Architecture of a Dynamic Heterogeneous Network System

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Structure of the Presentation

- Background
- An Example of a Vertical Handover Sequence – Speech Call in WCDMA -> GSM -> Back to WCDMA, another MSC
- Principles of the proposed Architecture
- Traffic Scenario examples
- Conclusion

Background

- Successful Seamless Media Independent communication combines together a number of access technologies, each of which have both strong and weak points
- A desired heterogeneous system would highlight the strong points of each of the access technologies – as seamlessly as possible
- Handover (horizontal) has it's roots in homogeneous cellular systems, what are the drivers to expand it to vertical handovers in the heterogeneous system?

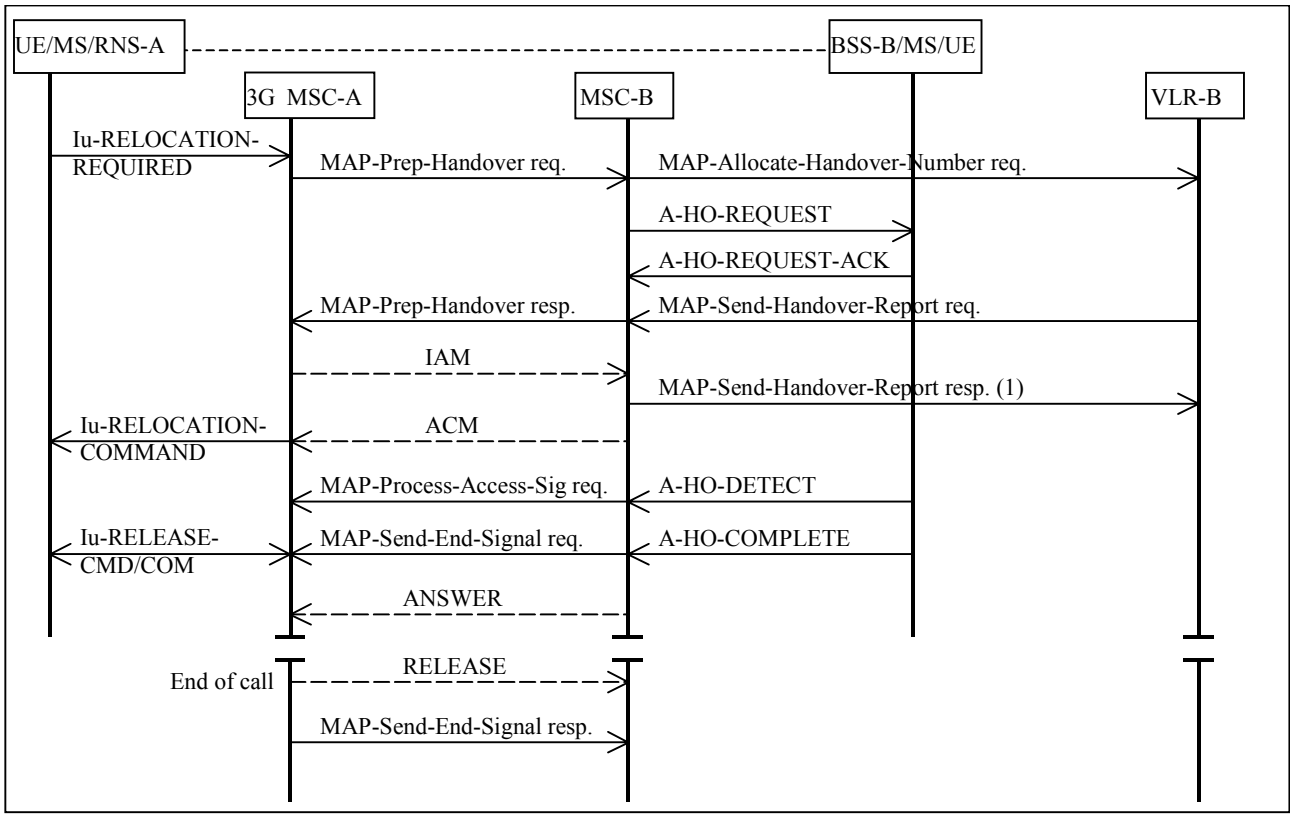
Background

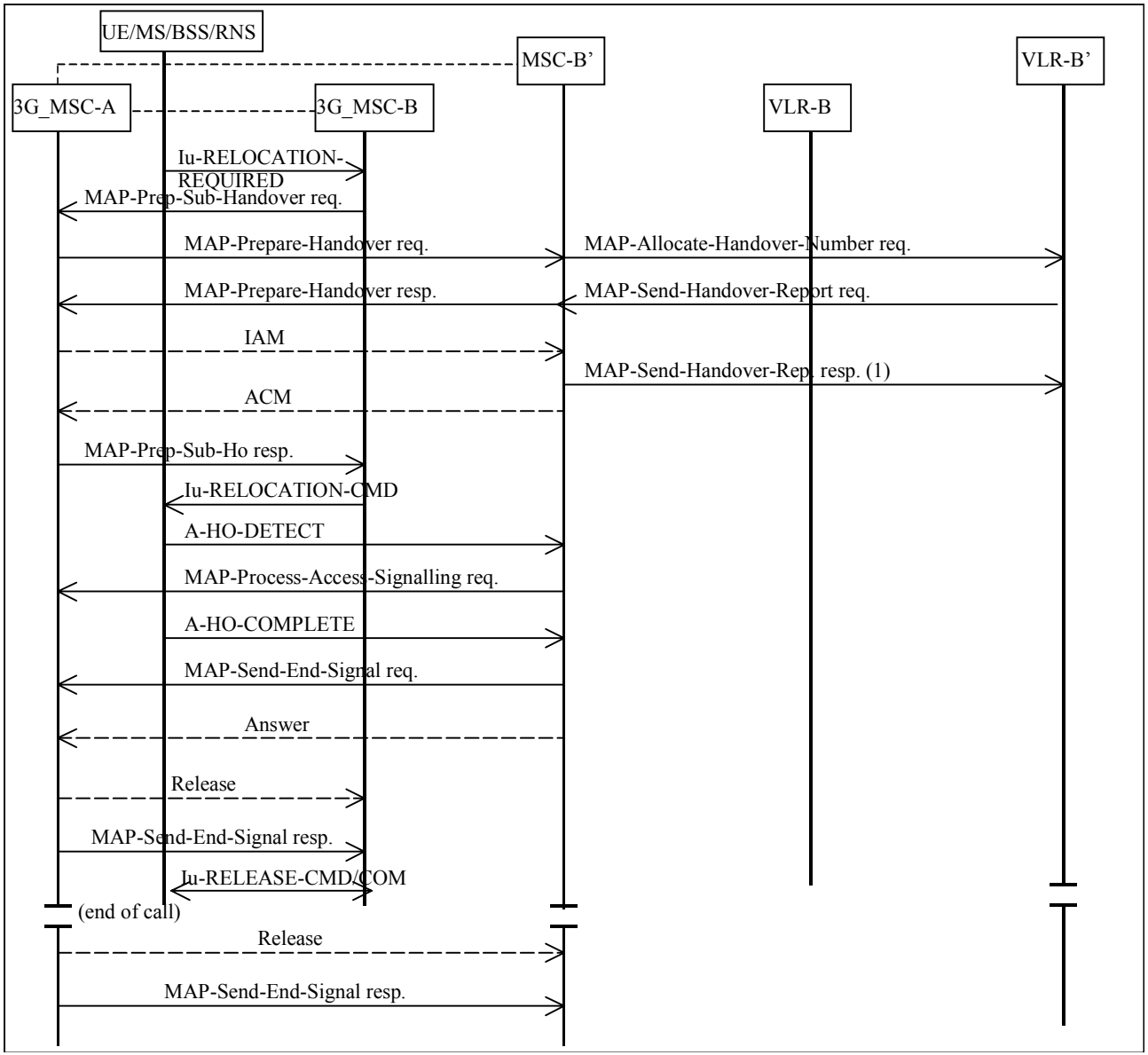
- Operating a Telecom System in a professional, mature way is a very complex task, operating a heterogeneous system is even more challenging
- Telemanagement Forum http://www.tmforum.org has developed a Telecom Operations Map (TOM), it is a high level view of the operational processes and helps in understanding the complexity

Background

- The introduction of Vertical Handovers will inevitably imply a number of interconnections between the individual network domains' processes – it is a lot more complex area than just the (L1/)L2/L3 issues on the (radio) links
- The aim of this presentation is to give an overview some of the issues related to vertical handovers, and to propose an alternative approach for further discussion

Example – Inter-MSC HO WCDMA -> GSM -> WCDMA (from 3GPP TS 23.009 5.8.0)




UE/MS/BSS/RNS
MSC-B'
VLR-B'
3G_MSC-A
3G_MSC-B
VLR-B
Iu-RELOCATION-REQUIRED
MAP-Prep-Sub-Handover req.
MAP-Prepare-Handover req.
MAP-Allocate-Handover-Number req.
MAP-Prepare-Handover resp.
MAP-Send-Handover-Report req.
IAM
MAP-Send-Handover-Rep. resp. (1)
ACM
MAP-Prep-Sub-Ho resp.
Iu-RELOCATION-CMD
A-HO-DETECT
MAP-Process-Access-Signalling req.
A-HO-COMPLETE
MAP-Send-End-Signal req.
Answer
Release
MAP-Send-End-Signal resp.
Iu-RELEASE-CMD/COM
(end of call)
Release
MAP-Send-End-Signal resp.

- In the example only (parts of) core network signaling is shown, the radio related signaling is behind the Iu/A-interfaces
- 3GPP series 25 and 45 specify the radio aspects of UMTS and GSM – a long list of advanced technical specifications created by hard work of very skilled people (look for example RRC spec)
- Vertical Handover approach means that the technical and operational aspects need to be revised considering all of the supported systems – also in the future for the coming systems - an impressive challenge to fulfill

Some other things to remember

- What is the functionality of the terminal? (speech coding, mobility functions, channels, sms, mms, mexe…)
- The security level of the system is as strong as the weakest point – the handover mechanisms shall not endanger the system security
- Monitoring must be supported throughout the system
- How will the services be handled vertically? (eg. will all 3GPP services work also in 802.xx)
- Charging
- Differences in the characteristics of the radio technologies, eg. in terms of the speed of the mobile host

What if ?

- One would try to minimize the impacts on the individual access technologies, and focus on building a mechanism that would highlight the best parts of the technologies
- Eg. 2nd generation cellular systems are very mature and stable, why not use their well field-tested functionalities directly, instead of re-inventing the wheel (eg. mobility management functionality…)

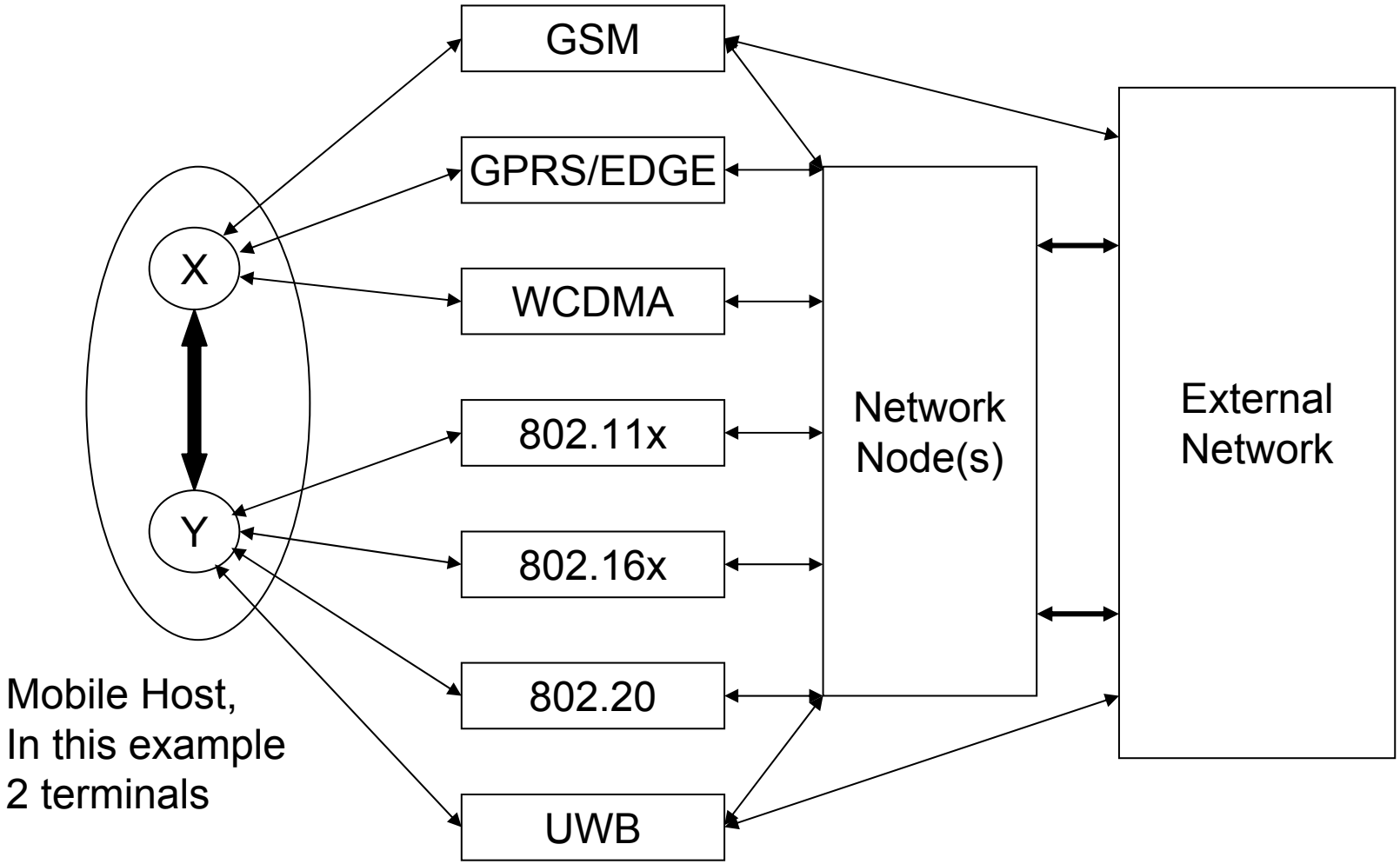
What if ?

- Raising the role of the mobile host in the heterogeneous network – also allowing it to communicate simultaneously over several access technologies and having more control of traffic
  - Requires strong AAA mechanisms
  - New chip technologies will inevitably lead to high-capacity processing also in mobile environments, the processing power could be used also for multi-band SDR and –MIMO – maybe even SoC will be possible?
  - Makes it possible to build a very robust system

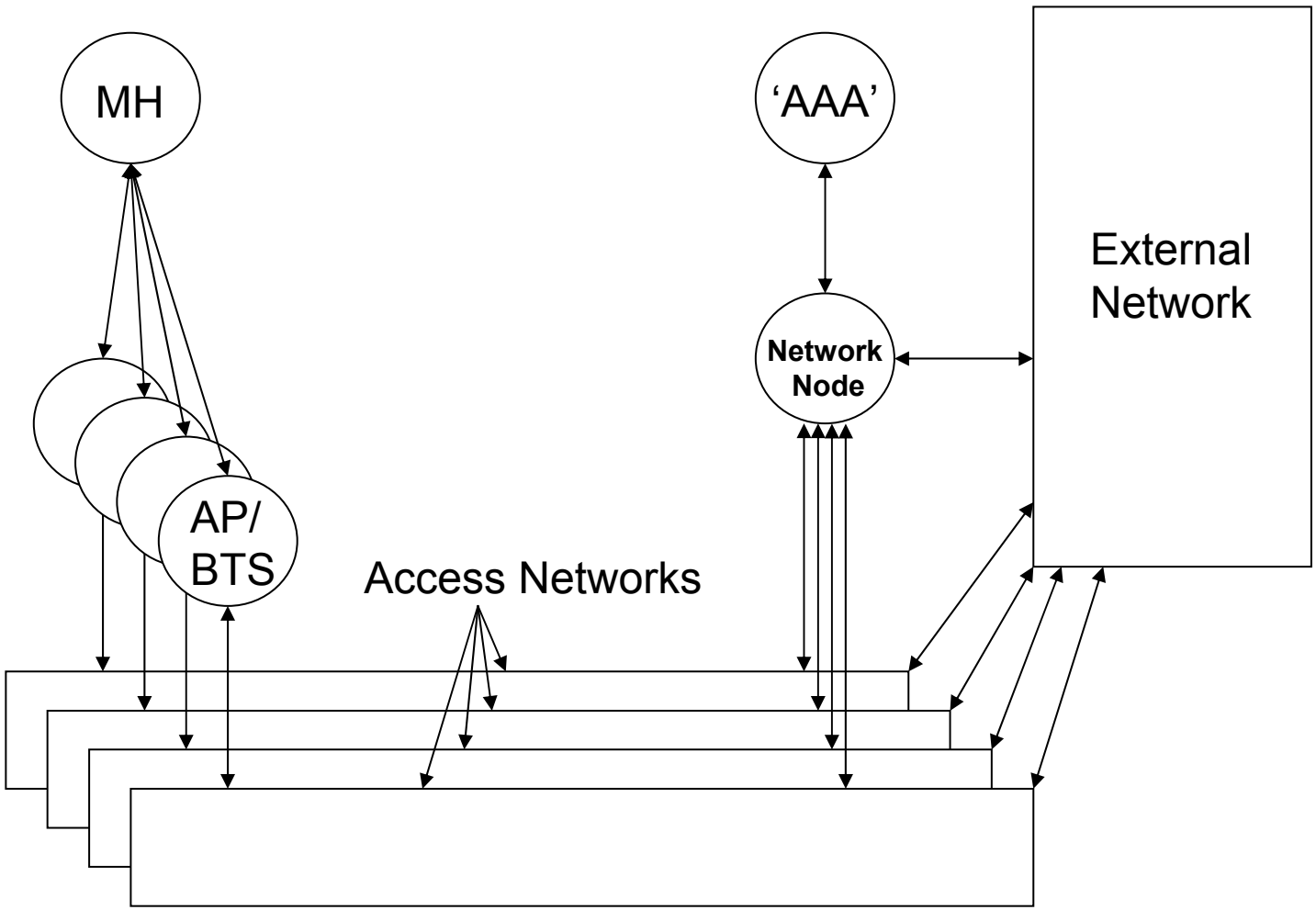
What if ?

- Using the ordinary call/session establishment/teardown mechanisms when redirecting the call to another access technology, the application is informed and can adapt itself to the new conditions
- Basing the mechanism on a common denominator that is present in all access technologies – the QoS, pref. measured

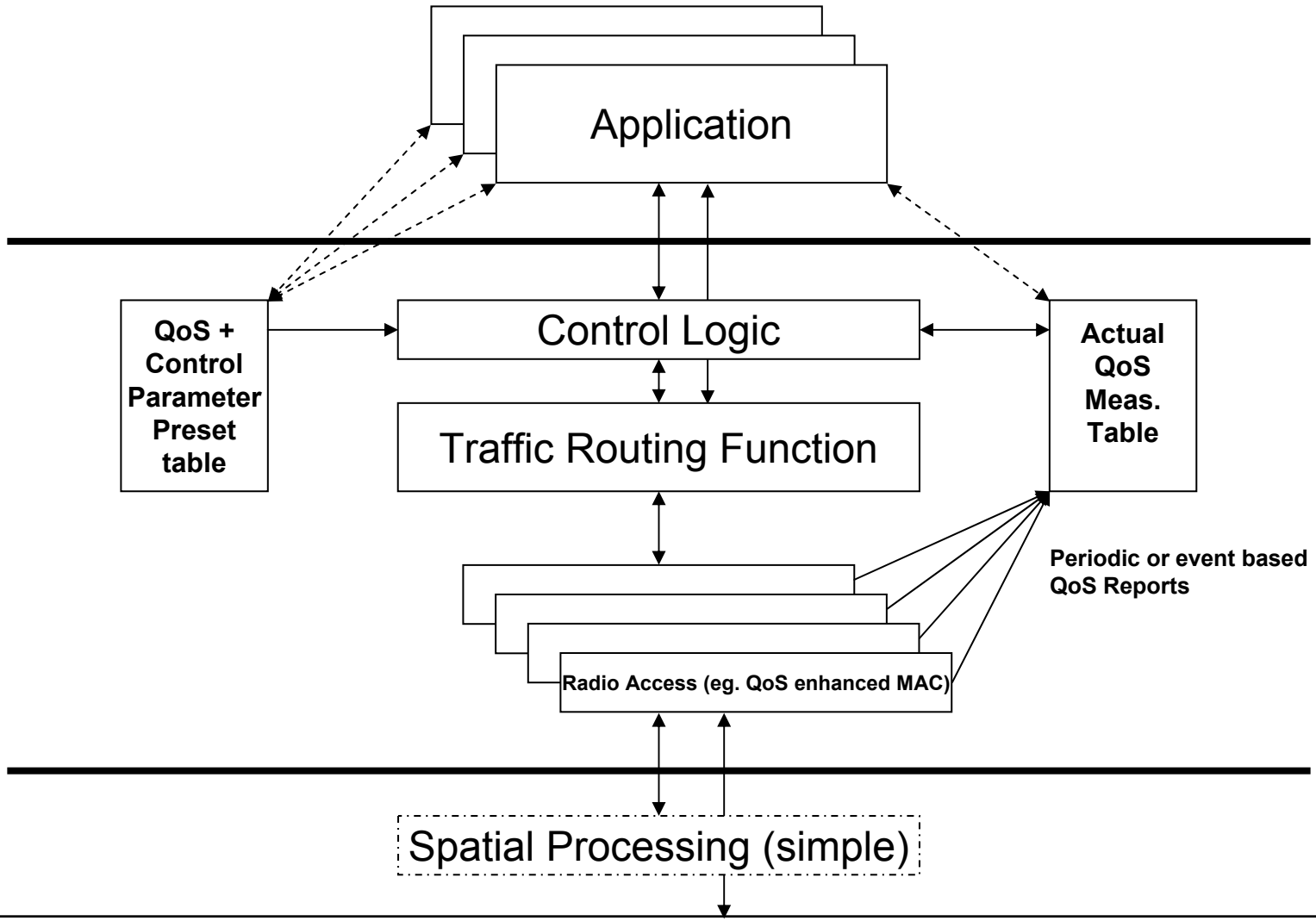
An Example of the Proposed Architecture



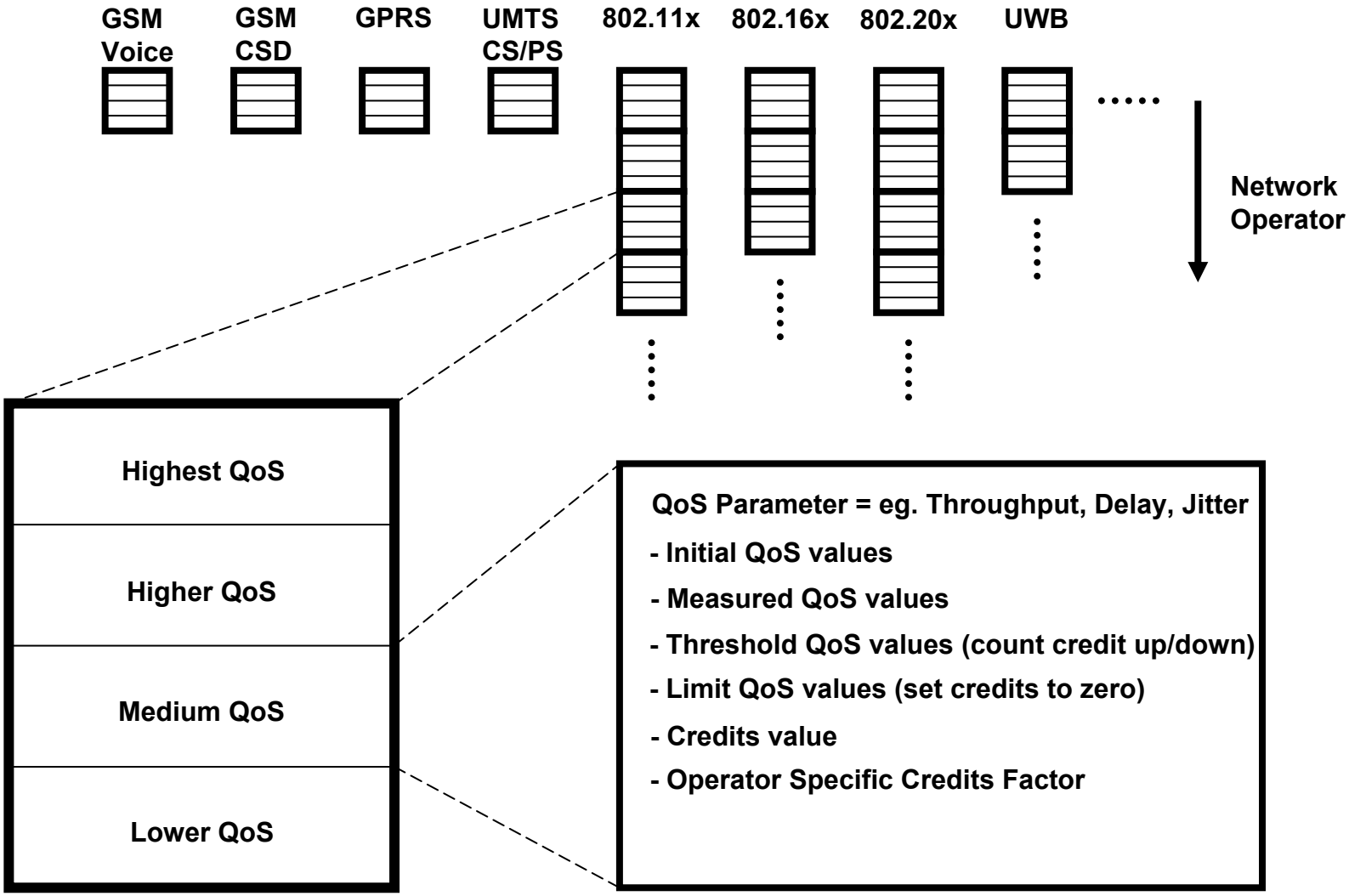
Proposed Architecture, another view



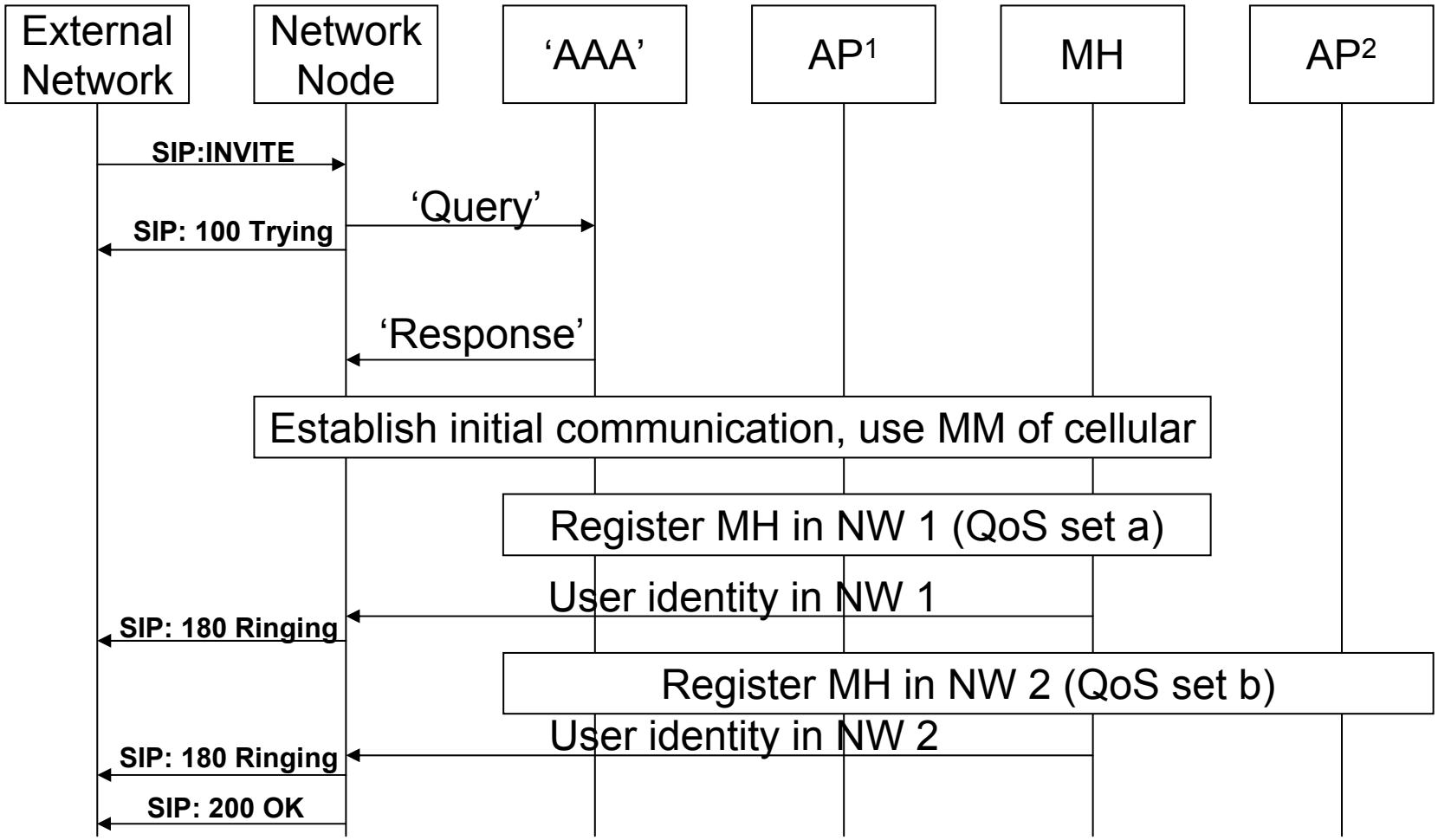
QoS Mechanism Architecture in the MH



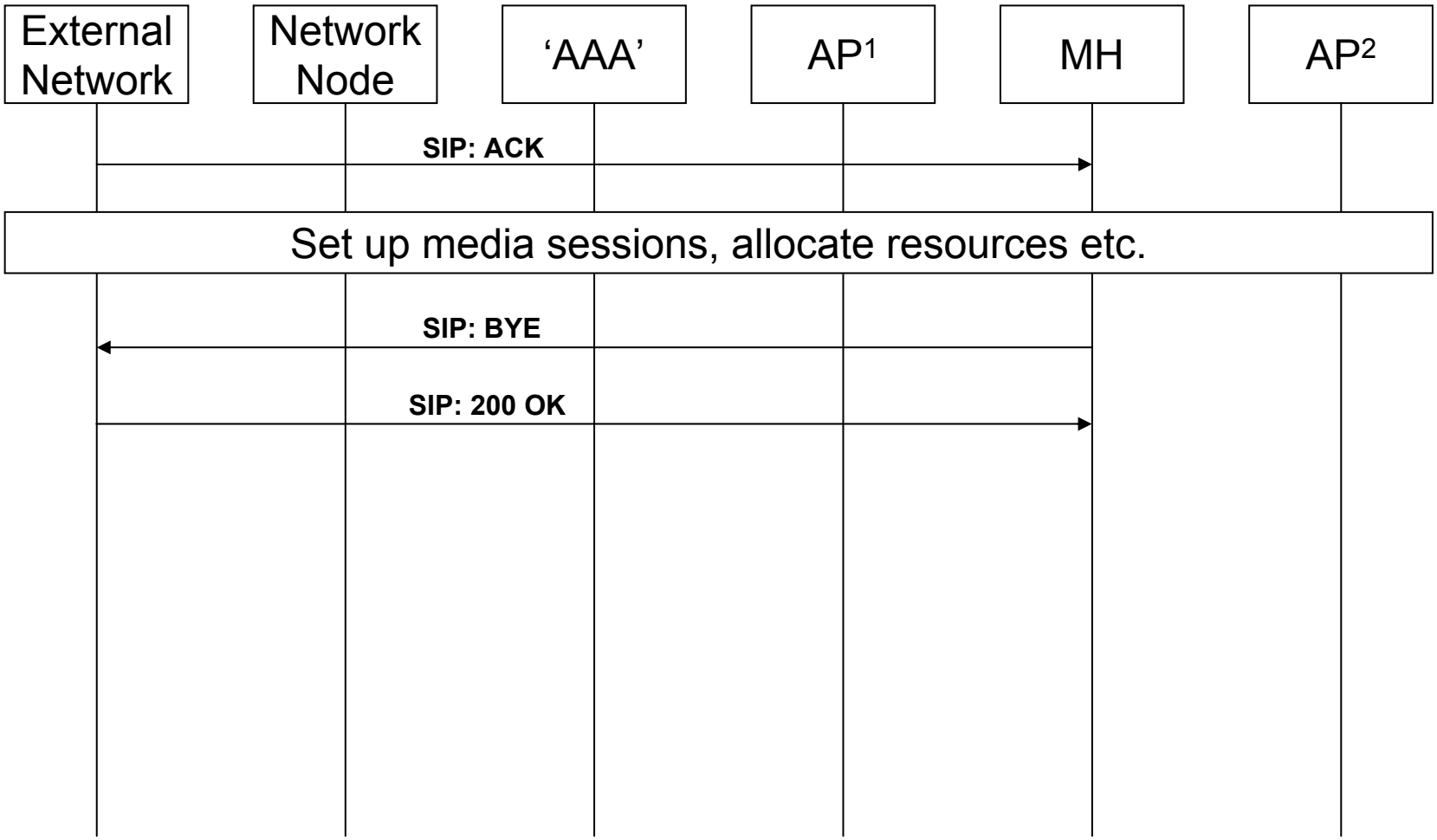
QoS Management Data Architecture in MH



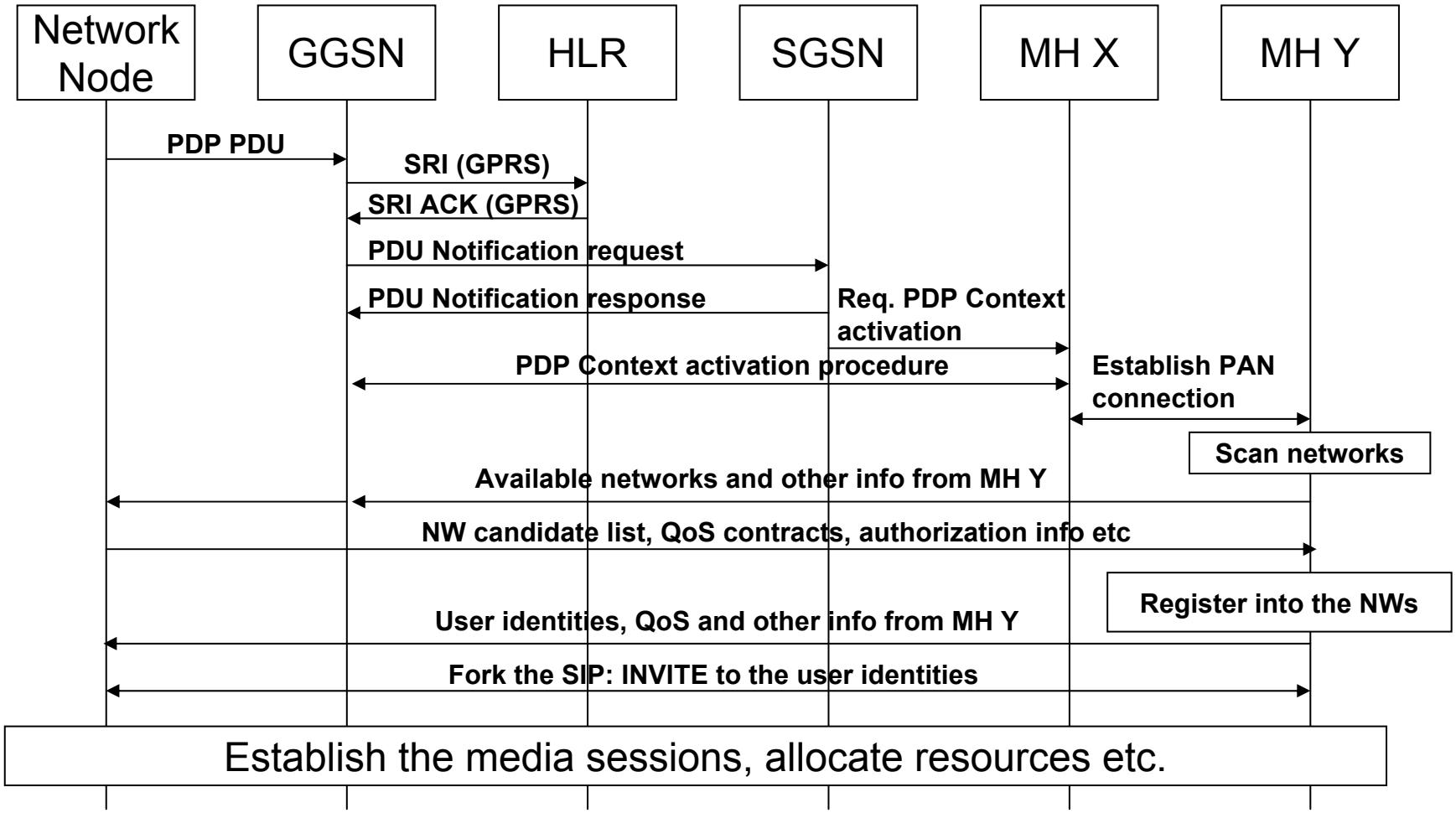
Traffic Scenarios – NW initiated session establishment



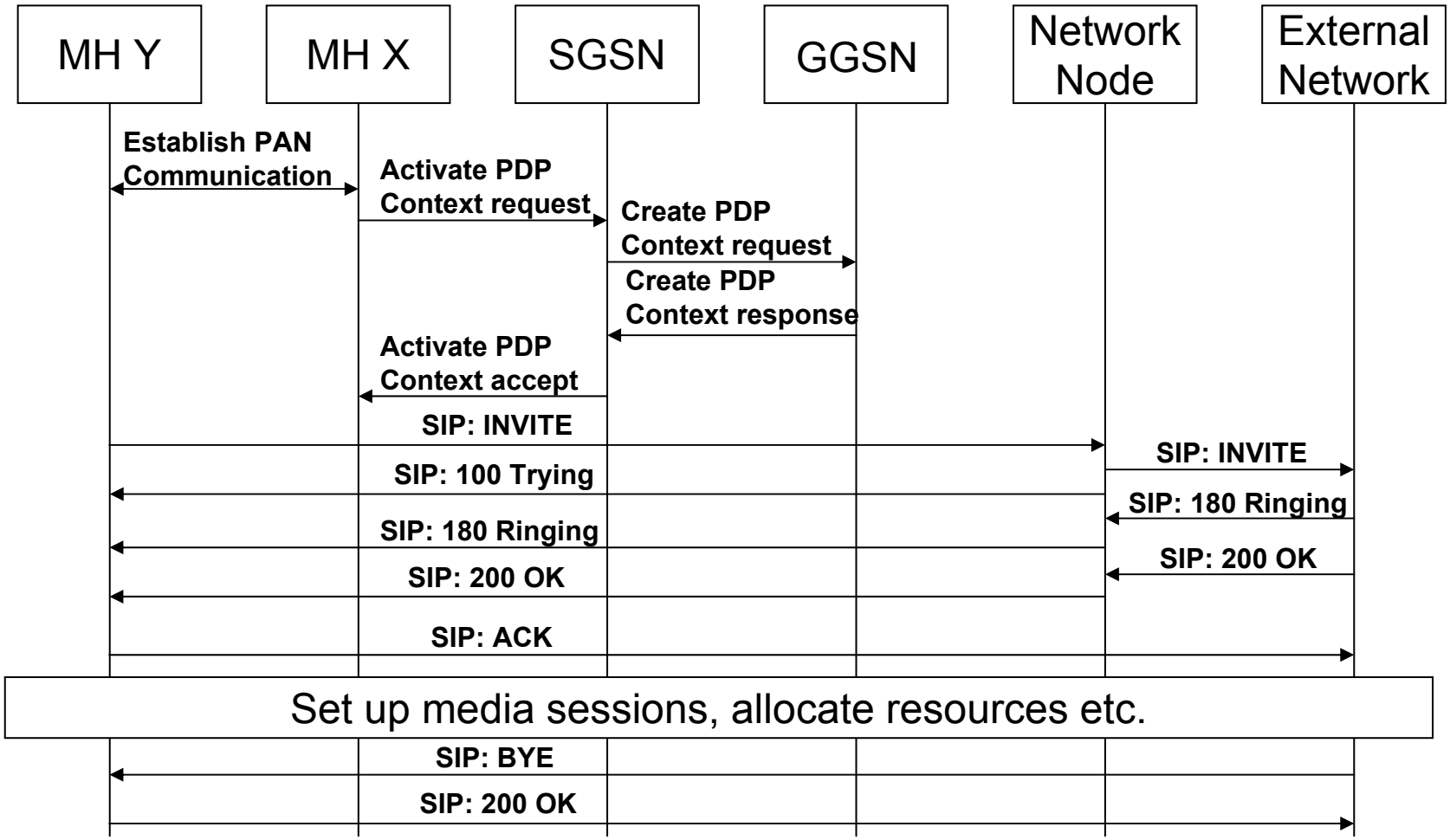
Traffic Scenarios – NW initiated session establishment



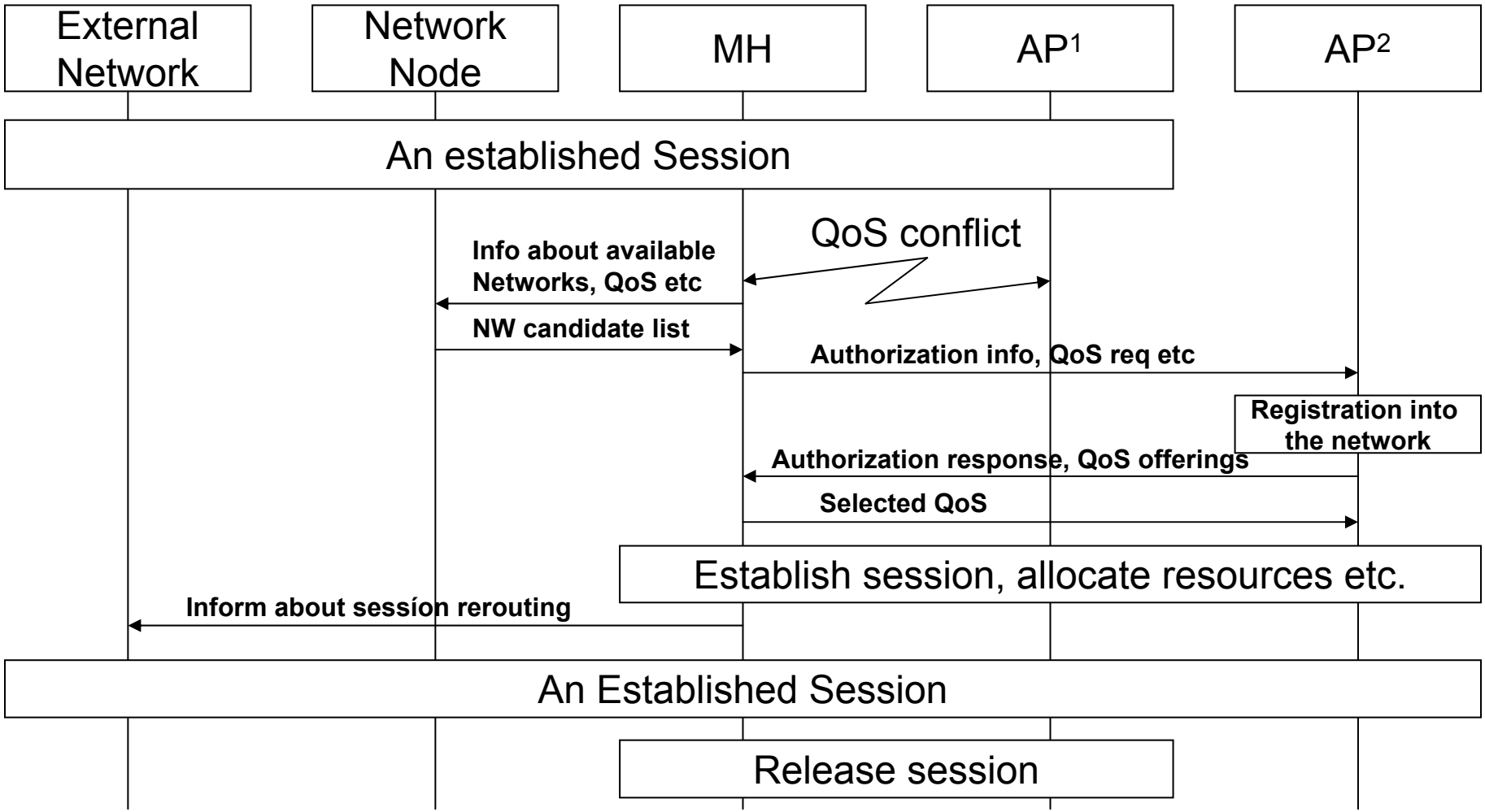
Traffic Scenarios – NW initiated session est. using GPRS



Traffic Scenarios – MH initiated session establishment



Traffic scenarios – session rerouting to another network



Conclusion

- The approach to support heterogeneous Media Independent communication based on handovers is complicated
- A coarse framework for an alternative approach was presented for further discussion
- The approach is simple, but very flexible

Conclusion

- The alternative approach is minimizing the impacts on individual technologies
- The Mobile Host has high role in traffic control
- The approach is aiming at highlighting the best parts of the access technologies – it will be a win-win situation for all of the participants in the architecture!