INSTITUT D'ELECTRONIQUE ET DE TELECOMMUNICATIONS DE RENNES

A simulation-based approach for performance evaluation of sdr baseband architectures

Brussels, Belgium
28th June, 2012

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Goal and objectives

Trends in the field of radio communication

- Mobile devices with more and more wireless interfaces, user applications and adaptation capabilities
- Parallel architectures clustered by application category to implement mobile terminals

Goal of our work

- To facilitate performance evaluation of SDR baseband architectures

Objectives of this presentation

- To propose simulation-based approach to analyze and compare the growing number of potential architectures
- To illustrate benefits of this approach with a realistic adaptive multi-service system

Model requirements

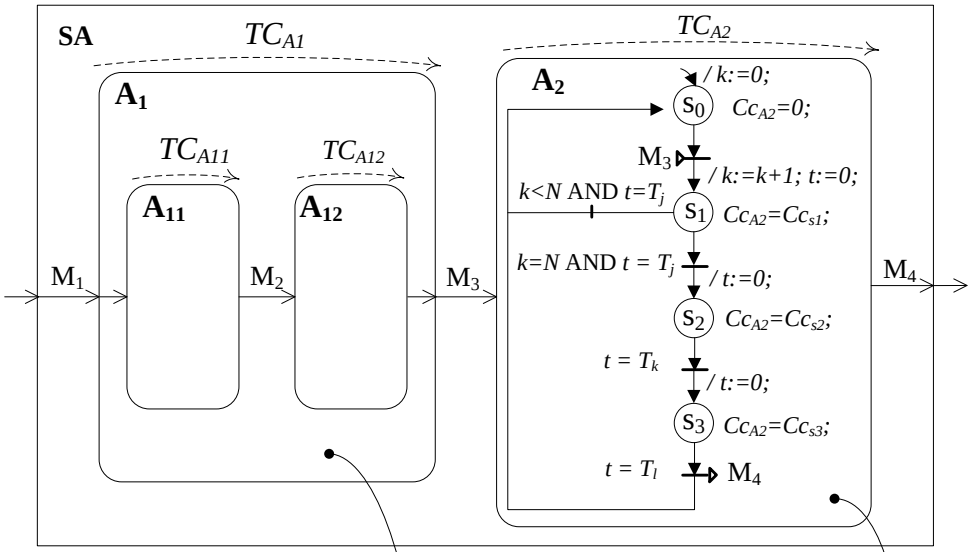
- **Specification design step**
  - Definition of the system properties and its performance requirements
  - Executable model to evaluate and compare performances of candidate architectures

- **Fundamental criteria to respect**
  - Quick-to-develop and lightweight to decrease modeling effort of the designer
  - Accuracy and simulation speed for different use cases

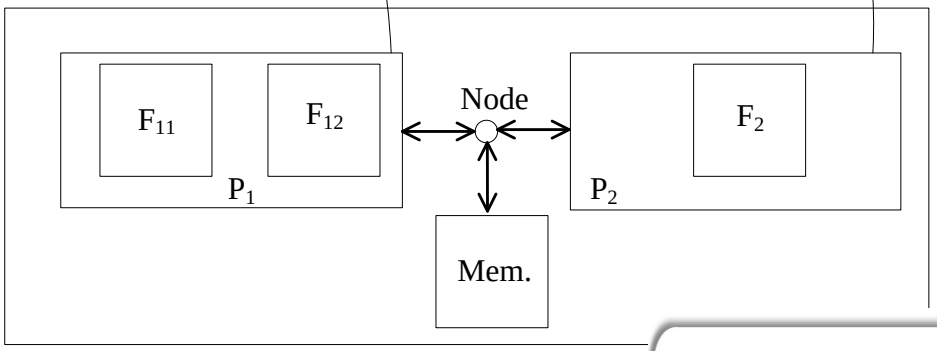
Considered modeling approach

- Performance evaluation of system architectures

Performance model of system architecture

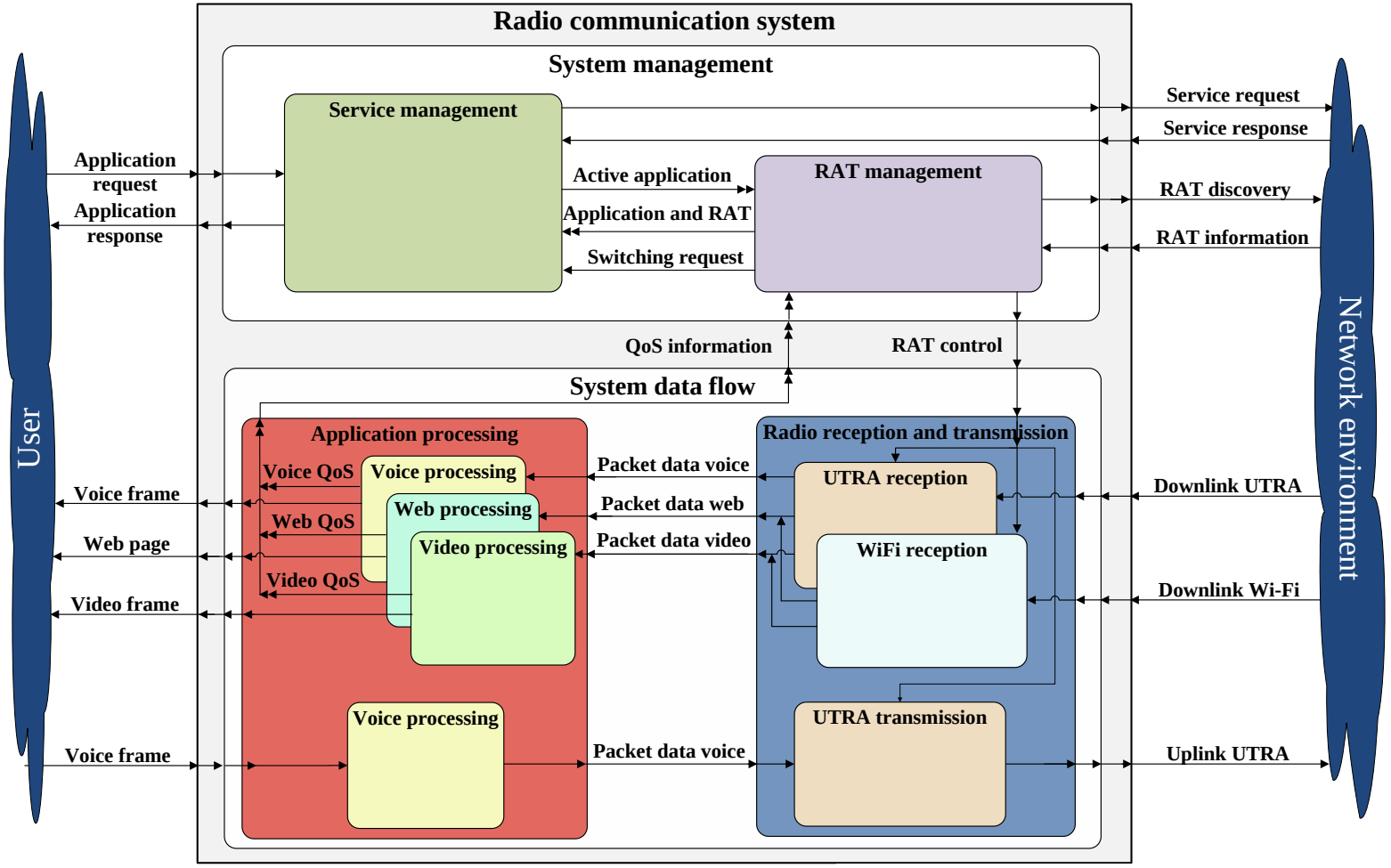


Considered system architecture



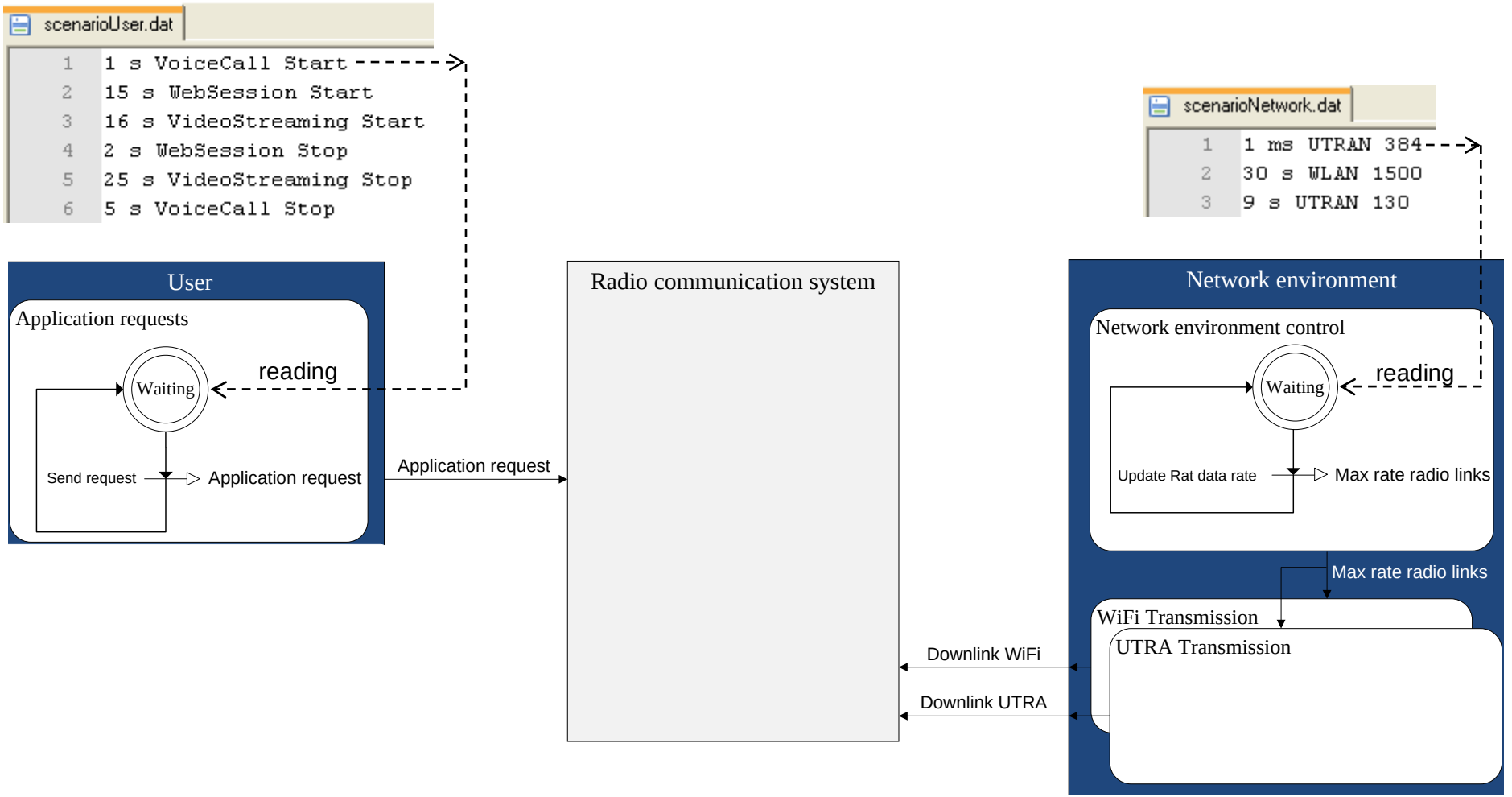
Considered case studied

- Activity diagram of an adaptive multi-standard and multi-application system and its environment



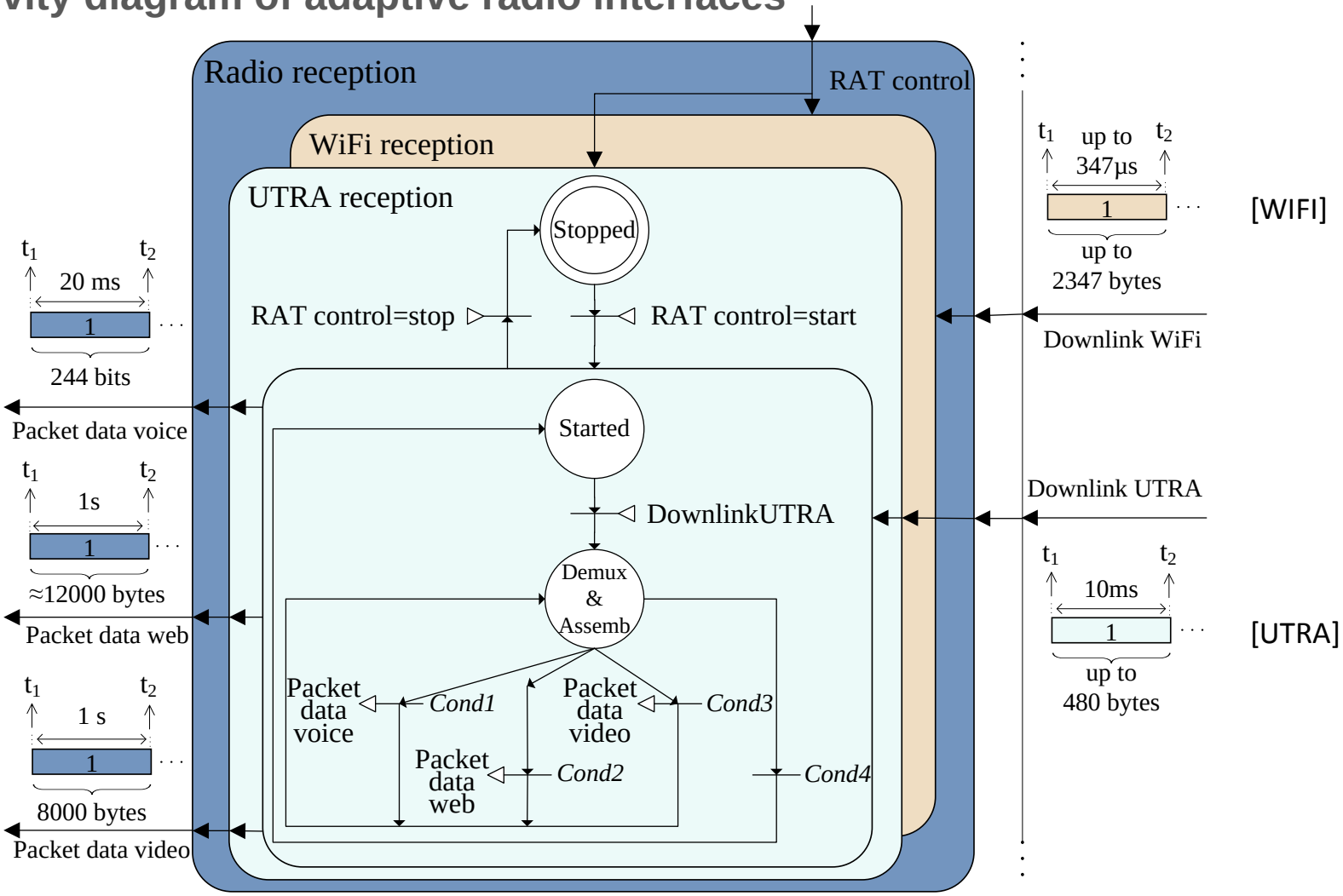
Modeling the system environment

- **Modeling technique based on scenario files**



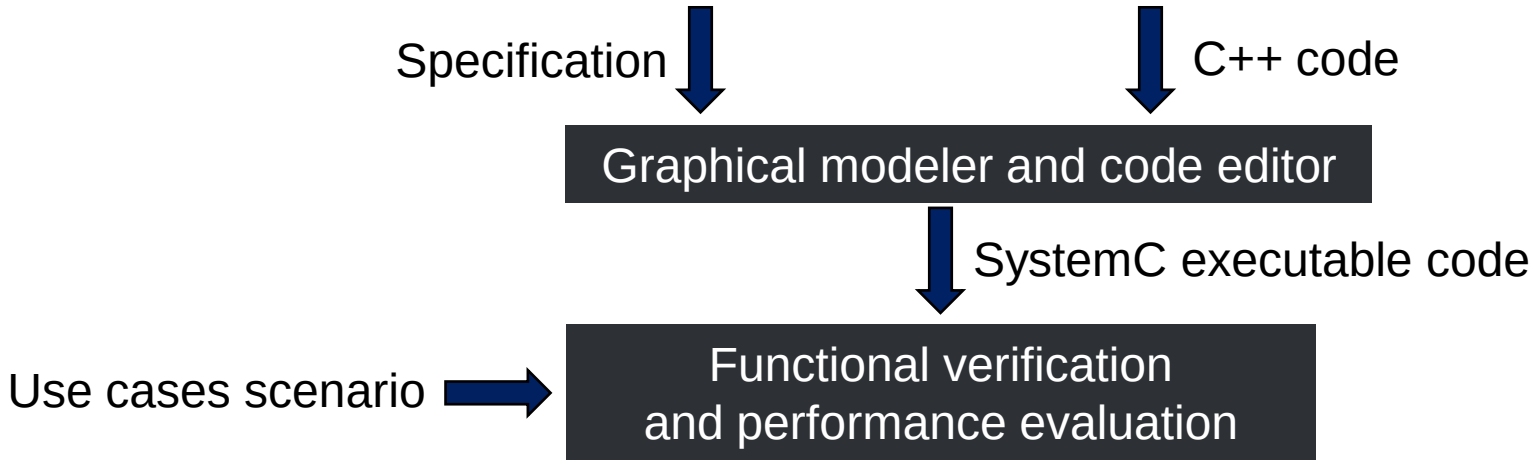
Modeling the communication interfaces

- **Activity diagram of adaptive radio interfaces**



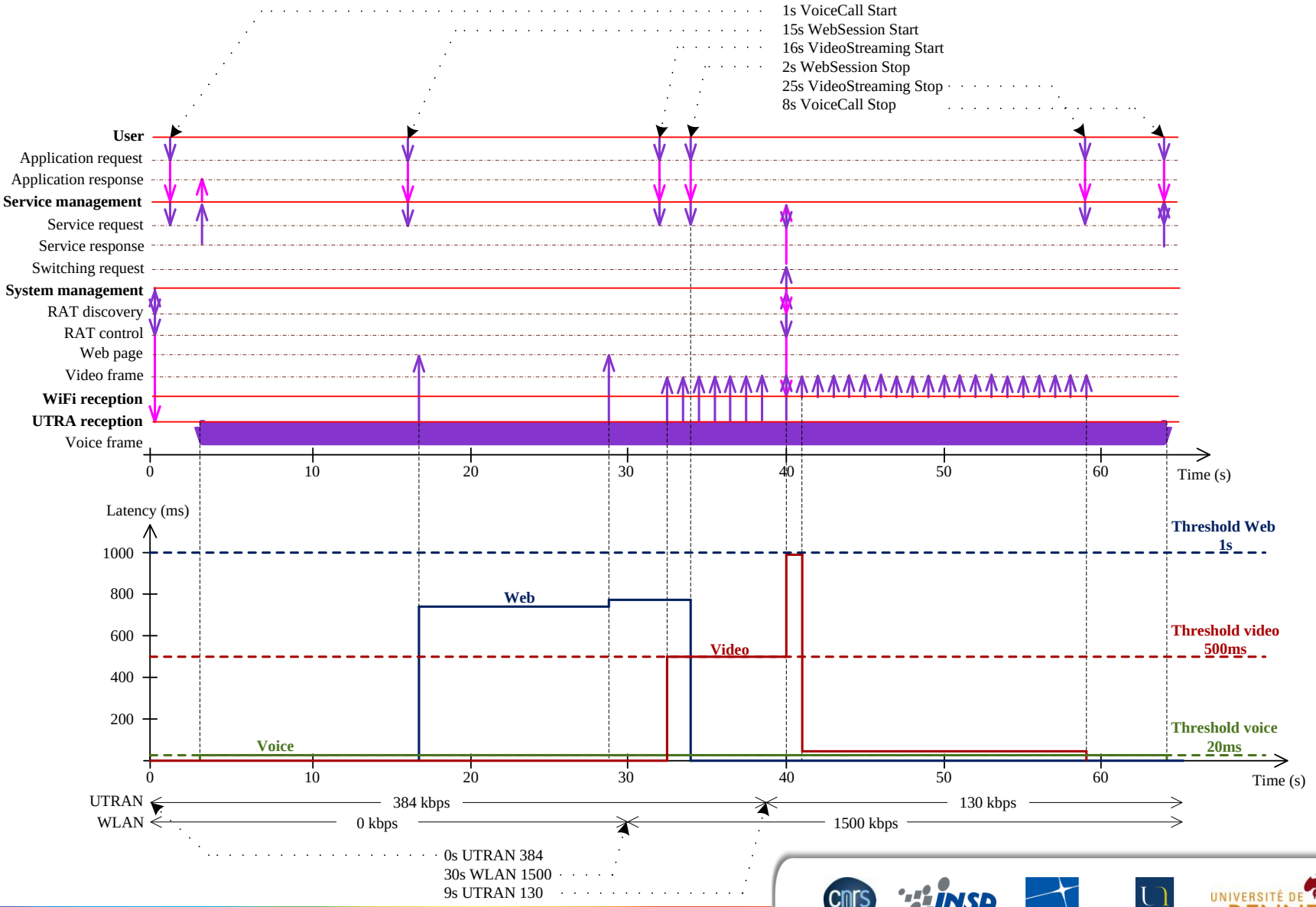
Generation and simulation of the performance model

- **Graphical modeler and ANSI C/C++ code editor to capture the performance model**
- **Generation of executable SystemC code from capture model**



- **Simulation of the executable SystemC program according to complex use case scenarios**
  - Evaluation of real time performances
  - Evaluation of the expected ressources

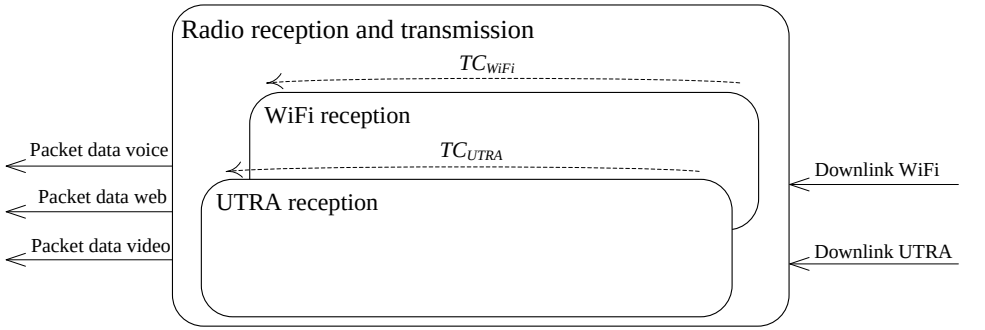
Temporal behavior analysis of the system



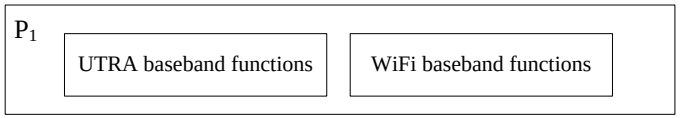
Performance evaluation of the flexible baseband architecture

- **Studied architecture to perform baseband processing related to activities UTRA and WiFi reception**
  - Architecture based on a set of dedicated hardware resources
  - Performance model express computational complexity per time unit each function causes on the resources when executed

Performance model of radio reception and transmission architecture



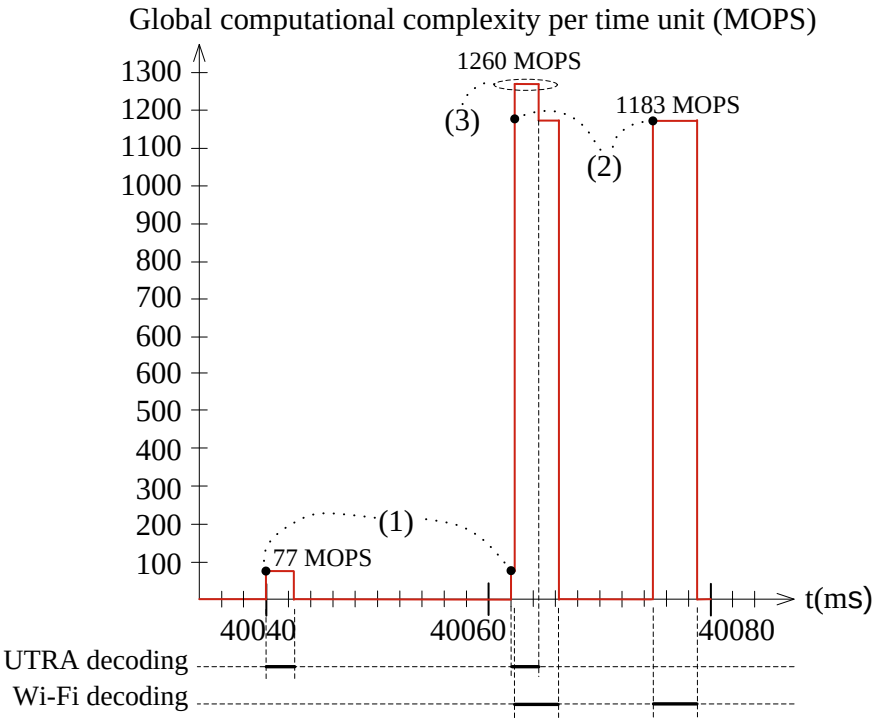
Studied architecture



Simulation results of the model

- **Evolution in time of the required computational complexity per time unit (in MOPS) for UTRA and WiFi decoding**

  - Observation for studied architecture and operating scenario considered
  - Maximal computational complexity per time unit observed
  - Resource utilization of P_1



Sum-up and conclusion

Sum-up

- Simulation-based approach and modeling technique to evaluate efficiently performances of candidate SDR baseband architectures
- Simulate easily multiple complex use cases
- Study dynamic and non determinist ic effects in the architecture model

Further work

- Validation of estimates providing by simulation
- Applying the same modeling principle to other non functional properties such as dynamic power consumption

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