



# Functional Architecture Overview for the Cognitive Management of Opportunistic Networks in the Context of Future Internet

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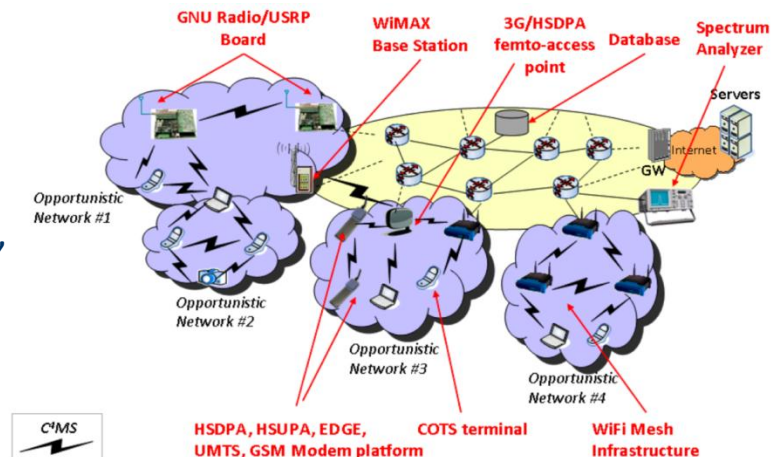
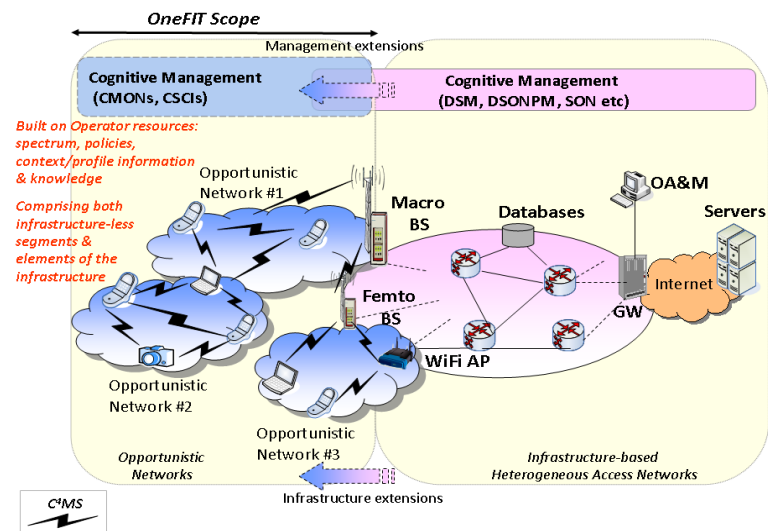
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# Presentation Overview

- OneFIT background
- Overview of System Requirements and Technical Challenges
- Functional Architecture
  - Detailed Functional Architecture in the Operator's Infrastructure
  - Detailed Functional Architecture in the Terminal
- System Architecture
- Control Channels for the Cooperation of Cognitive Management Systems (C4MS)
- Conclusions

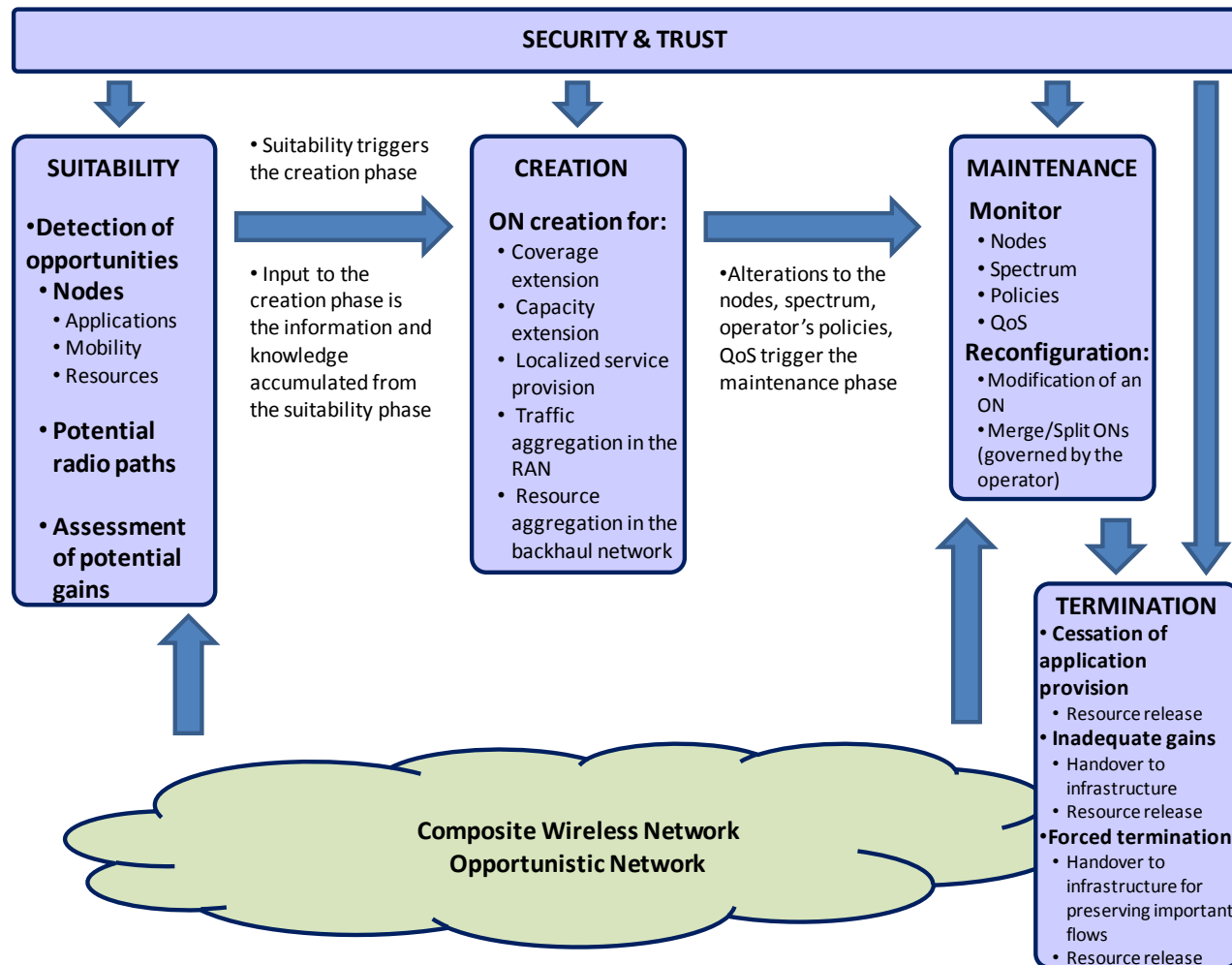
# OneFIT background

- “The main objective of the project is to design, develop and validate the concept of applying opportunistic networks and respective cognitive management systems for efficient application/ service/ content provisioning in the Future Internet”
- Opportunistic networks are operator governed (through resources, policies, and information/knowledge) and can be coordinated extensions of the infrastructure for a particular time interval
- Cognitive management systems required: (i) Cognitive system for the Management of the Opportunistic Network (CMONs); (ii) Cognitive System for Coordination with the Infrastructure (CSCIs);
- Control Channels for the Cooperation of Cognitive Management Systems (C4MS) required: information definition, signaling flows, protocols (packet structures, exchange)
- Challenges: Suitability determination (candidate node discovery, spectrum opportunity identification and generation); opportunistic network creation, maintenance and release



# Technical Challenges

- Main phases in the operation of an ON and related key functionalities



# System Requirements

## General Requirements

## User Requirements

## Network Management Requirements

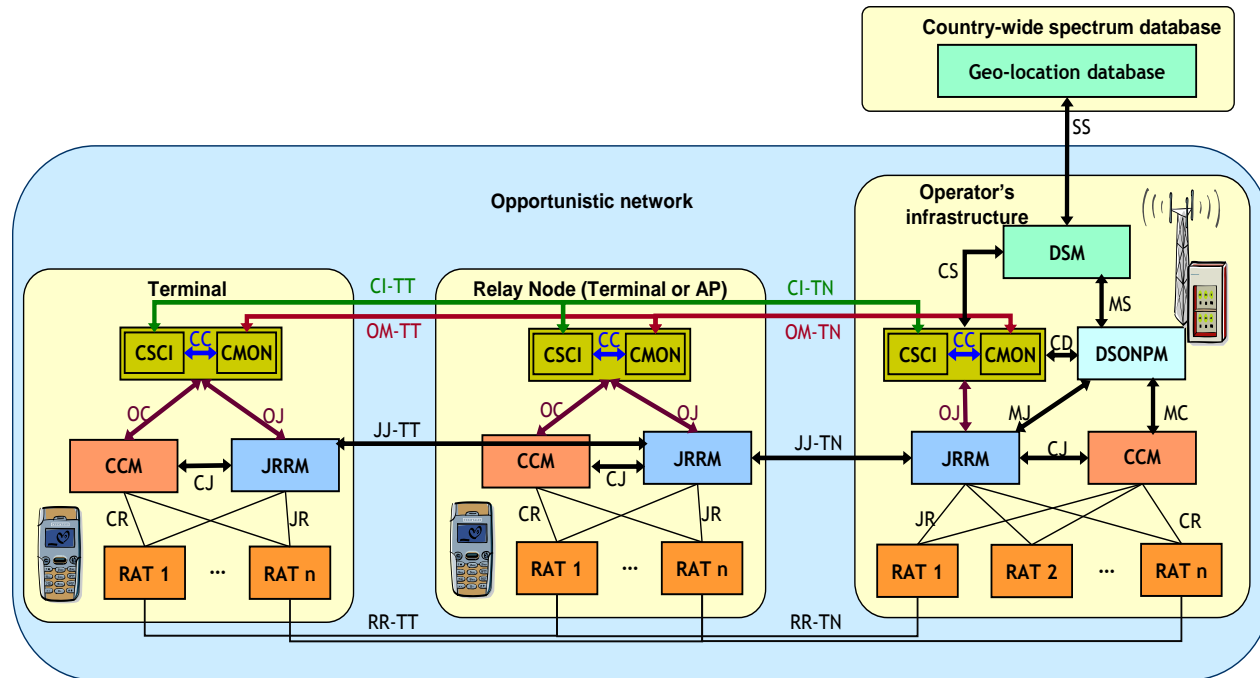
## Algorithms Requirements

## Protocol Requirements

## Security Requirements

Nbr.	Title of the requirement
G1	Communication with the infrastructure
G2	Communication between terminals
G3	Versatile spectrum use
G4	Versatile RAT/RAN use
G5	Mobility
G6	Relaying
G7	Creation of opportunistic networks
G8	Opportunistic Networks controllable by single operator
G9	Preservation of legacy RAN operation
G10	Compatibility with legacy RAN deployments
G11	Resource efficiency
U1	Hide complexity from the end user
U2	User's service perception
U3	Availability of ON-related information to the service layer
M1	Identification of the need for an opportunistic network
M2	Suitability determination
M3	Creation of opportunistic networks
M4	Connection set-up
M5	Maintenance of opportunistic networks
M6	Release of opportunistic networks
M7	Coordination of opportunistic networks with the infrastructure
M8	Opportunistic network identification
M9	Maximum size of an opportunistic network
M10	Coexistence of opportunistic networks
M11	Assignment of bandwidth
A1	Context awareness
A2	Decision making
A3	Routing
A4	ON Advertisement
P1	Protocol usage
P2	Broadcast/Multicast
P3	Unicast/Dedicated addressing
P4	Secure as well as unsecure communication
P5	Protocol efficiency
S1	Security
S2	Accountability, charging and billing

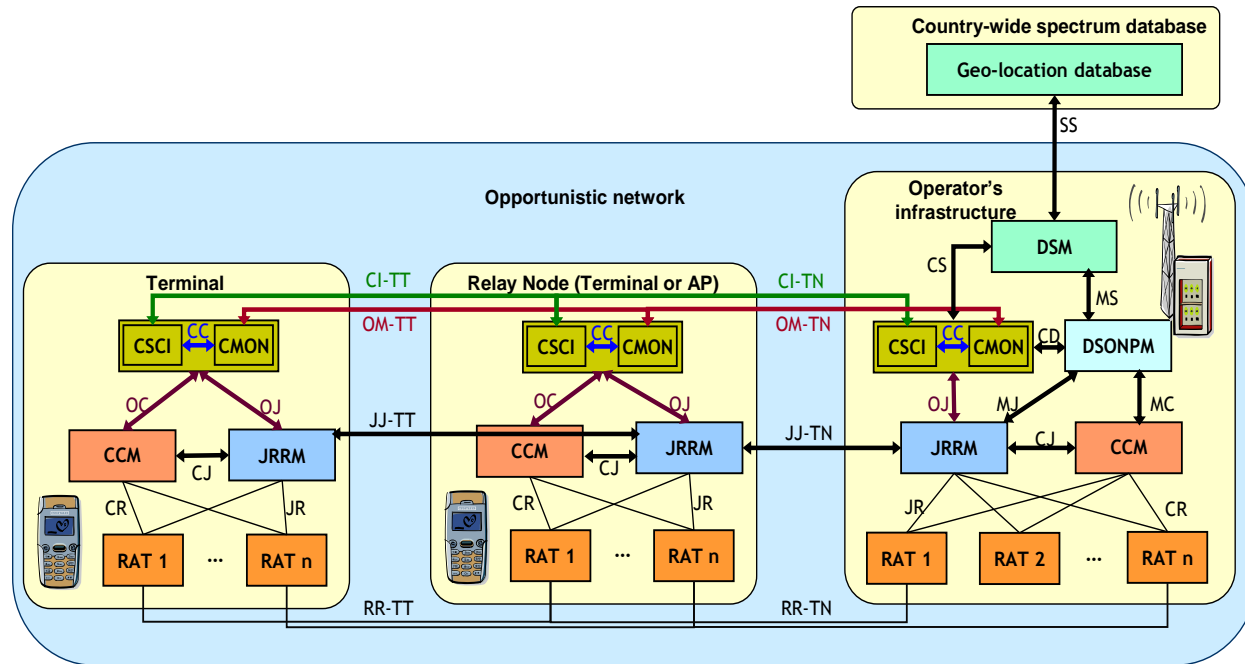
# Functional Architecture (1/3)



## Building blocks

- Cognitive management System for the Coordination of the infrastructure (CSCI)
- Cognitive Management system for the Opportunistic Network (CMON)
- Dynamic Spectrum Management (DSM)
- Dynamic, Self-Organising Network Planning and Management (DSO-NPM)
- Joint Radio Resources Management (JRRM)
- Configuration Control Module (CCM)

# Functional Architecture (2/3)



## Interfaces

- *CI for “Coordinating the Infrastructure” between CSCI-instances*
  - *CI-TT connecting CSCI-instances of two terminals*
  - *CI-TN connecting the CSCI in a terminal with the CSCI on the Network side*
  - *CI-NN connecting the CSCI-instances of two network entities.*
- *OM for the “Opportunistic Management” between CMON-instances*
  - *OM-TT connecting CMON-instances of two terminals*
  - *OM-TN connecting the CMON in a terminal with the CMON on the Network side*
  - *OM-NN connecting the CMON-instances of two network entities*
- *CC connecting the CSCI in a node with the CMON in the same node*
- *CS: Between CSCI/CMON and the DSM*
- *OJ: Between JRRM and CSCI/CMON: OJ-T and OJ-N*
- *OC: Between CCM and CSCI/CMON*
- *CD: Between DSONPM and CSCI/CMON*

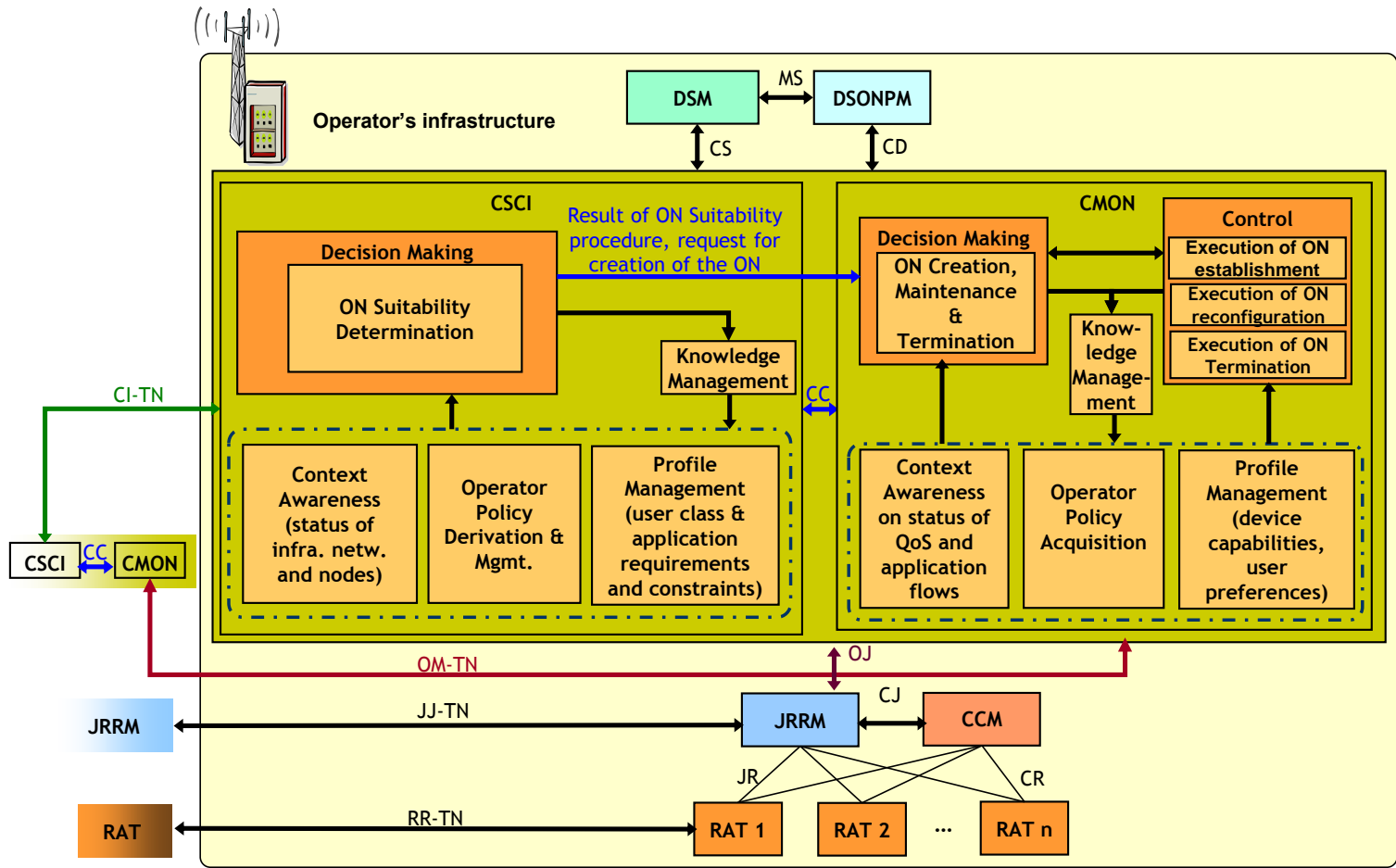
# Functional Architecture (3/3)

- Functional split between CSCI and CMON

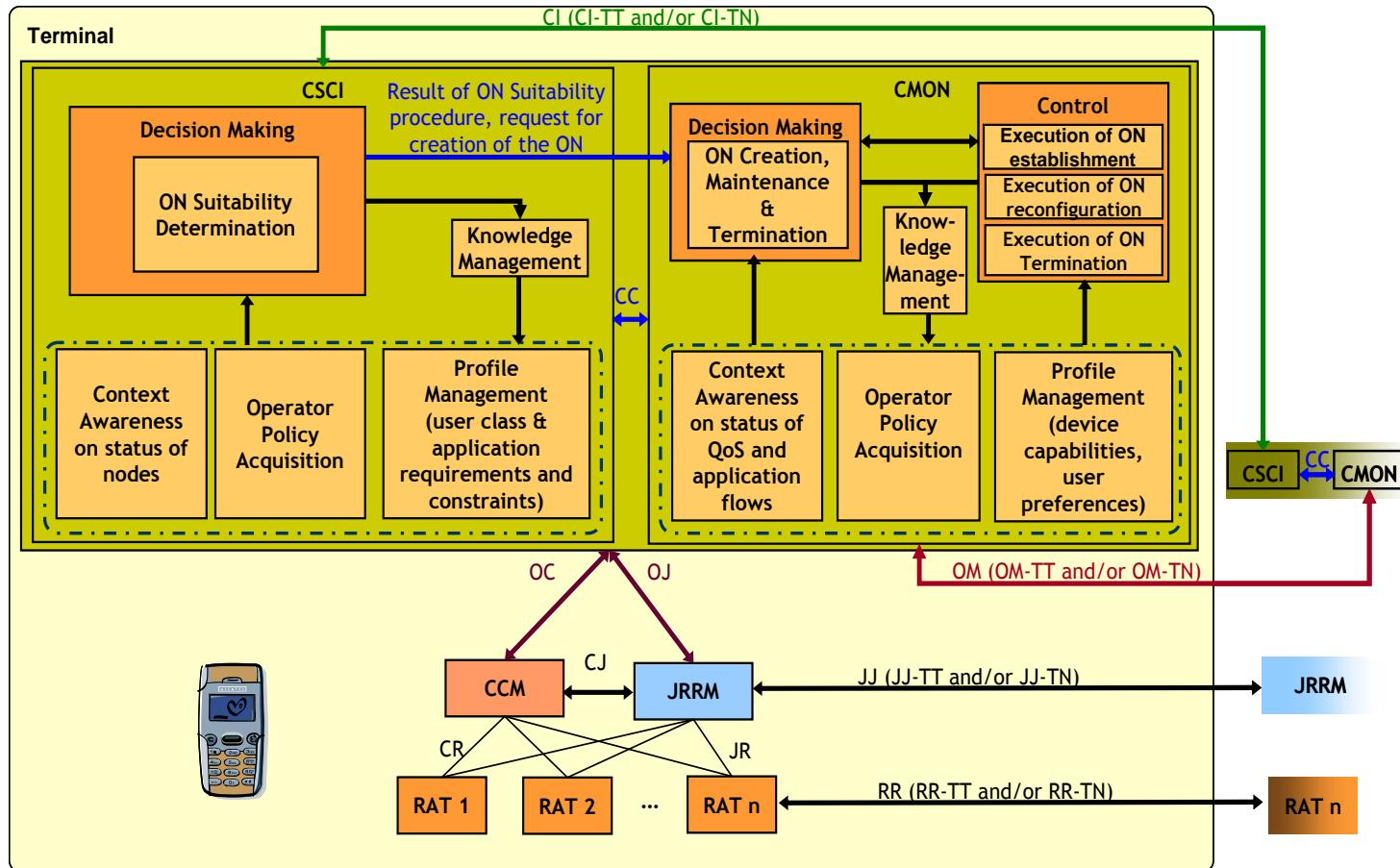
	CSCI	CMON
Coordination with the Infrastructure (Infrastructure not necessarily part of the ON)	YES	-
Coordination with other nodes in the ON	-	YES
Detection of situations where an ON may be useful	YES, typically based on external triggers, e.g. information from JRRM	-
ON Suitability determination	YES	-
Execution of ON establishment/creation	-	YES
Maintenance of ON, e.g. reconfiguration	-	YES
Decides on termination of ON when ON is no longer suitable	-	YES, typically based on external triggers
Execution of ON termination	-	YES



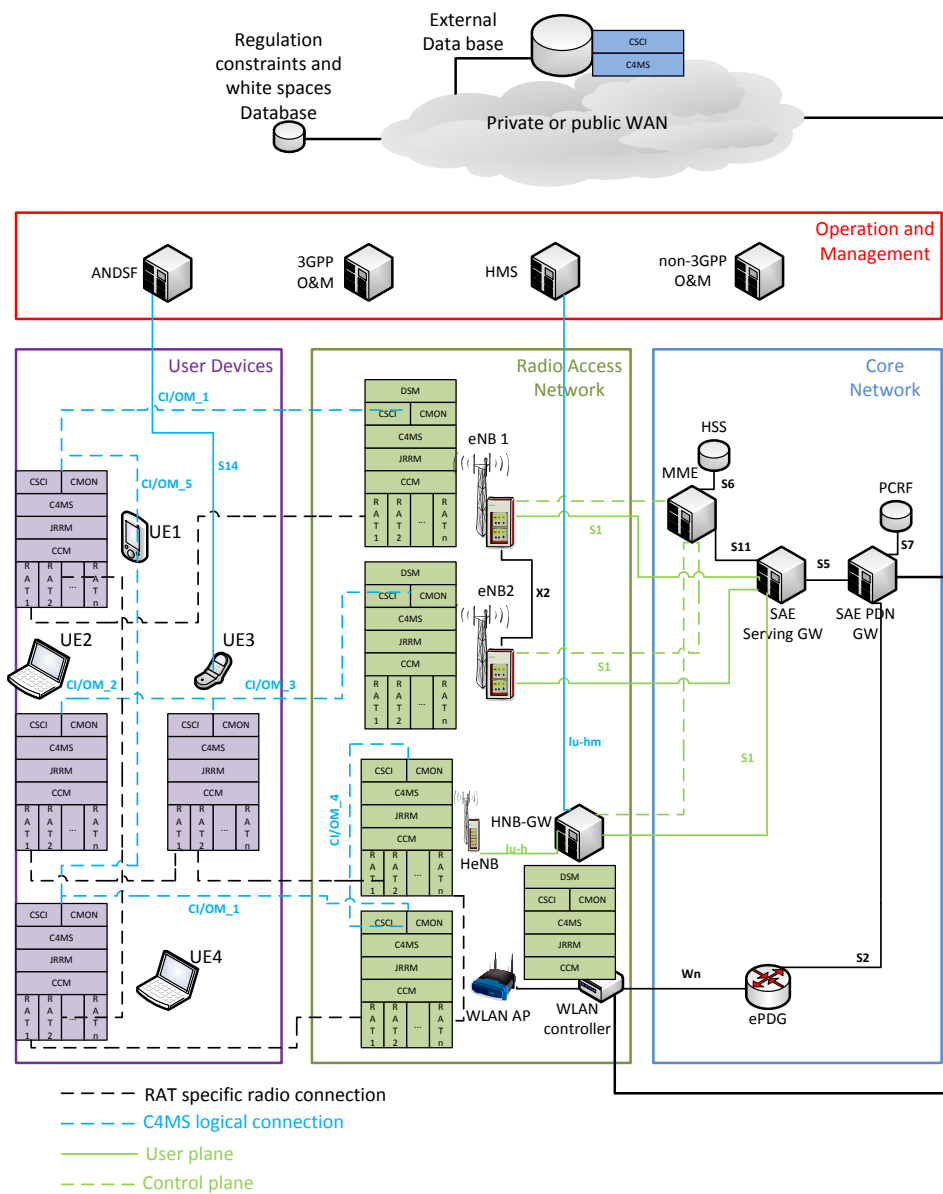
# Detailed functional view of the CSCI and CMON in the operator's infrastructure



# Detailed functional view of the CSCI and CMON in the terminal



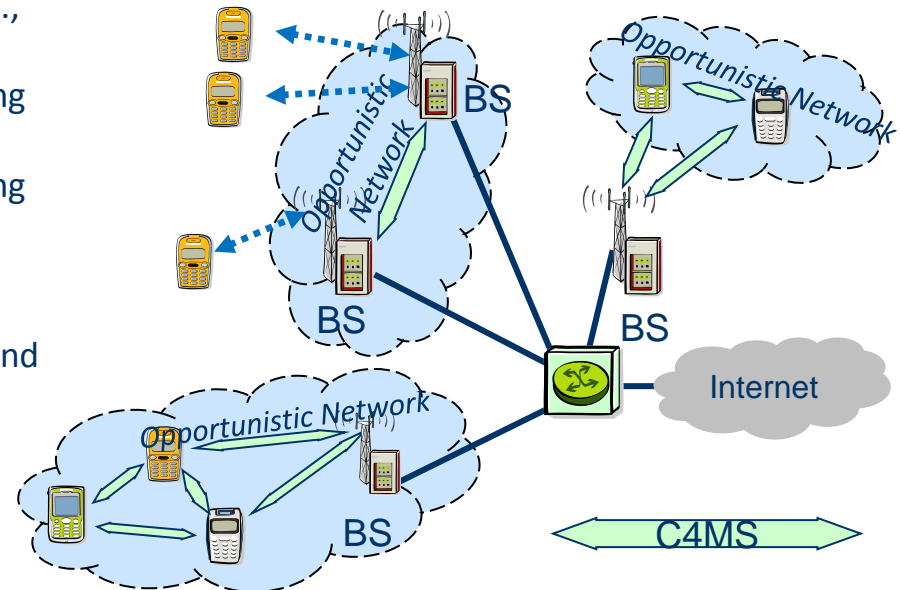
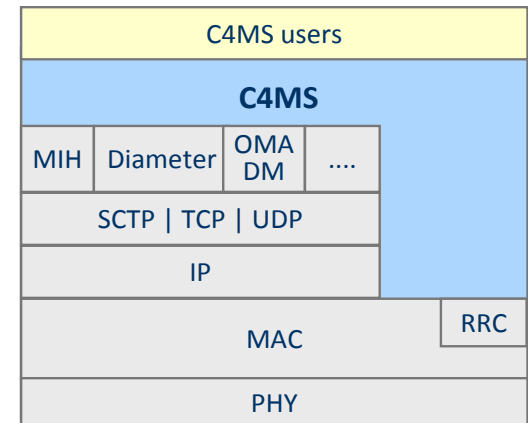
# System Architecture



# Control Channels for the Cooperation of the Cognitive Management System (C4MS)

**C4MS can be defined as a logical (and optionally in part a physical) channel which enables and coordinates the exchange of context and management information between cognitive systems (CSCIs and CMONs) located in different nodes**

- Provides a common framework integrating CPC and CCC/CCR concepts:
  - Communication between terminals and infrastructure network
  - Communication between terminals
- Provides functionalities originally defined for CPC and CCC/CCR:
  - exchange of context information, policies, etc., to enable better radio resource utilization,
  - provision of context information for supporting terminals in their start-up phase,
  - provision of context information for supporting spectrum scanning and spectrum sensing procedures
  - providing means for enabling the coexistence and coordination among different networks and devices
- Provides new functionalities
  - means for enabling the management of Opportunistic Networks through cognitive systems



# Conclusions

- Opportunistic networks are proposed as operator-governed networks through resources, policies, and information/knowledge and can be coordinated extensions of the infrastructure in a particular place, on a temporary basis
- Cognitive management systems are required (CSCI/CMON) for the management and coordination of opportunistic networks
- Control Channels for the Cooperation of Cognitive Management Systems (C4MS) are required in order to enable information definition, signaling flows, protocols (packet structures, information exchange)
- For further information, please visit:

[www.ict-onefit.eu](http://www.ict-onefit.eu)