

Coordinated Control and Spectrum Management for 5G Heterogeneous Radio Access Networks



Offloading and Slicing in 5G Networks

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infocom Infocom world

25/10/2017, Athens, Greece

General info

14 partners / 9 countries

Start date: 1/7/2015

Duration: 30 months

(balance among industry, telecom operators, universities, research institutes and SMEs)

Budget: ~ 6m€ THALES EURECOM GCeller Adility inea CREATE-NET **O** travelping SWEDISH SICS ecc UNIVERSITÄT DUISBURG Fairspectrum A! Offen im Denken



GROUP OF COMPANIES



The Concept

Goal

Design, develop and showcase **a novel control framework for 5G heterogeneous radio networks**, so as to deal with the control and coordination problem in large-scale HMNs in order to release the full potential of 5G networks.

Benefits

- Dynamic and efficient control of wireless network resources;
- Capacity improvement;
- ✓ Spectrum reuse efficiency;
- Energy efficiency, and;
- Advanced user experience.





Project Objectives

Research and develop a unified control and coordination framework for **5G heterogeneous radio access networks** (RAN), which focuses on:

- 1. Software Defined Networking for heterogeneous RANs.
- 2. Efficient radio resource modelling and management.
- 3. Flexible spectrum management
- 4. Support for Network Slicing and RAN Sharing



Coherent

Innovations

Three innovations in control and coordination of 5G networks:

- Physical and MAC layer modelling and abstraction, to provide a simple network view of low-layer reality, and thus to enable a scalable and flexible control and coordination framework for complex resource coordination and spectrum management in 5G networks.
- Programmable control based on the low-layer abstraction with well-defined open interfaces and protocols to greatly simplify the management of HMN, to be verified by efficient resource coordination algorithms developed for identified 5G use cases.
- Flexible and coordinated spectrum management based on full awareness of spectrum usage through the COHERENT network abstractions





COHERENT Concept

Develop an additional programmable control framework, being aware of underlying network topology, radio environment and traffic conditions, and being able to efficiently coordinate wireless network resources cross the border of cells.



Heterogeneous mobile network





Logical RAN Entities in COHERENT

• **Radio Transceiver (RT):** RT is a logical radio access entity with full RAN node functions, which is the flexible combination of R-TP, vRP and RTC functions. A set of RTs is forming a radio access network which is coordinated and controlled by C3.

• Radio Transmission Point (R-TP): is a radio access point implementing full or partial RAN node functions. An R-TP may include control plane functions.

• Virtual Radio Processing (vRP) a computing platform enabling centralized processing of full or partial RAN node functions. The vRP is offloaded from one or multiple R-TPs and may include control plane functions.

• **Real Time Control (RTC):** is a logical entity in charge of local or regionwide control, targeting real-time control operations. Local network view. It could run directly on one RT or on a virtualized platform and receives monitoring information gathered from one/multiple RTs.







COHERENT Scenarios & Use Cases

Scenario 1 – Virtualisation and sharing of satellite communications platforms

U.C. 1.1: RAN sharing among heterogeneous

mobile networks

U.C. 1.2: Supporting RAT sharing

U.C. 1.3: Cooperation among multi-operators

Scenario 3 – Critical Comunications

U.C. 3.1: Coordination of rapidly deployable mesh networks U.C. 3.2: Flexible resource sharing for BB PMR networks U.C. 3.3: Coverage extension and support of out-of-coverage comms (D2D comms)

Scenario 2 – Spectrum Magnagement

U.C. 2.1: Massive MIMO / distributed antenna system in dense small cell deployments

U.C. 2.2: Flexible spectrum access

Scenario 4 - Network Slicing

U.C. 4.1: Enhanced Mobile Virtual Network Operator (MVNO) for PMR services U.C. 4.2: Dynamic eMBMS for public safety applications U.C. 4.3: User groups' differentiation in multimedia service provision U.C. 4.4: Service differentiation

Scenario 5 - Massive IoT

U.C. 5.1: Wireless over power line

Scenario 6 - Enhanced broadband communications in public transportation

U.C. 6.1: Air-to-ground communications

U.C. 6.2: Delivery of services in public or private transportation in urban areas U.C. 6.3: Caching at the edges





COHERENT Use Cases







Network Slicing

Network slice: A partition of RAN with specific configurations used for particular business case.

- The collection of all network slices aggregated form the total network resources of an operator.
- Slices can be spanned over a multitude of RATs / different operators.
- Span all domains of the network:
 - Different slices contain different network functions / configuration settings.
 - For each slice, network functions / storage resources located at network edges.





Offloading & Network graph mapping

The requirements at the process of load balancing between eNodeB/WiFi:

- A common user interface when he is using a service through the mobile or Wi-Fi network.
- Seamless service connectivity between the two networks.
- *Minimum latency at the offloading-load balancing process.*





Summary

- The COHERENT architecture delivers:
 - A uniform control and coordination framework for multiple RATs
 - Control scalability, flexibility and programmability at RAN to "meet" the 5G service requirements

Key features:

- Network abstraction and RAN programmability
- Agile control and coordination framework
- Support for network slicing





Thank you!





13



For Further Communication

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14