NML RG Meeting #2 @ IETF #95 (Buenos Aires)

"Machine-learning based policy derivation and evaluation in broadband networks"

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Outline

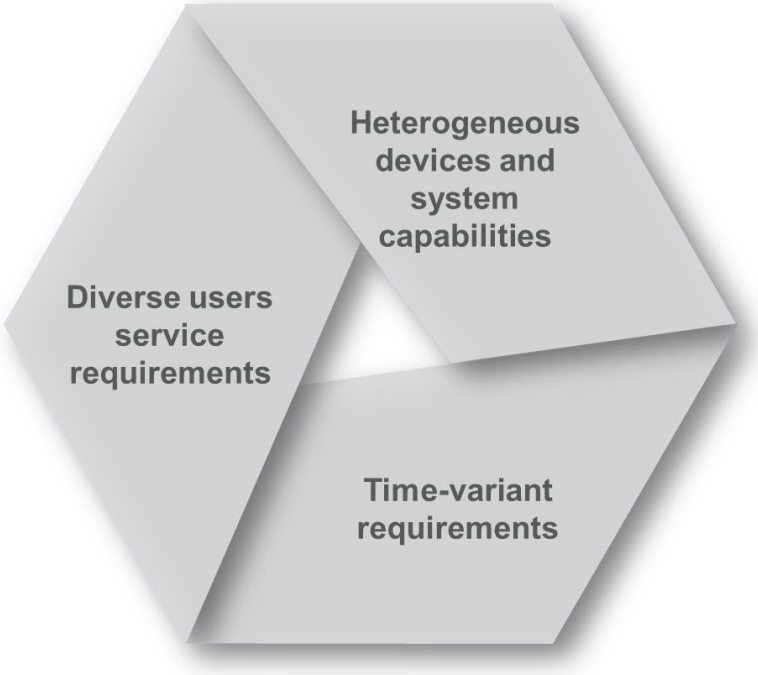
- Motivation
  - The need for combining machine learning and policy-based management
- Complexity of service provision in wireless/mobile broadband networks
- Approach for efficient service provision
  - Agile system behaviour
  - Agility needs solution to computationally intensive problems
- The role of policies
- The role of machine learning
- Next steps

Storyline

Specific Challenge:

- Service provisioning is becoming more complex.
  - For instance, there are services having diverse quality requirements, there is variance of the requirements in time and space , and there is the need for utmost resource efficiency.
- Full agility
  - Is needed in order to accomplish resource efficient service provisioning.
  - Requires the solution of computationally intensive tasks over time and space.
- In this respect, policies can play a role: specify the network behaviour in time periods and service area regions.
- In this direction, machine learning can have an fundamental role, e.g., for learning situations encountered and “good” ways (policies) for handling them.
- The talk will address the role that machine learning can play for policy derivation and evaluation.
- In more detail the talk will address: the requirements on the role of machine learning, architectural aspects, including potential inputs and outputs.

Motivation: complexity of service provisioning



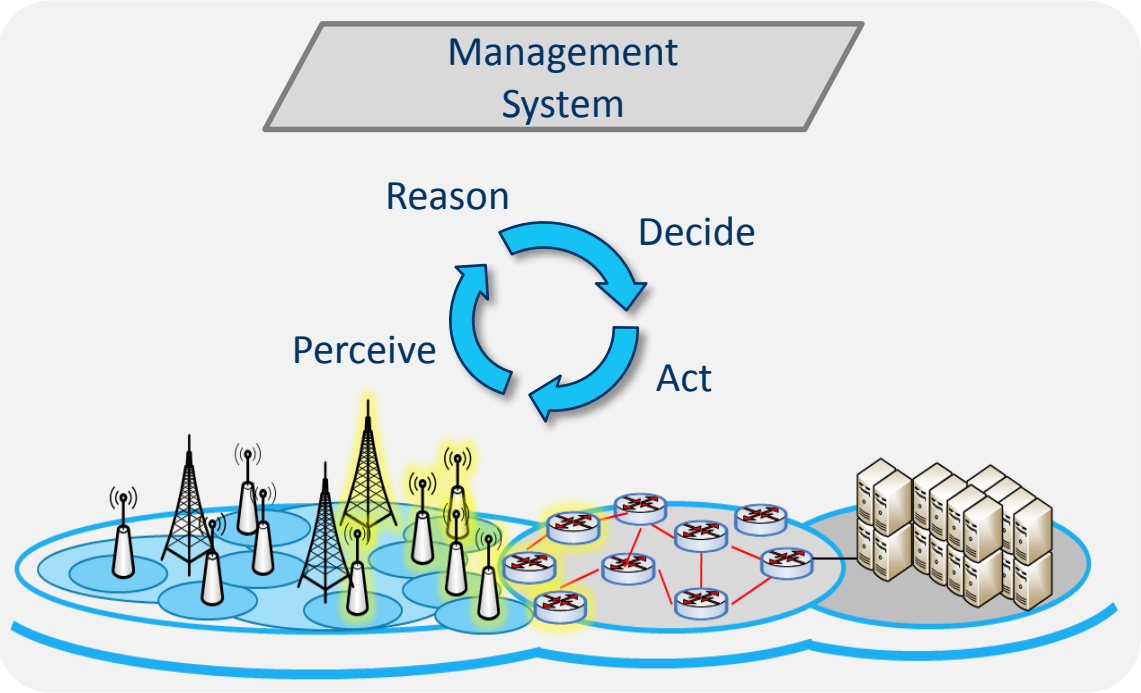
Requirements for service provisioning

- Deliver needed quality levels
- Exploit system capabilities
- Utmost resource efficiency for cost (and environmental sustainability) Adaptations

Factors influencing

- Users with different requirements in terms of quality
- Diverse services
  - Mobile Broadband (MBB)
  - Massive Machine Type Communications (MTC)
  - Mission Critical Communications (MCC)
  - Vehicular to X (V2X)
  - …
- Devices of various capabilities
- Variance in time and space
- Powerful systems

Approach for efficient service provision and associated difficulties



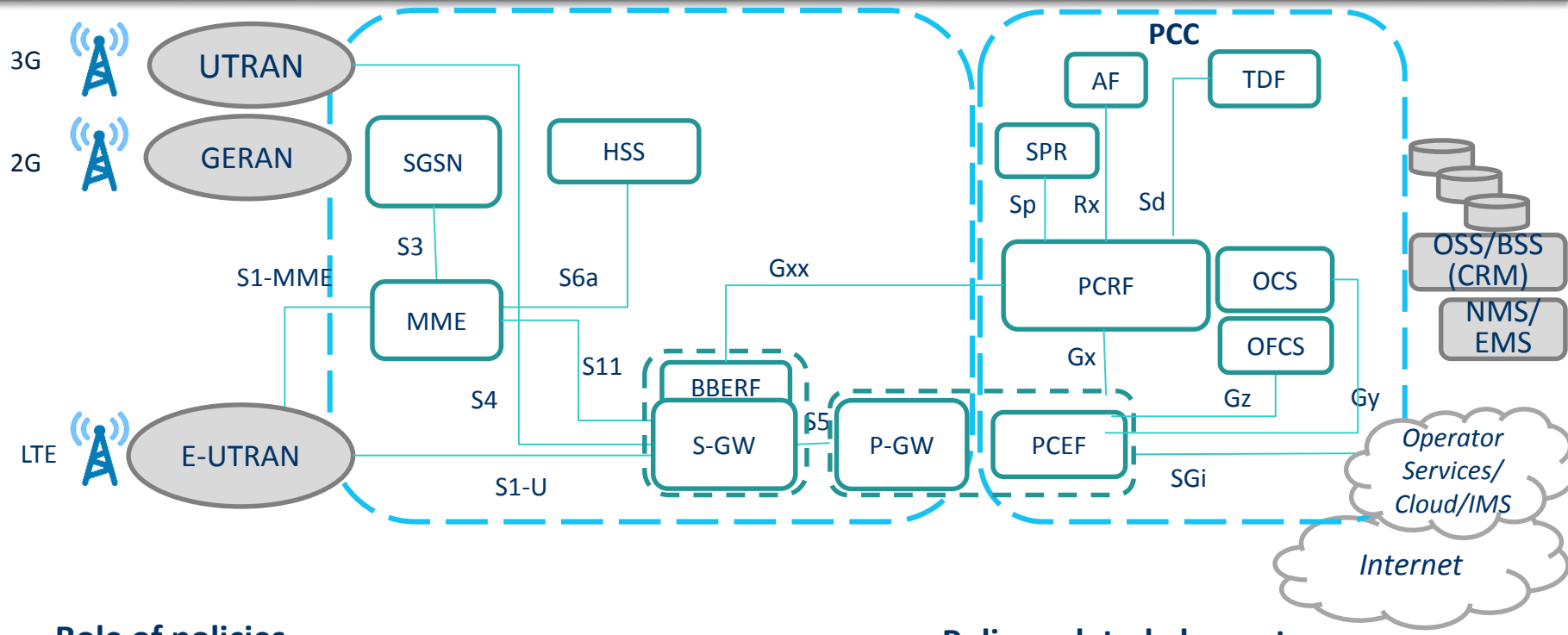
Approach

- Agile system behavior
- Satisfaction of service requirements, while achieving resource efficiency
- Exploitation of time and space variance

Difficulty

- Computationally hard problems
- Input
  - User information
  - Services
  - Traffic, mobility in time and space
  - System capabilities
  - …
- Output
  - Network configuration
  - Traffic allocation
- Objective function
  - QoS, resource consumption
- Constraints
  - Quality above certain levels per service
  - Resource use within certain quantitative bounds and overall framework

The role of policies (wireless/mobile broadband)



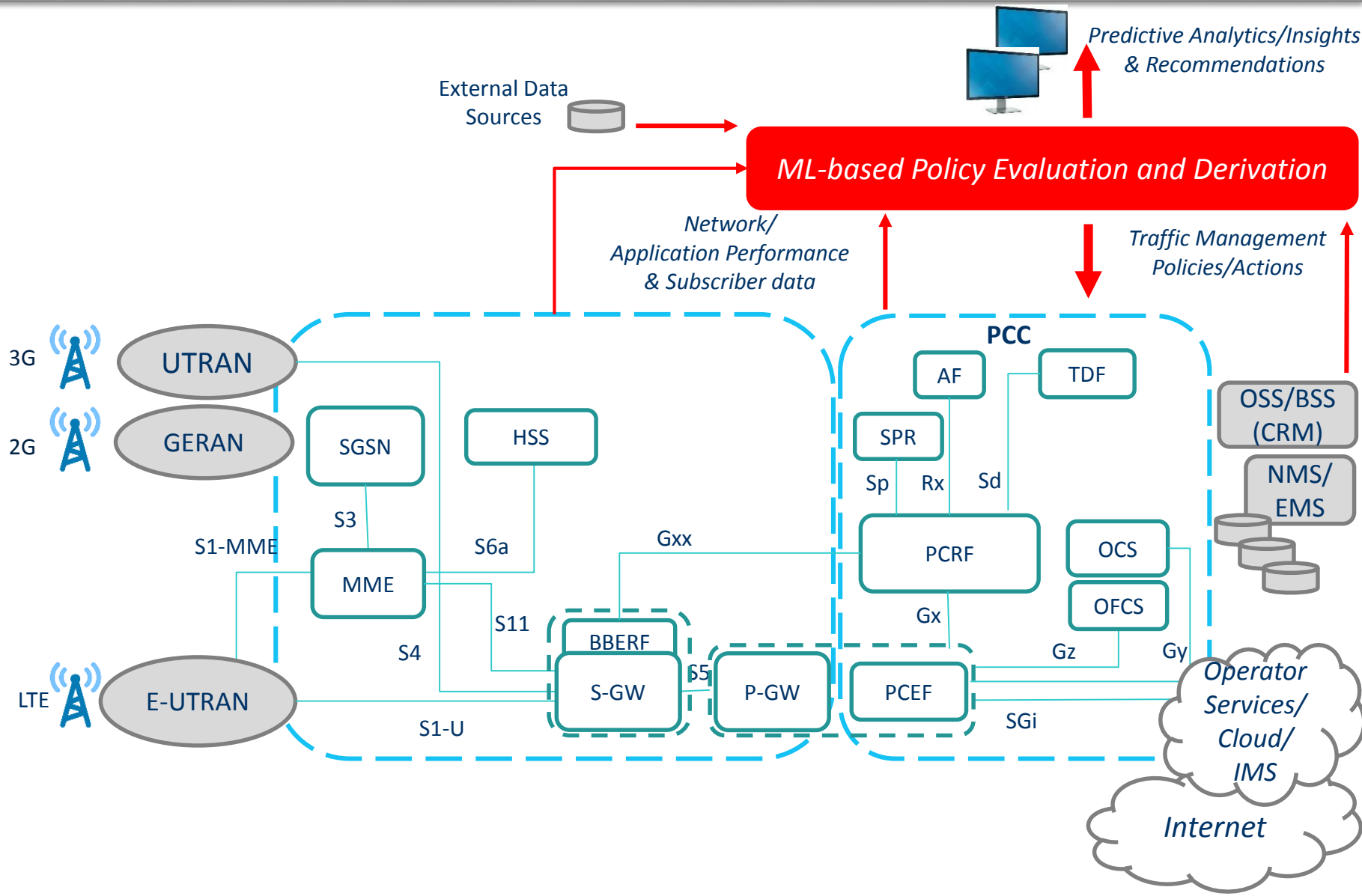
Role of policies

- Devise "optimal ("good enough", "appropriate") system behaviour for time periods and areas
  - "Pre-solve" optimization problems
- Yield appropriate quality levels and minimize resource consumption
- Constant improvements through policy evaluations, and enforcement of new policies

Policy-related elements

- PCC (Policy Control and Charging)
- PCRF (Policy and Charging Rules Function)
- PCEF (Policy and Charging Enforcement Function)

The role of machine learning



Conclusions – Way Forward

- Specify the architecture (the networks) that are in scope
  - Focus on particular segments
  - Consider the impacts of softwarization
- Clarify the role of policies
  - More or less inline with the
- Outline relevant machine learning approaches
  - How to obtain knowledge regarding policy evaluation and how to derive policies
- Interfaces for supporting diverse algorithms / machine learning schemes

Thank You!

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