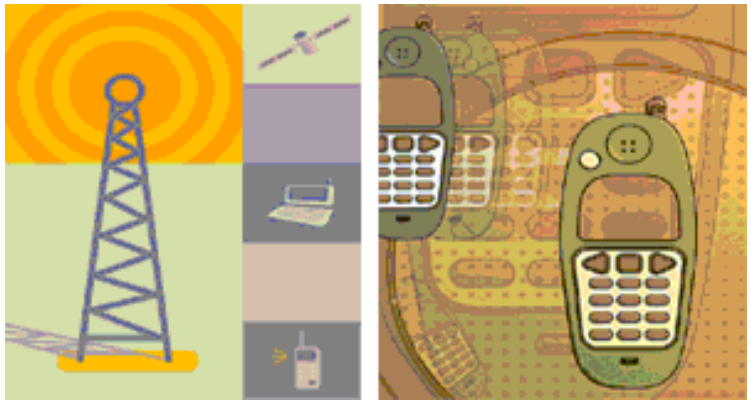
Exploiting Protocol Agility Issues in Beyond 3G Systems



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Outline

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- Proposed Approach
- Design Considerations of the Proposed Approach
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- Relation to IEEE P1900
- Directions for Future Interactions
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Motivation/Scope

- Convergence of legacy, future and emerging systems raises the need for the introduction of a key solution that will support this vision → Reconfigurability
- Spawning in mobile devices and networks nodes, the reconfigurability concept yields the introduction of flexibility in all underlying layer layers, starting from the application layer and protocol stack, up to the hardware layer.
- If we focus on the protocol stack,
  - ✓ The wide range of protocol stack stratifications and manifestations
  - ✓ The need for remote equipment management and support of bug-fixing scenarios
  - ✓ The resource constraints in mobile phones, i.e. not enough memory to have embedded every standardised RAT
  - ✓ The evolution towards Autonomic Communication with the introduction of self-* capabilities (i.e. self-configuring protocols)

⇒ render Protocol Reconfiguration in Mobile Devices an important topic.

Proposed Approach

- Introduction of a protocol reconfiguration scheme based on component based design.
  - ✓ Specification of the Control Signalling for Protocol Reconfiguration
  - ✓ Provision of a generic framework for Protocol Reconfiguration
  - ✓ Specification of the Protocol Reconfiguration procedure
  - ✓ Incorporation of the proposed scheme in a generic management & control architecture for mobile equipment (also hooked to the E^2R architectural approach for mobile equipment)

Design Considerations of the Proposed Approach

- **Control Signalling for Protocol Stack Reconfiguration**
  - ✓ Decision mechanisms that
    - o specify the protocol stack configuration (protocol layers, protocol components within each layer)
    - o check if the protocol layers/components exist in the protocol component repository
    - o trigger the downloading/installation of missing protocol components

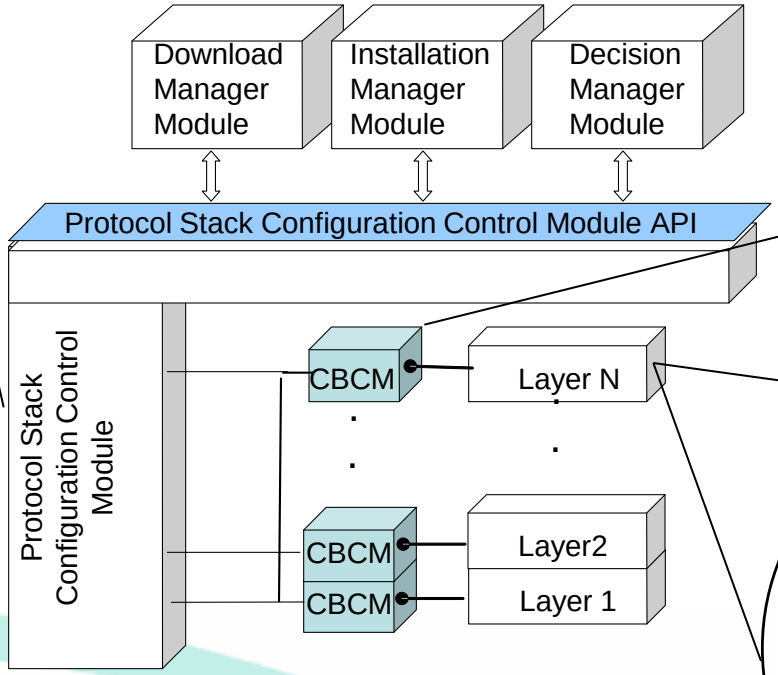
- **Protocol Stack Reconfiguration in terms of**
  - ✓ Dynamic composition of protocol layers to form a protocol stack
  - ✓ Dynamic composition of component services in fully-fledged protocol service
  - ✓ Dynamic runtime replacement of the functionality of concrete protocol layers
  - ✓ Dynamic runtime replacement of distinct protocol components within these protocols.

- **Reliable and transparent reconfiguration execution**
  - ✓ No loss of existing connections and data,
  - ✓ Minimum performance overhead

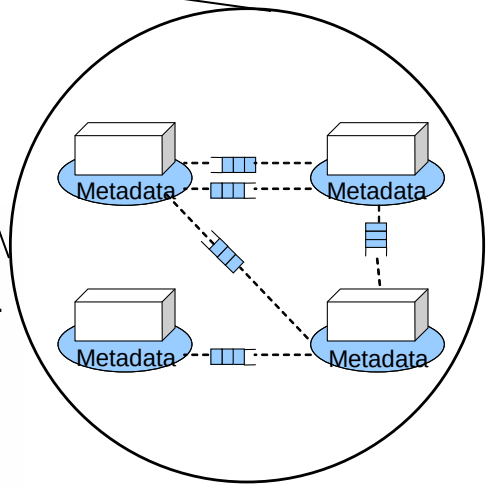
A Management & Control Architecture Enabling Protocol Reconfguration

Generic Management functionality for the overall control of the protocol stack configuration and reconfiguration.

Mechanisms related to Control Signalling for Protocol Stack Reconfiguration



Intra-Layer Management functionality for the control of the dynamic component binding and replacement



Queue-based Scheme for Component-based Protocol Reconfiguration

Introduction of metadata to incorporate knowledge for the component configuration and the verification of the procedure.

Relation to IEEE P1900

- IEEE P1900.1, Draft Standard Definitions and Concepts for Spectrum Management and Advanced Radio Technologies, captures architectural and functional aspects for cognitive and software-defined radio.
- Section 6.32 on Protocol Agility provides an abstract description of “the need to manage the dynamics of the protocol changes as different networks, or protocols within one network, are used”.
- Examples on protocol agility for cognitive/non cognitive approach are given.
- However there is a gap in specifying
  - ✓ A generic framework that provides the necessary mechanisms for transparent protocol reconfiguration

Directions for Future Interactions

- The proposed approach provides a key solution regarding the gap in the specification.
- The latter is realized with the introduction of a scheme for self-configuring protocols based on component-based design.
  - ✓ Incorporation of the proposed scheme in a generic management&control architecture for mobile devices
  - ✓ Provision of a generic framework to facilitate deployment aspects
  - ✓ The specified protocol reconfiguration procedure does not affect the protocol functionality / communication with peers / other constituent components
  - ✓ Advantages: Queue-based scheme: no recursion; no time consumption; no suspension of external channels; no empty-status requirement at replacement time

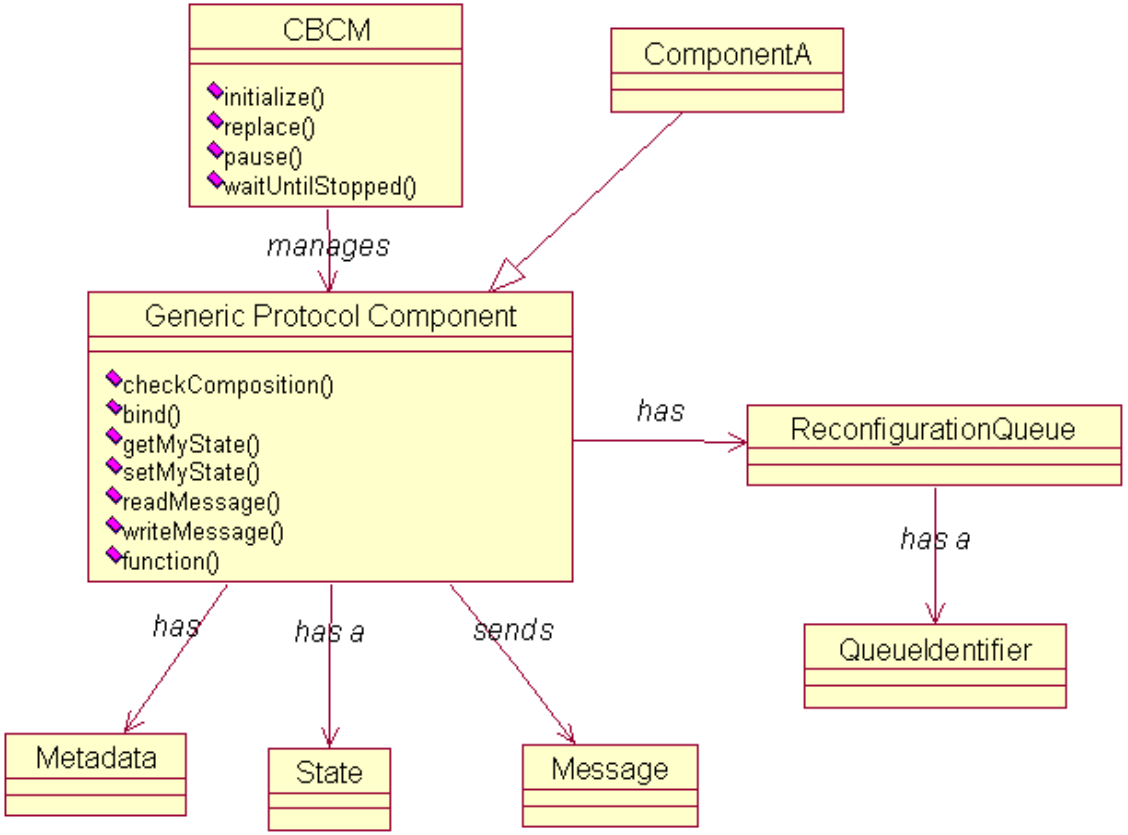
References

- E.Patouni, N.Alonistioti “A Framework for the Deployment of Self-Managing and Self-Configuring Components in Autonomic Environments”, accepted for the International IEEE WoWMoM Workshop on Autonomic Communications and Computing (ACC 06) , Niagara-Falls / Buffalo-NY, 26-29 June, 2006
- E.Patouni, N.Alonistioti Towards Self-Configuring Protocols for Reconfigurable Systems, accepted for the 13th International Conference on Telecommunications (ICT 2006), Madeira, Portugal, 9-12 may 2006
- E. Patouni, N. Alonistioti, and P. Magdalinos, “A Framework for Protocol Reconfiguration”, in the Proceedings of the Seventh IFIP International Conference on Mobile and Wireless Communication Networks, Marrakech, Morocco, Sept. 2005.
- Z.Boufidis, E.Patouni, N.Alonistioti, P.Magdalinos, D.Bourse, K.El-Khazen, “Exploiting the Reconfiguration Management Plane for Protocol Adaptation and Quality of Service Negotiation in B3G Systems”, Wireless World Research Forum (WWRF), 15th Meeting, WG6, Paris, France, 08-09 December 2005.

Thank you!

BACKUP SLIDES

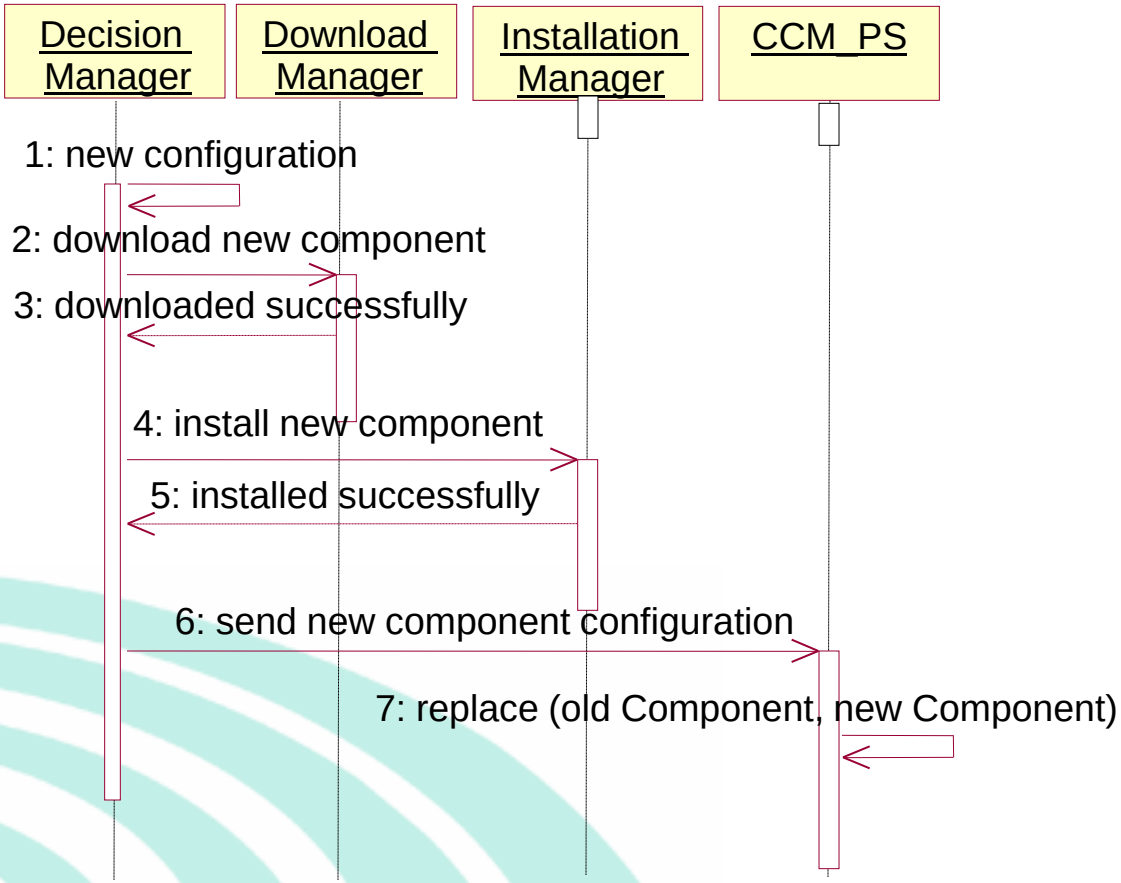
Modeling Self-Configuring Protocols



- ✓ Provision of a generic framework for the definition of protocol components
- ✓ Introduction of a generic protocol component
- ✓ Introduction of functionality for the deployment of reconfiguration capabilities:
  - o verification and establishment of the protocol component bindings
  - o establishment of the components communication
  - o retrieval and update of the component's state
- ✓ Deployment of component-specific functionality

Dynamic Configuration of Protocol Components

A. Control Signalling for Protocol Self-Configuration



B. Dynamic Replacement of Protocol Components