Quality of Service Provisioning in WiMAX Networks: Chances and Challenges

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Outline

- QoS in WiMAX
- WiMAX QoS chances
- WiFi / WiMAX QoS Integration
- Discussion and conclusion

QoS in WiMAX

QoS in WiMAX: basics

- Connection oriented
  - QoS per connection
  - all services are applied to connections
  - managed by mapping connections to "service flows"
  - bandwidth requested via signaling

QoS in WiMAX: basics (cont.)

- Three management connections per direction, per station
  - basic connection: short, time-critical MAC / RLC messages
  - primary management connection: longer, delay-tolerant messages
    - authentication, connection setup, etc.
  - secondary management connection: e.g. DHCP, SNMP
- Transport connections
  - unidirectional; different parameters per direction

QoS in WiMAX: services

- Four types of scheduling service
  - Unsolicited Grant Service (UGS)
    - for real-time flows, periodic fixed size packets
    - e.g. VoIP or ATM CBR
  - Real-Time Polling Service (rtPS)
    - for real-time service flows, periodic variable size data packets
    - e.g. MPEG
  - Non-Real-Time Polling Service (nrtPS)
    - for non real-time service flows with regular variable size bursts
    - e.g. FTP or ATM VBR-NRT
  - Best Effort (BE)
    - for best effort traffic
    - e.g. UDP or ATM UBR

QoS in WiMAX: services (cont.)

- Specified via QoS parameters
  - max. sustained traffic rate (MSR)
  - min. reserved traffic rate (MRR)
  - max. latency
  - max. jitter
  - priority
  - vendor specific parameters

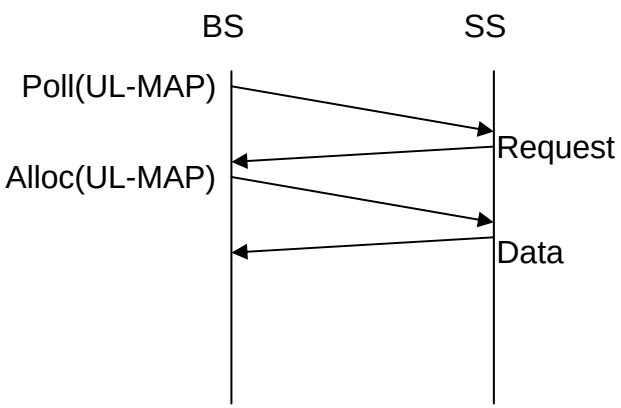
Bandwidth request and allocation (1)

- Subscriber Stations (SSs)may request bandwidth (bw) in 3 ways:
  - Use the ”contention request opportunities” interval upon being polled by the BS (multicast or broadcast poll).
  - Send a standalone MAC message called ”BW request” in an allready granted slot.
  - Piggyback a BW request message on a data packet.

Bandwidth request and allocation (2)

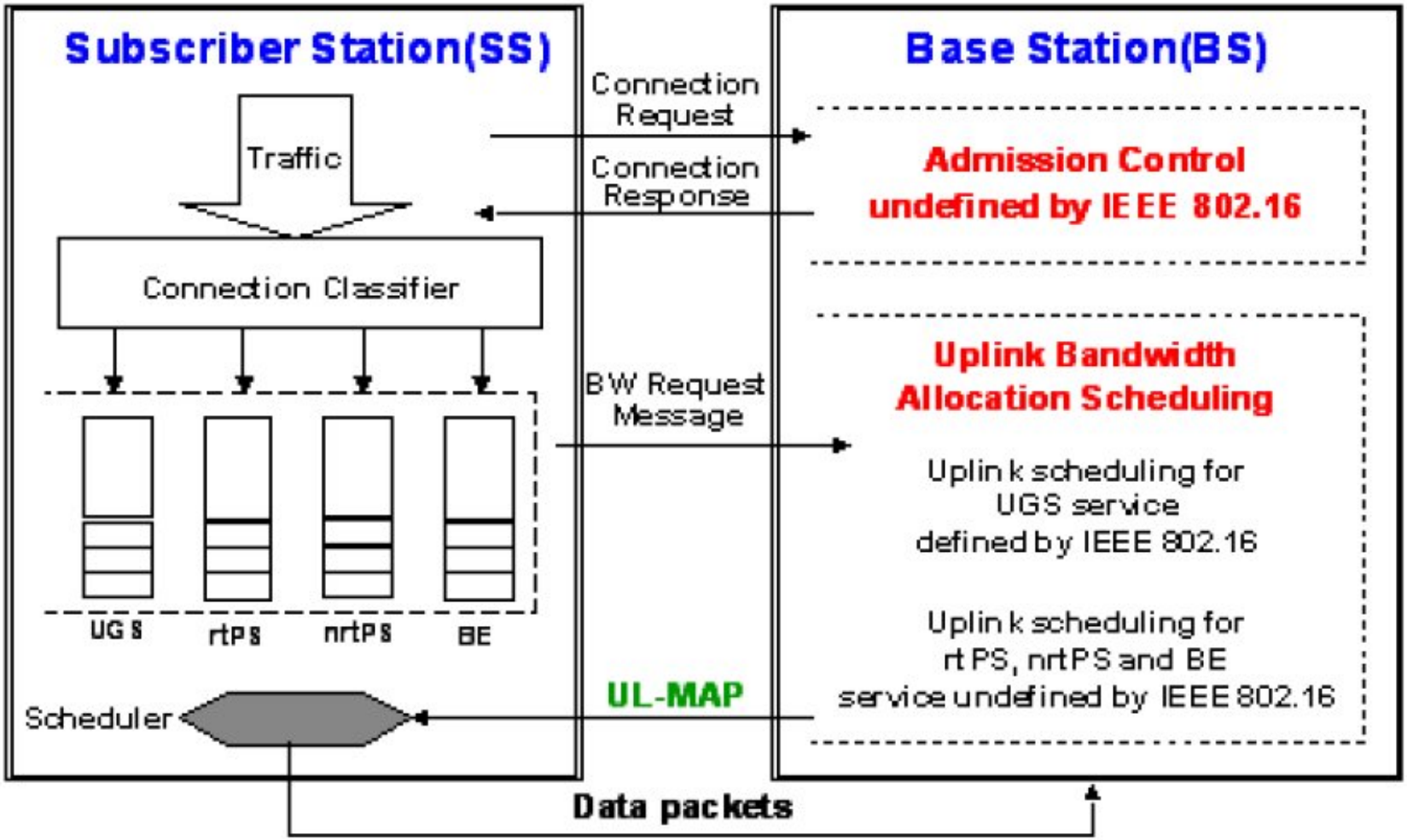
- BS grants/allocates bandwidth in one of two modes:
  - Grant Per Subscriber Station (GPSS)
  - Grant Per Connection (GPC)
- Decision based on requested bw and QoS requirements vs. available resources.
- Grants are realized through the UL-MAP.

Unicast Polling

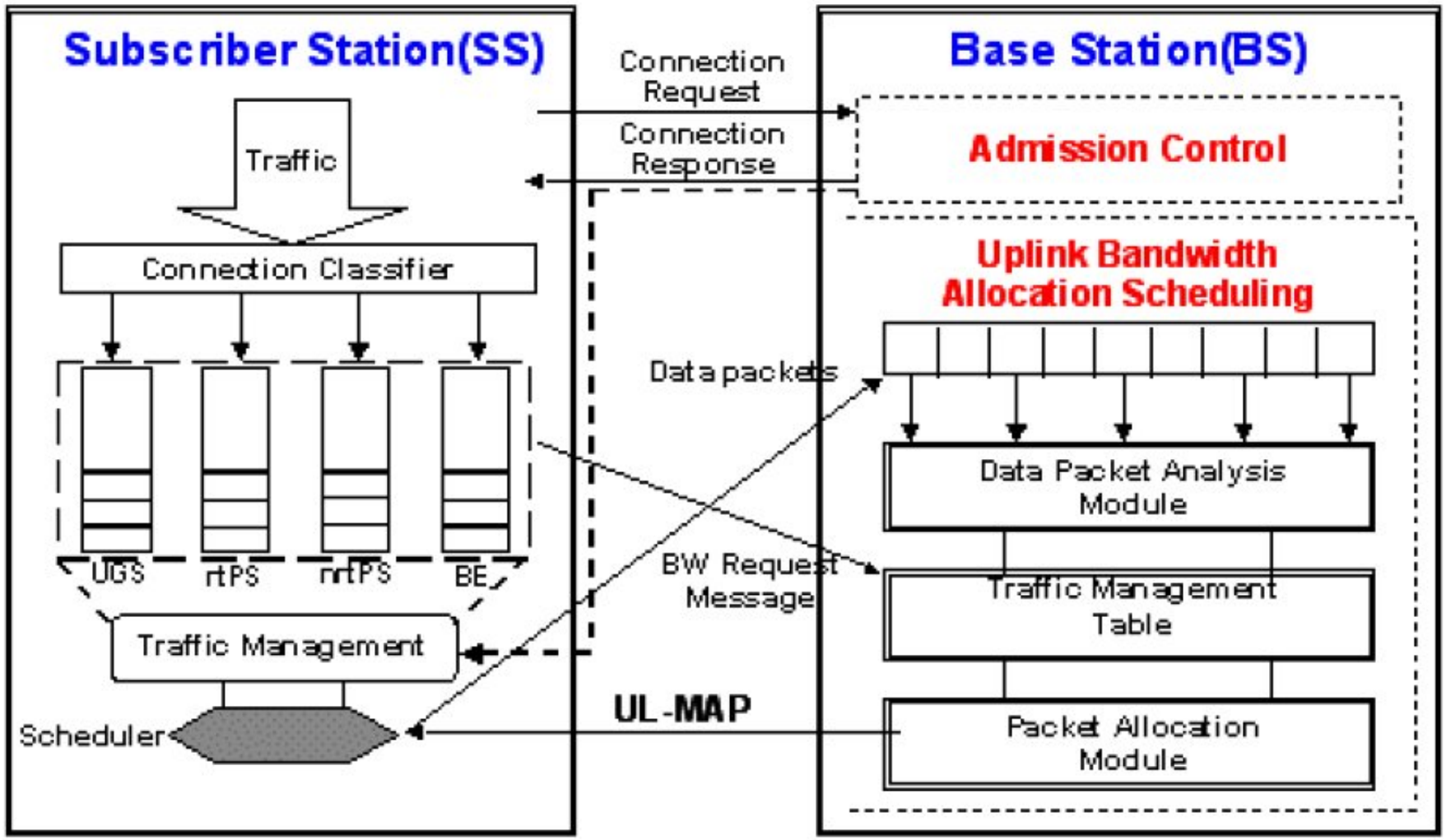


1. BS allocates space for the SS in the uplink subframe.
2. SS uses the allocated space to send a bw request.
3. BS allocates the requested space for the SS (if available).
4. SS uses allocated space to send data.

QoS architecture of WiMAX



A new QoS architecture of WiMAX [5]



WiMAX QoS chances [3]

Bad ideas for 802.16 QoS

- Support for end-to-end QoS across the Internet
  - Never happened, and probably never will
- 802.16 QoS as replacement for IP QoS
  - QoS must be preserved at all layers
- Complicated QoS configurations
  - Simple ones suffice to support IP traffic
  - QoS configuration errors / software bugs are often reasons for failure

What can 802.16 QoS do for us?

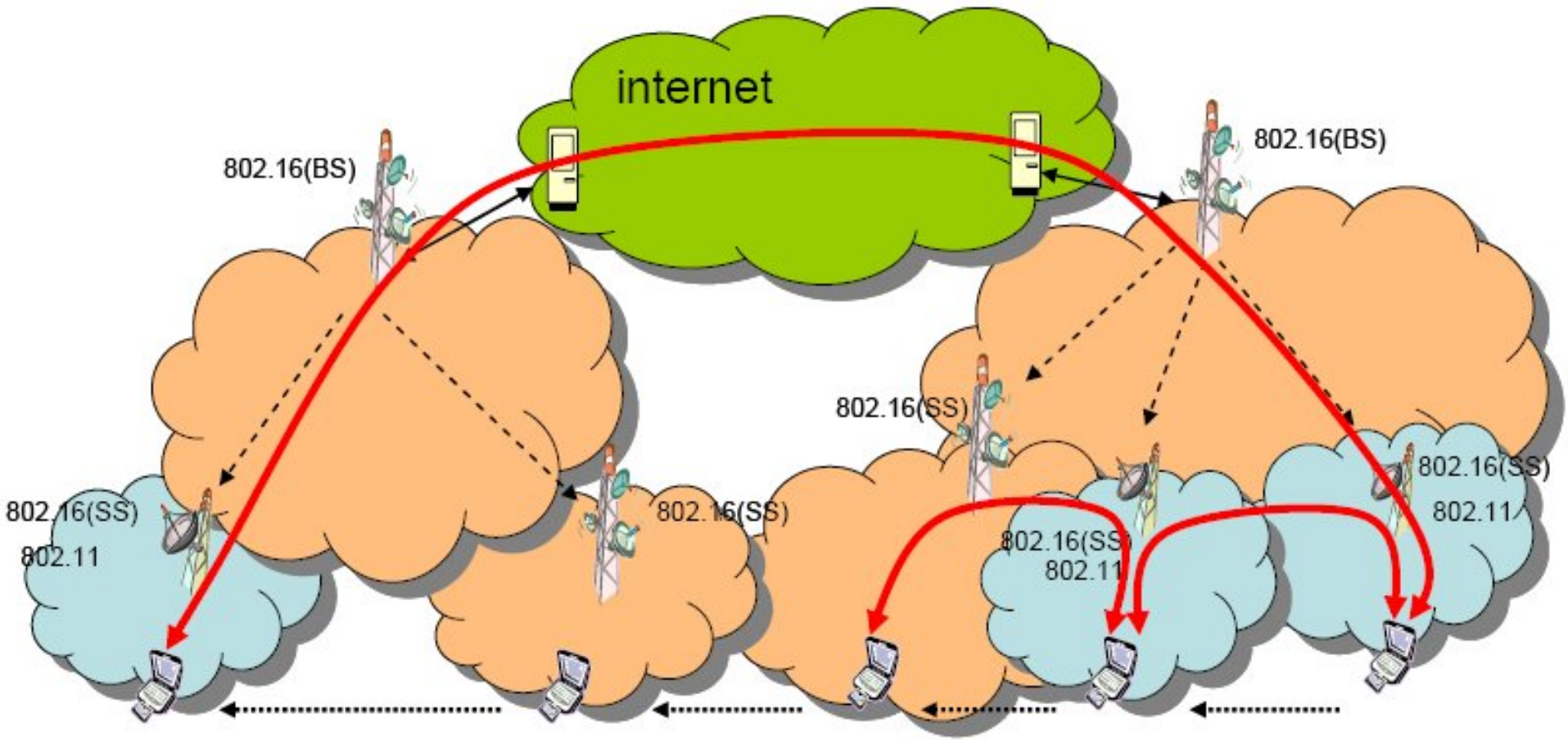
- Nowadays, IntServ, DiffServ, MPLS are traffic management tools
  - e.g. protect TCP traffic from UDP
  - reasonable when overprovisioning is not a solution
    (i.e. it is more expensive or impossible)

- IP QoS does not work with incompatible link layers

- Classifier in 802.16: assign IP packets to "service flows"
  - can use destination address, source address, protocol, DSCP
  - DSCP QoS association: "glue" between 802.16 QoS and IP QoS
    - enables DiffServ

WiFi/WiMAX QoS Integration

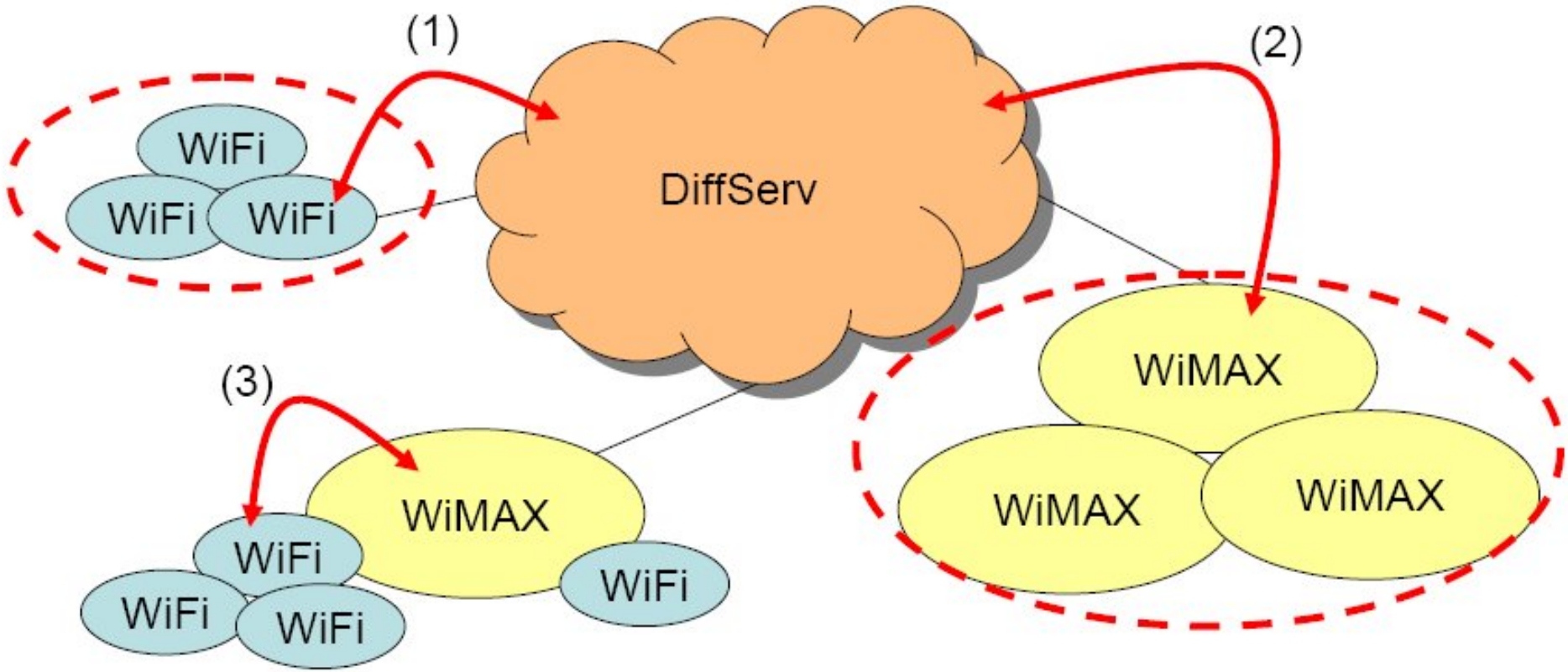
Inter-system QoS guarantees



QoS integration challenges

- connection-oriented (WiMAX) vs. contention-based (WiFi)
- QoS parameters mapping
  - Should define three QoS mapping interfaces
    - WiFi to Internet
    - WiFi to WiMAX
    - WiMAX to Internet

QoS mapping


(1)
(2)
(3)
DiffServ
WiFi
WiFi
WiFi
WiMAX
WiMAX
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WiFi
WiFi

Discussion and Conclusion

- We need a good signaling protocol to setup the QoS connection
  - SIP
  - Soft state RSVP [6]
    - Prediction and resource reservation
- QoS must be preserved at all layers
  - Vertical QoS mapping and horizontal QoS mapping
- QoS with Mobility

References

[1] IEEE Std. 802.16-2001 IEEE Standard for Local and MANPart16:Air Interface for Fixed Broadband Wireless Access Systems, IEEE Std 802.16-2001, 2002.

[2] Michael Welzl, Max Mühlhäuser: "Scalability and Quality of Service: a Trade-off?", IEEE Communications Magazine Vol. 41 No. 6, June 2003

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[4] G. Huston: “Next Steps for the IP QoS Architecture“, RFC 2990

[5] D. H. Cho, J. H. Song, M. S. Kim and K. J. Han, “**Performance Analysis of the IEEE 802.16 Wireless Metropolitan Area Network**,“ *Proceedings of the First International Conference on Distributed Frameworks for Multimedia Applications*, 2005.

[6] W. T. Chen and L. C. Huang, ”**RSVP mobility support: a signaling protocol for integrated services Internet with mobile hosts,”** INFOCOM 2000, 26-30 March 2000.

[7] http://www.wirelessnetdesignline.com/