (V1.2.1): "Reconfigurable Radio Systems (RRS); Mobile Device (MD) information models and protocols; Part 3: Unified Radio Application Interface (URAI)".

[i.6] ETSI EN 303 146-4 (V1.1.2): "Reconfigurable Radio Systems (RRS); Mobile Device (MD) information models and protocols; Part 4: Radio Programming Interface (RPI)".

[i.7] ETSI TR 103 062 (V1.1.1): "Reconfigurable Radio Systems (RRS); Use Cases and Scenarios for Software Defined Radio (SDR) Reference Architecture for Mobile Device".

[i.8] Recommendation ITU-R S.1709-1: "Technical characteristics of air interfaces for global broadband satellite systems".

[i.9] From "Bent Pipes" to "Software Defined Payloads": Evolution and Trends of Satellite Communications Systems, Piero Angeletti, Riccardo De Gaudenzi and Marco Lisi, June, 2008.

[i.10] IETF RFC 7426: "Software-Defined Networking (SDN): Layers and Architecture Terminology".

[i.11] ETSI GS NFV 002 (V1.1.1): "Network Functions Virtualisation (NFV); Architectural Framework".

3 Definition of terms, symbols and abbreviations

3.1 Terms

Void.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

FFT	Fast Fourier Transform
FPGA	Field Programmable Gate Array
GEO	Geostationary Earth Orbit
IoT	Internet of Things
LEO	Low Earth Orbit
LLC	Logic Link Control
MURI	Multi Radio Interface
NR	New Radio
RA	Radio Application
RadioApps	Radio Application Store
RAP	Radio Application Package
RAT	Radio Access Technology
RLC	Radio Link Control
RRS	Reconfigurable Radio Systems
SCC	Satellite Control Center
SDR	Software Defined Radio
SW	SoftWare
USB	Universal Serial Bus
V2X	Vehicle to Everything
RF	Radio Frequency
RX	Receive
TX	Transmit

4 Radio Equipment Reconfiguration Use Cases

4.1 Overview

This clause provides some use cases of the SW reconfiguration and related equipment-specific application scenarios. Use cases considered in this clause are as follows:

- Use Case "Smartphone Radio Reconfiguration" in clause 4.2.
- Use Case "Connected Vehicle Radio Reconfiguration" in clause 4.3.
- Use Case "Network Radio Reconfiguration" in clause 4.4.
- Use Case "IoT Device Reconfiguration" in clause 4.5.
- Use Case "Radio Reconfiguration through an external Component" in clause 4.6.
- Use Case "Reconfigurable Satellite Telecom Payload" in clause 4.7.

- Use Case "Bug-fix and security updates" in clause 4.8.

NOTE: Use Cases given in clauses 4.2, 4.3, 4.4, 4.5, 4.6 and 4.7 are design Use Cases; the Use Case given in clause 4.8 is a Use Case for achieving a defined purpose.

4.2 Use Case "Smartphone Radio Reconfiguration"

4.2.0 General

The average lifetime of smartphones is substantially shorter (~2 years) compared to other radio equipment (> 2 years) such as vehicles, base stations, etc. Since smartphones are also generic computing platforms, they are subject to gradual obsolescence - in terms of computing power - when new use cases and software-based solutions become available. Therefore, radio reconfiguration use cases corresponding to the evolution of communication standards do not seem to be a major factor in the case of smartphones. Rather, the scenario of optimizing the operation of smartphones in accordance to the functional blocks in a given Radio Application code that might be downloaded from RadioApp Stores will be the main factor determining the use case of the smartphone radio reconfiguration. In this context however, minor updates to Radio Applications remain critical in order to provide technical corrections and address security vulnerabilities. RadioApps, provided as the ETSI SW Reconfiguration solutions, extend or modify existing radio features and define solutions for technical, certification and security needs.

4.2.1 Scenario "Optimize the operation of Smartphone"

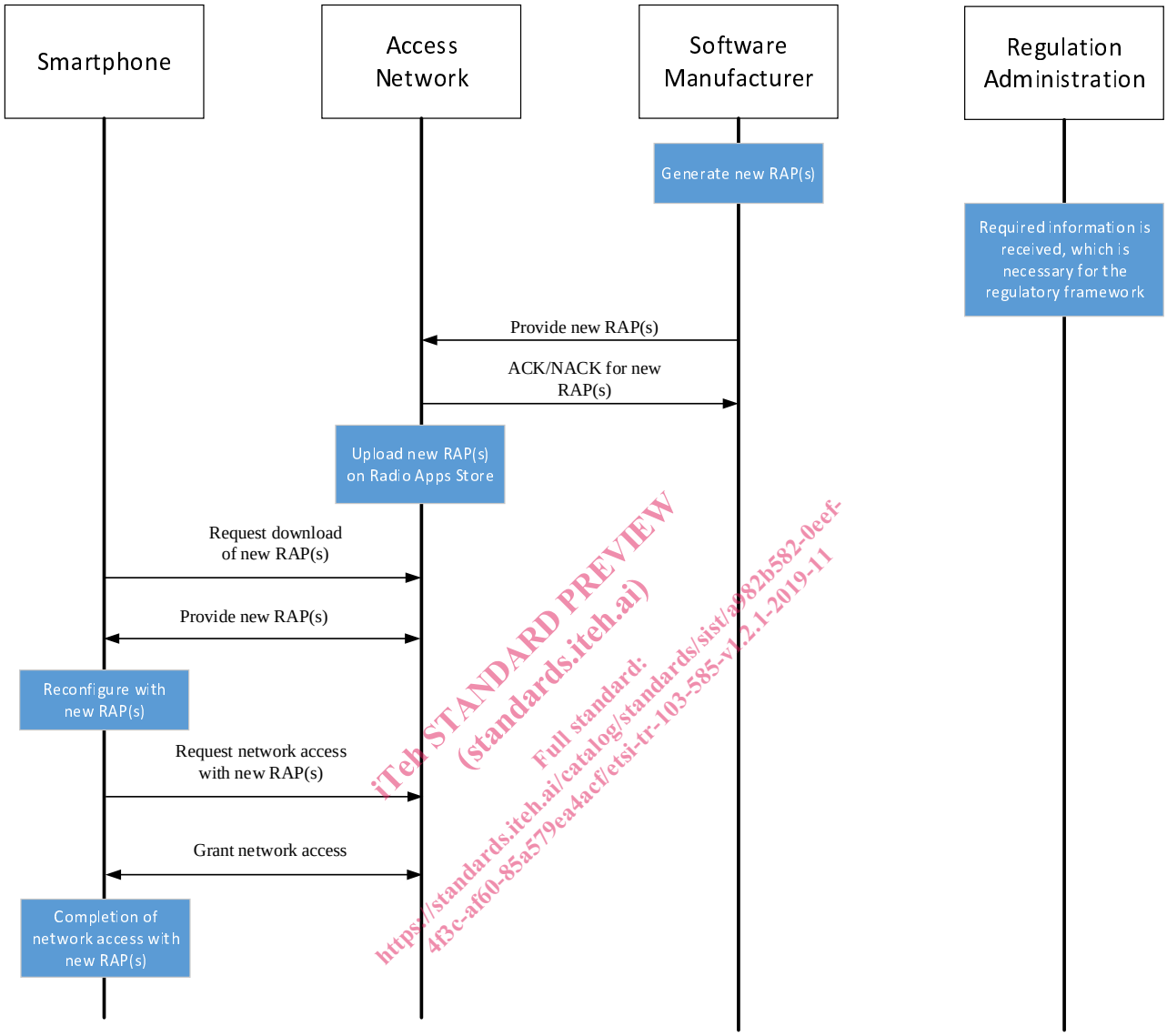
In this scenario, the operation of smartphone is optimized using an RA code corresponding to the required functional block(s) of desired communication protocol(s) downloaded from RadioApp Store upon user's request. For example, a LTE smartphone user could update his/her RA code of LTE protocol with a new FFT functional block which, for instance, utilizes less computational resources compared to the FFT functional block in the given RA code in order to save the computational complexity. The optimization of smartphone operation is achieved in general by replacing some functional blocks with new ones or the entire RA code with a new one.

4.2.2 Stakeholders

- End users: the users of the smartphones accessing internet and other similar mobile data services.
- Network operators:
  - operate and maintain the required infrastructure;
  - might provide information on the availability of new RAP(s) to the end users; might provide the new RAP(s) to the end users.
- Software Manufacturer: may provide new RAP(s) for optimizing the operation of smartphone.
- National Regulatory Authority: provides framework for certification of new RAP(s) provided by software manufacturers.

4.2.3 Information Flow

4.2.3.1 Information Flows for Scenario "Optimize the operation of Smartphone"



NOTE: The RAP(s) shown in Figure 4.2.3.1-1 is for functional block(s) of desired communication protocol(s) or entire RAT.

Figure 4.2.3.1-1: Information Flow for Scenario "Optimize the operation of Smartphone"

NOTE: The "required information" for the Regulation Administration is issued by a suitable source. In this Use Case, no assumption on the responsible party for regulatory compliance is made.

4.3 Use Case "Connected Vehicle Radio Reconfiguration"

4.3.0 General

Since the lifetime of automotive communication components is substantially longer (> 10 years) compared to smartphones (~2 years), it seems to be necessary for the communication platform in a vehicle to cope with the new communication standard through the SW reconfiguration. The challenge is to ensure that a radio communications component remains relevant over the entire life-time of a vehicle, i.e. 10 years and beyond. It is almost certain that a V2X framework feature-set will evolve within this period. SW Reconfiguration will enable Manufacturers to replace specific SW and thus maintain related feature-sets up-to-date without requiring changes to the hardware. Accordingly, the use case for the connected vehicle should be based on the SW reconfiguration of the communication platform in accordance to the changes in the communication standard being used in vehicular communications.

4.3.1 Scenario "Upgrade of Feature-Set"

It is expected that LTE C-V2X will further evolve towards 5G New Radio based V2X services and beyond. Consequently, new features will be added by a continued standardization activity. In this scenario, it is assumed that an initial radio component design will comprise supplementary computational and memory resources which may remain unused during a first phase; with upcoming new features, however, corresponding software components will be made available to provide required feature-sets by exploiting those resources. Typically, the resources include FPGA (Field Programmable Gate Array), DSPs (Digital Signal Processors), memory and other resources.

4.3.2 Scenario "Addressing Vulnerabilities"

Automotive communication components are a likely target for malicious attacks due to the large scale deployment, the high potential for causing damage through attacks and the long life-time of radio components. Indeed, the life-time corresponds to the life-time of a vehicle which is typically 10 years or more. It is therefore likely that vulnerabilities will be identified during this substantial time period. Those vulnerabilities may relate to design choices, protocol weaknesses, etc. When such a vulnerability is identified, it is essential to modify affected functionalities such that no damage can be caused to concerned vehicles and persons. Preferably, this modification is implemented on all relevant vehicles within the shortest time possible. Over-the-Air Software updates are a suitable means to achieve this objective.

4.3.3 Stakeholders

- End users: the users of the connected vehicles accessing internet and other similar mobile data services.
- Network operators:
  - operate and maintain the required infrastructure;
  - might provide information on the availability of new RAP(s) to the end users; might provide the new RAP(s) to the end users.
- Vehicle manufacturers: provide information on the availability of new RAP(s) to the network operators; might provide new RAP(s) to network operators.
- National Regulatory Authority: provides framework for certification of new RAP(s) provided by vehicle manufacturers.

4.3.4 Information Flow

4.3.4.1 Information Flows for Scenario "Upgrade of feature-Set" and "Addressing Vulnerabilities"

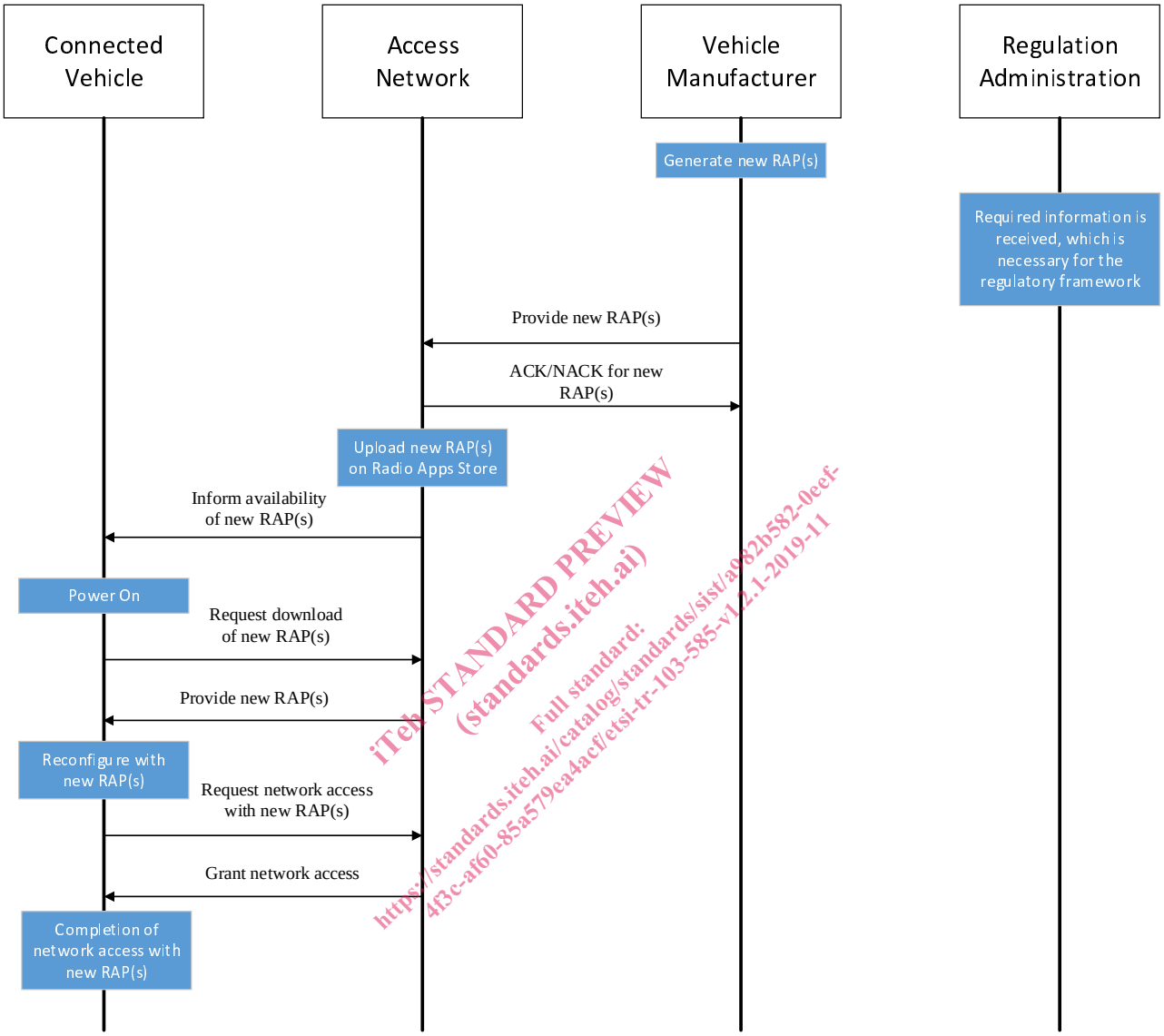


Figure 4.3.4.1-1: Information Flow for Scenarios "Upgrade of feature-Set" and "Addressing Vulnerabilities"

Note that the RAP(s) shown in Figure 4.3.4.1-1 is for upgrade of feature-set or addressing vulnerabilities. A typical example RAP for the upgrade of feature-set might be a 5G New Radio (NR) protocol that will be available as the standard of mobile communications evolves from 4G to 5G. A typical example for the addressing vulnerabilities might be a security-related RAP as a countermeasure against malicious attack(s). It is noteworthy that vehicle manufacturers not the 3rd party software manufacturer provide the RAP in the vehicle use case. The reason being so is that only the RAP of which the operation is fully verified is provided by vehicle manufacturers in the use case of connected vehicle.

NOTE: The "required information" for the Regulation Administration is issued by a suitable source. In this Use Case, no assumption on the responsible party for regulatory compliance is made.