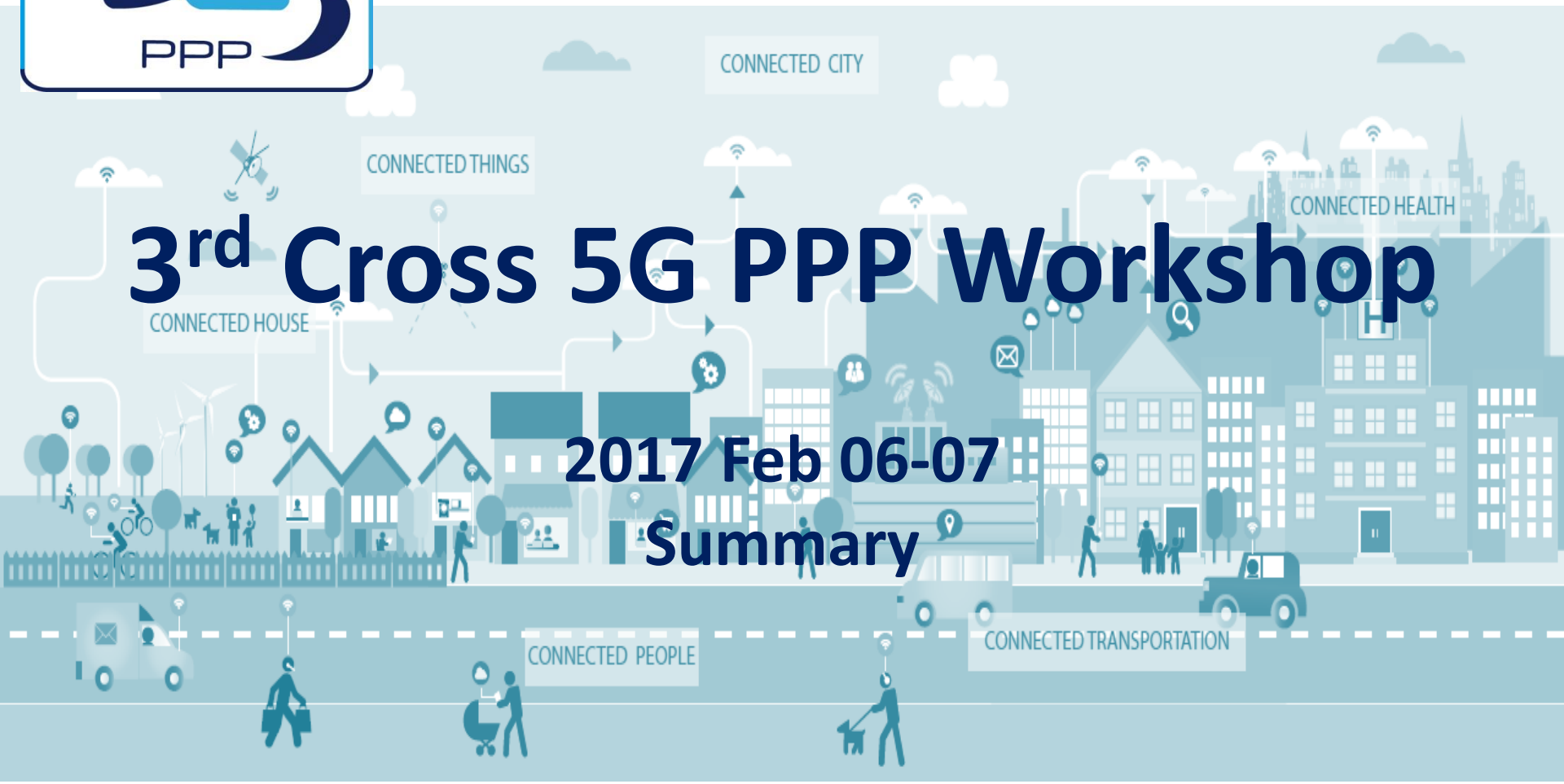

3rd Cross 5G PPP Workshop

2017 Feb 06-07

Summary

Topics Treated

1. Overall 5G RAN design and Overall 5G architecture
2. Network slicing and Control Plane Architecture and SDN for 5G
3. Security
4. Air interface design
5. Complexity
6. Usecases, models & performance

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1. Overall 5G RAN design and Overall 5G architecture

Presentations and presenters
Session by: METIS-II

- METIS-II Considerations on 5G RAN Architecture
  METIS-II – Patrick March, Oemer Bulakci
- Architecture concepts, Architectural aspects of mm-wave RAT integration with low-band support
  mmMAGIC- David Gutierrez Estevez
- Architecture concepts, Putting them in practice, Challenges
  Superfluidity - George Tsolis

Summary

- In the future of SDN/NFV more attention needs to be paid to where functions run since the function and location are not strictly coupled.
- Splitting control and user plane from each other and across deployments requires care when deciding where to split.
- A number of technologies for LTE and NR interworking has been developed and seem to work.

2. Network slicing and Control Plane Architecture and SDN for 5G

Presentations and presenters
Session by: METIS-II

- Application of SDN/NFV paradigms to operational windparks
  VirtuWind - George Petropoulos
- RAN Slicing
  5G NORMA - Mark Doll
- Control Plane Architecture for 5G Systems
  CONFIG - Riccardo Trivisonno
- 5G-XHaul approach on Network Slicing
  5G-XHaul - Paris Flegkas
- Network Slicing in Transport, Definition and implementation
  5G-Crosshaul - Andres Garcia Saavedra
- Slicing
  CHARISMA - Konstantinos Katsaros
- Impact of Slicing in the RAN
  METIS-II - Panagiotis Spapis

Summary (1/2)

- There are many ways to use slicing and at this stage and there is no usecase that can be ruled out. Some of the more prominent uses are:
  - Separating businesses
  - Separating services with different quality requirements
  - Hierarchical use cases, e.g. a many service slices exists inside one network slice
- It is necessary that all use cases are catered for in the design.

Summary (2/2)

- When discussing slices it is important to distinguish between a blueprint, which is a description of a class of slices, and instances of slices.
- In 5G PPP there is a growing consensus on what functions that can be shared between slices and which functions that need to have one (or more) instance per slice


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3. Security

Presentations and presenters
Session by: 5G ENSURE

- 5G Security
  5G ENSURE – Pascal Bisson
- Security aspects in CHARISMA
  5G CHARISMA – Eleni Trouva
- Symnet: scalable symbolic execution for modern networks
  SUPERFLUIDITY - Matei Popovici
- Some thoughts about 5G Security from RAN perspective
  METIS-II – Olav Queseth

Major findings 1/3

- Presentations from each of the 4 contributing projects to the 5G Security session (i.e. 5G-ENSURE, CHARISMA, SUPERFLUIDITY and METIS II) very much appreciated by the audience since raising additional awareness on 5G Security for the benefit of the whole 5G-PPP Programme
  - Each of the presenters got couple of questions they did answer
- Opportunity was also taken to inform on 5G-PPP Security WG and activities performed there since relevant

Major findings 2/3

- A number of major (actionable) results on 5G Security have been reported at the Session.
  - 5G Security Architecture, 5G Security enablers, 5G Security testbed (5G-ENSURE); Virtualised security (CHARISMA)
  - 5G-PPP Projects collaboration actions on the security area (workshop and testbed experimentation)

Major findings 3/3

- In addition to this, additional security enabler but also perspective (i.e. on RAN Security) where brought respectively by SUPERFLUIDITY and METIS II that we can only welcome to join 5G-PPP Security WG to further discuss and exchange
- Overall we are confident that results of interest would be valued by the projects attended.

4. Air interface design

Presentations and presenters
Session by: FANTASTIC 5G

- Design framework and suitability assessment proposal for 5G air interface candidates
  METIS-II – Tomasz Mach
- mm-Wave Radio Interface
  mmMAGIC - Jian Luo
- Phase Noise Analysis for 5G NR
  mmMAGIC - Ali Zaidi
- Link design: Investigation and outcomes
  FANTASTIC-5G - Hao Lin
- Agile Multi-Service Network Design, with emphasis on RRM
  FANTASTIC-5G - Klaus Pedersen

Summary (1/3)

- The 3 5G PPP projects working on the air interface design (METIS-II, mmMAGIC, FANTASTIC-5G) have shared their main findings.
- METIS-II – having a more global and integrative point of view – has presented their views on how to set up the design framework and how to do the suitability assessment for 5G air interface candidates
- It became apparent that the relevant projects share a very consent view on this

Summary (2/3)

- Then mmMAGIC and FANTASTIC-5G have given 4 presentations overall providing a more specific view on the relevant parts of the air interface design both for >6GHz (mmMAGIC) and <6GHz (FANTASTIC-5G).
- Aspects being specific to the respective frequency range have been presented and discussed such as:
  - For >6GHz: initial Access & multiple Access techniques when having a beam-centric system and isseus related to phase noise at higher frequencies.
  - For <6GHz: Complementary set of network-based ICIC techniques for macro-cellular networks and relevant PHY techniques for the efficient support of MMC.

Summary (3/3)

- Finally, fundamental assumptions and design choices having a common relation have been presented and discussed such as:
  - Waveform design: all projects have a rather aligned view on basic aspects related to the waveform selection.
  - Frame design: both mmMAGIC and FANTASTIC-5G are proposing rather compatible frame configurations and numerology choices supporting the strong emphasize of METIS-II to have both frequency ranges to be designed in an harmonic manner.

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5. Complexity

Presentations and presenters
Session by: flex5Gware

- Waveform complexity and implementation aspects
  Flex5Gware - Miquel Payaro

Summary

- We have now available results on the required processing for new waveforms in terms of complexity and silicon area.
- The results can be used when making the design tradeoff(s) for 5G waveforms.

6. Usecases, models & performance

Presentations and presenters
Session by: METIS-II

- COHERENT – George Agapiou
- 5G CHARISMA, 5G-XHaul – Konstantinos Filis
- Flex5Gware - Fredrik Tillman
- METIS-II – Michal Maternia, Salah-Eddine El Ayoubi
- FANTASTIC-5G: Integration of the AI Components and Performance Evaluation – Malte Schellmann
- mmMAGIC - Miltiadis Filippou

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Summary

- Projects moved to performance evaluation phase (cf. presentations from FANTASTIC-5G, METIS-II, mmMAGIC), first 5G performance values available
- 5G-Xhaul is investigating energy efficiency of transport network that could complement results for RAN

Where do we stand with 5G requirements?

KPIs evaluated by inspection (statements)

- Bandwidth and channel bandwidth scalability ✓
- Coexistence with LTE ✓
- Deployment in IMT bands ✓
- Interworking with 3GPP legacy technologies and 802.11 WLAN ✓
- Operations above 6 GHz ✓
- Spectrum flexibility and sharing ✓
- Support of wide range of services ✓
- Low cost requirements ✓

Where do we stand with 5G requirements? KPIs evaluated by analysis (pen and paper)

KPI	Requirement	METIS-II performance	Key contributor
C-Plane latency	< 10 ms	7.125 ms	RRC Connected Inactive, reduction of processing time in BS and UE
U-Plane latency	< 1ms	0.763 ms	Shortening of TTI, reduction of processing time in BS and UE
mMTC energy efficiency	> 10 years on a single 5 Wh battery	> 10 years on a single 5 Wh battery	Extension of DRX, C-Plane latency reduction, deep sleep energy conservation features
Peak data rates	> 20/10 Gbps for DL/UL	21.7/12.4 Gbps for DL/UL	MIMO spatial multiplexing (for lower frequencies), exploitation of mmW bands
Mobility interruption time	0 ms	0 ms	Multi-connectivity + make-before-brake

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Where do we stand with 5G requirements?

KPIs evaluated by simulation in METIS II use cases

KPI	Requirements	METIS-II performance	Comments
User throughput (use case 1, UC2 and UC3)	UC1: 300 Mbps UC2: up to 5 Gbps UC3: 50/25 Mbps for DL/UL	UC1: 1 Gbps+ UC2: up to 7.85 Gbps UC3: 50/25 Mbps for DL/UL	Only DL values for UC1 and UC2 Different methodology applied for UC3 evaluation
mMTC device density (UC4)	> 1 mln/km^2	4 mln/km^2	Depends heavily on the traffic/report periodicity of mMTC devices. 1 upload of 1000 bits every 100 s was used in METIS-II
Reliability (UC5)	99.999% at 50/1000m for urban/highway	99.999% at 45/150m for urban/highway	For highway scenario, requirements seems very difficult to meet (revision needed?)
Network energy efficiency (UC1, UC3)	Should follow (at least) capacity improvement	For the capacity x1000, network energy efficiency improvements of 350-7500 were reported	Evaluation done only for Dense Urban environment. Savings depend on the load level in LTE-A/5G network

Pictures etc.

Opening session