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QoS Abstraction Layer in 4G Networks

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QoS Abstraction Layer – Rationale

- 4G networks
 - wireless, heterogeneous
 - 802.11, 802.15.1, 802.16, GPRS, UMTS, ...
- Flexible L2 QoS architecture needed
 - To accommodate existing technologies
 - To facilitate addition of new technologies
 - To fit in L3 QoS architectures (e.g., IntServ, DiffServ)
- Possible solution → QoS abstraction layer
 - Complemented with technology dependent drivers which translate generic QoS requests into technology specific primitives

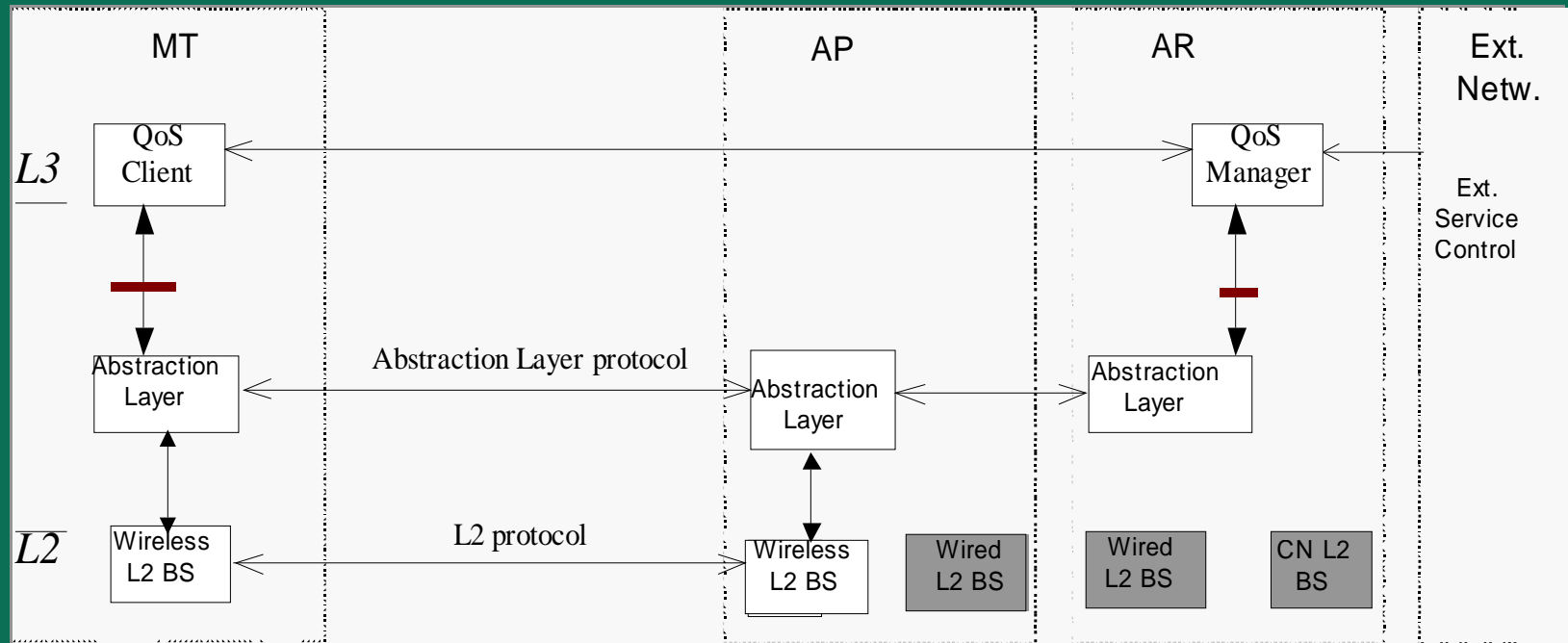


QoS Architecture - Components

- Inspired by UMTS and IntServ QoS models
- Network elements
 - Mobile Terminal (MT): MIPv6 based
 - Access Points: L2, IEEE 802.x based or UMTS
 - Access Router: MIPv6 based
- Modules
 - QoS Client / QoS Manager: manage end-to-end QoS resources
 - Abstraction Layer: manages QoS resources in Access Network



QoS Architecture



Abstract Interface – Primitives (./..)

- QoS reservation
 - _ Activation of virtual connection with QoS
 - Parameters: TargetAddr, TSpec, RSpec
 - Returns: connection identifier
 - _ Modification of existing QoS connection
 - Parameters: connection identifier, TSpec, RSpec
 - _ Tear down QoS connection
 - Parameters: connection identifier
- Notification of link degradation
 - _ Parameters: connection identifier, TSpec, RSpec, BER



Abstract Interface – Primitives (../..)

- Information regarding available resources in the AN
 - _ Query available resources in an AP
 - Parameters: AP address
 - _ Information of available resources
 - Parameters: APAddr, Bandwidth, Delay
- L2 Handover optimisations (studying)
 - _ Handover preparation
 - Parameters: new AP
 - _ Handover execution

Abstract Interface – Main Parameters

- *TargetAddr* - MAC/IPv6 address of the destination entity
- *CnxID* - integer identifying an abstraction layer connection
- *TSpec* - Characteristics of the flow transported in an AL connection
 - *Peak bitrate (p)*; *Average bitrate (r)*; *Maximum burst size (b)*
 - *Maximum Transmission Unit (M)*; *Minimum Policed Unit (m)*
- *RSpec* - Reservation Specification
 - *ClassIdentifier* (Conversational, Transactional, Streaming, Best Effort)
 - *ReservedBitrate* (Bandwidth)
- Other parameters (BER, delay) inferred from *ClassIdentifier*
- *Bandwidth* - bandwidth currently available in the access network

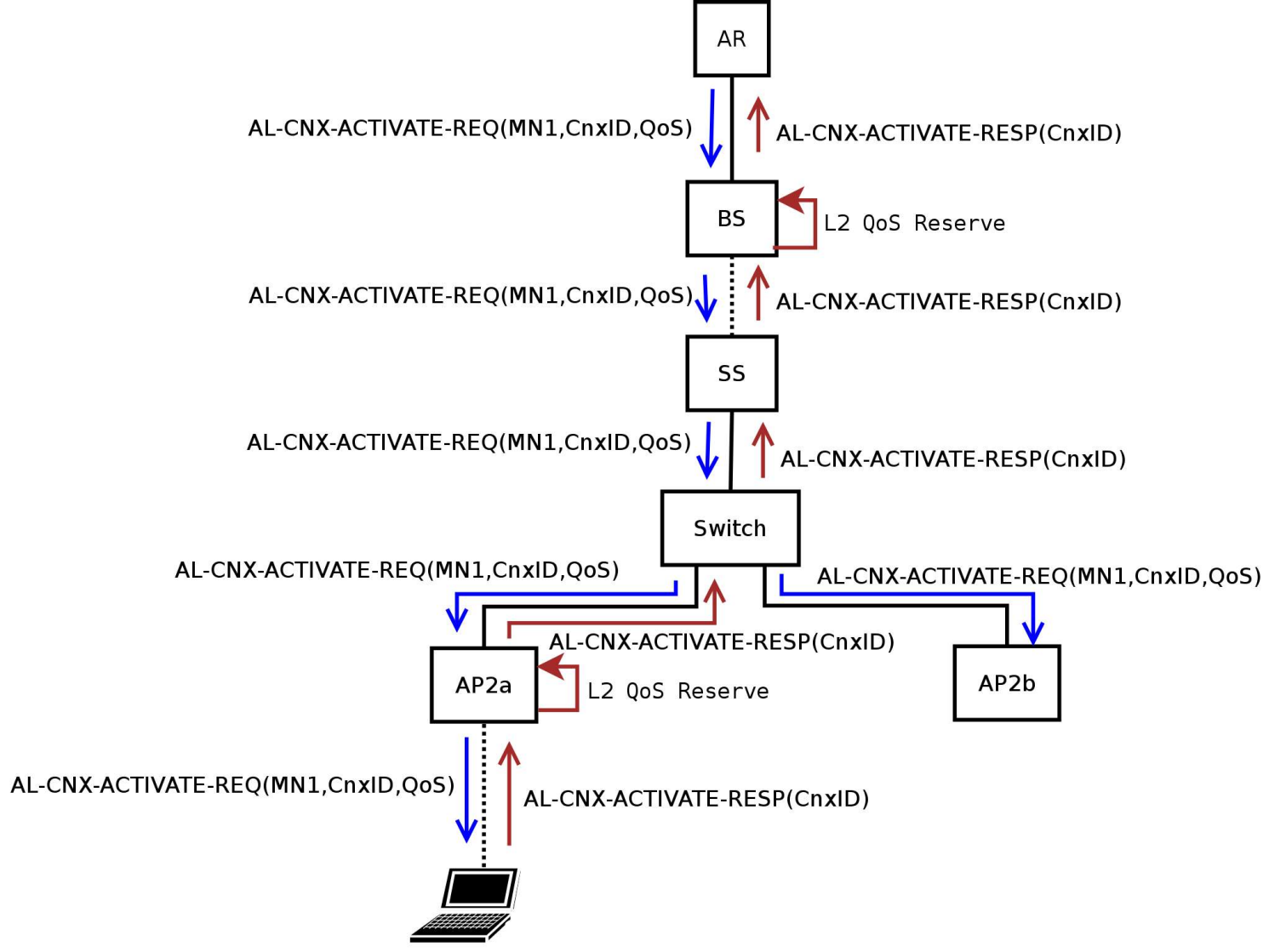


QoS Abstraction Layer – Signaling

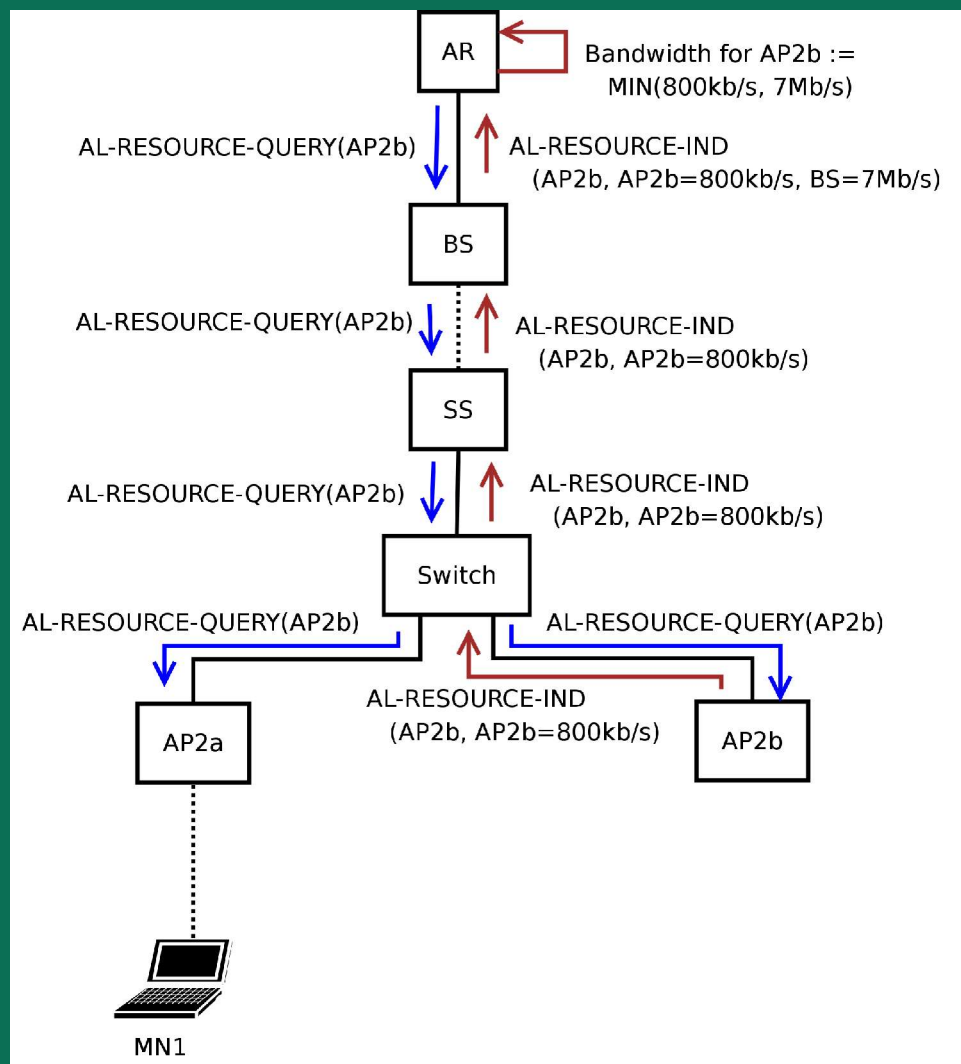
- Motivation
 - Access Router needs to communicate with Access Points
 - APs may be scattered across a multi-hop L2 network
 - QoS reservation in each L2 segment is required
- Functional requirements
 - Support any network topology
 - Recoverable from transmission errors
 - Technology independent PDUs
- Desirable properties
 - Not rely on availability of TCP/IP in L2 nodes
 - Auto discovery of network topology
- Other properties
 - Use L2 frames, not IP packets
 - Request-confirmation based
 - Let Ethernet protocols (e.g., learning bridge) find the path to the MT
 - Soft-state → periodic refresh needed



Signalling Example - Reservation



Signalling Example - Resource Query for AP



Conclusions

- QoS Abstraction Layer solves a number of problems in 4G
 - Reserve QoS resources for a terminal
 - Independent of type of L2 technology
 - Query available resources in neighbour APs
 - Information can be used as input to handover target selection algorithms
 - Receives QoS degradation notifications (triggers)
 - Useful for cross-layer design and handover decisions
 - Support for smooth L2 handovers
 - Modular architecture
 - Support a new technology = write a new driver
 - Automatic discovery of topology

