



A Metering Infrastructure for Heterogeneous Mobile Networks

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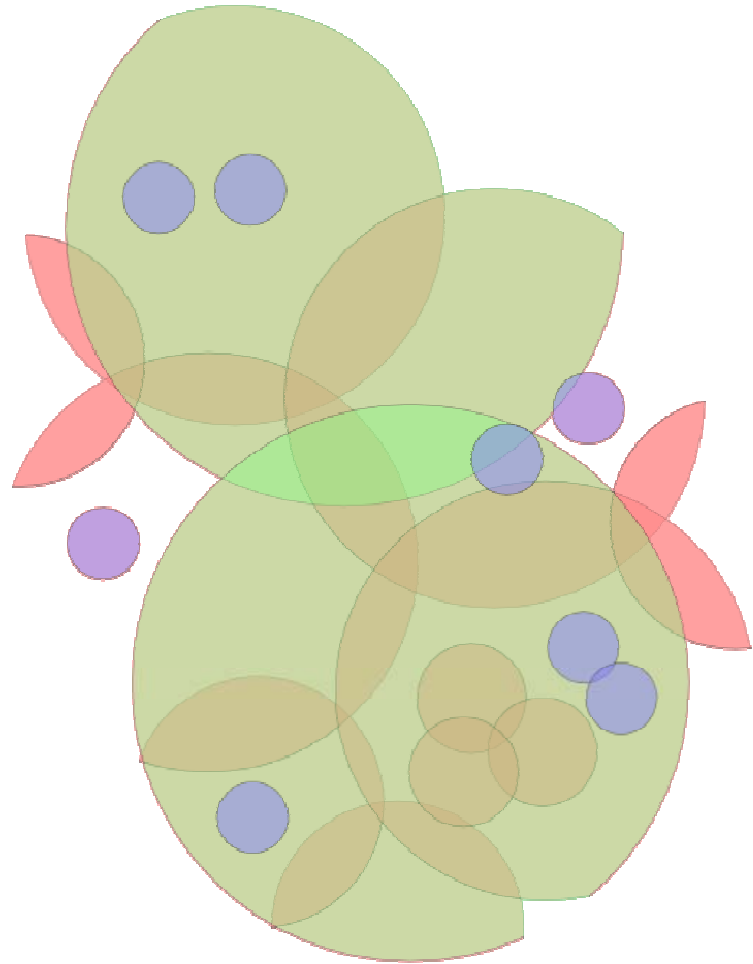
scaleNet
SYMPATHIE Core





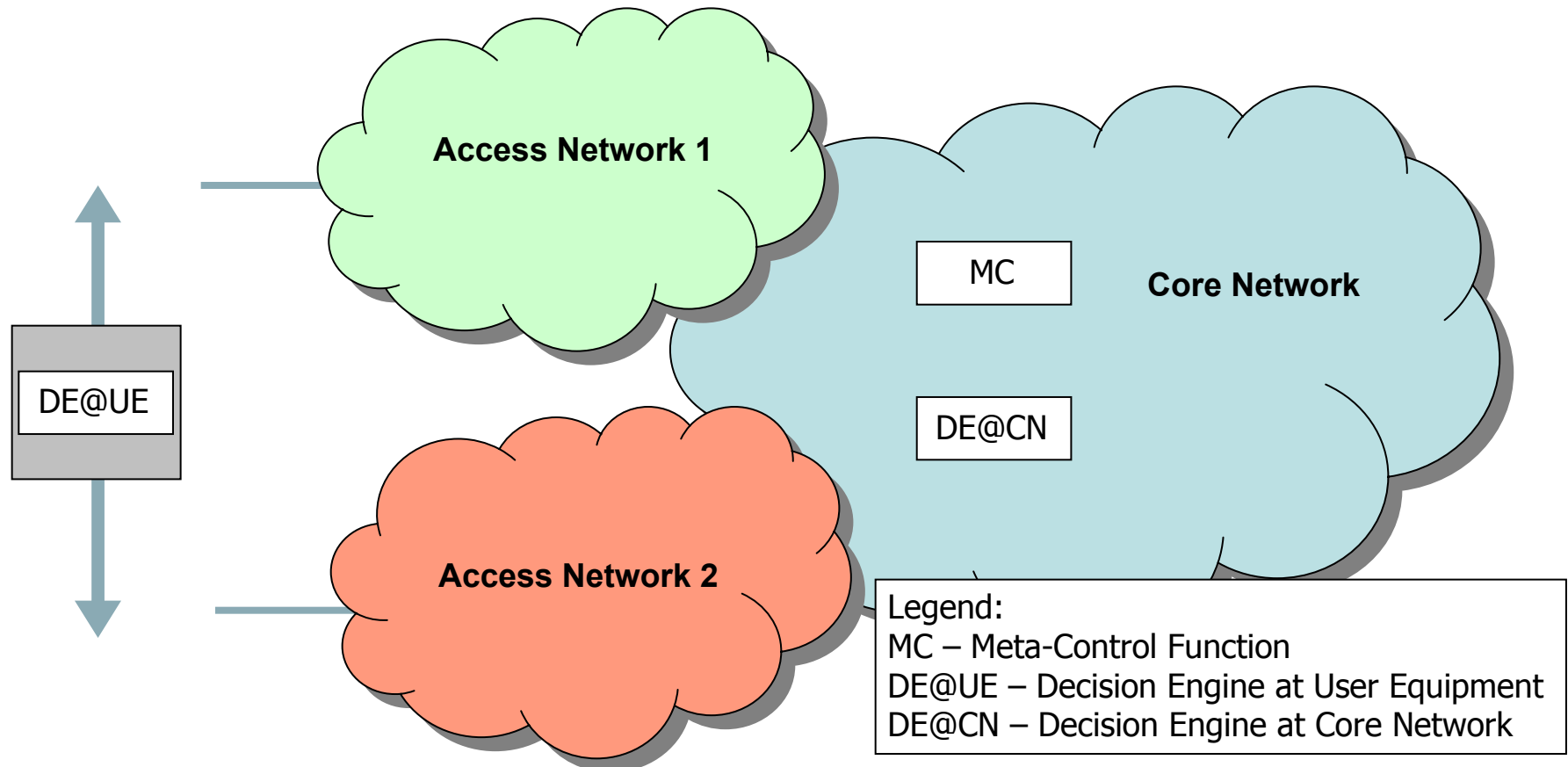
Introduction

- ❑ Heterogeneous access networks
- ❑ Customer is in an area with a bad **UMTS** coverage (Mobility Management)
 - ➔ Should be moved to **LTE**
- ❑ An **UMTS**-Cell is overloaded (Resource Management)
 - ➔ If possible, customers should be moved to **WLAN**





General Concept of Policy-based Resource Management in SYMPATHIE Core



- ❑ Where does the data for the network-side decisions come from?



Problem statement

- ❑ We need data such as
 - load, perceived QoS, signal quality, mobility / location, ...
- ❑ Today's monitoring is too slow:
 - Typically a network element (i.e. RNC) collects data for 30 minutes.
 - Then an ASN-1 encoded file is generated from the data.
 - Finally, this file is uploaded to a management system via FTP.
- ❑ Observation
 - the data could be used for other purposes as well,
 - i.e. management, security / intrusion detection



Bildquelle:
Wikipedia.de



Generic Metering Infrastructure (GMI) – Overview

❑ Publish / Subscribe System

- Clients just subscribe to the data they currently need.

❑ Clients

- The nodes that are interested in our data.
- N-RM, other management systems, intrusion detection, ...

❑ MMCEs

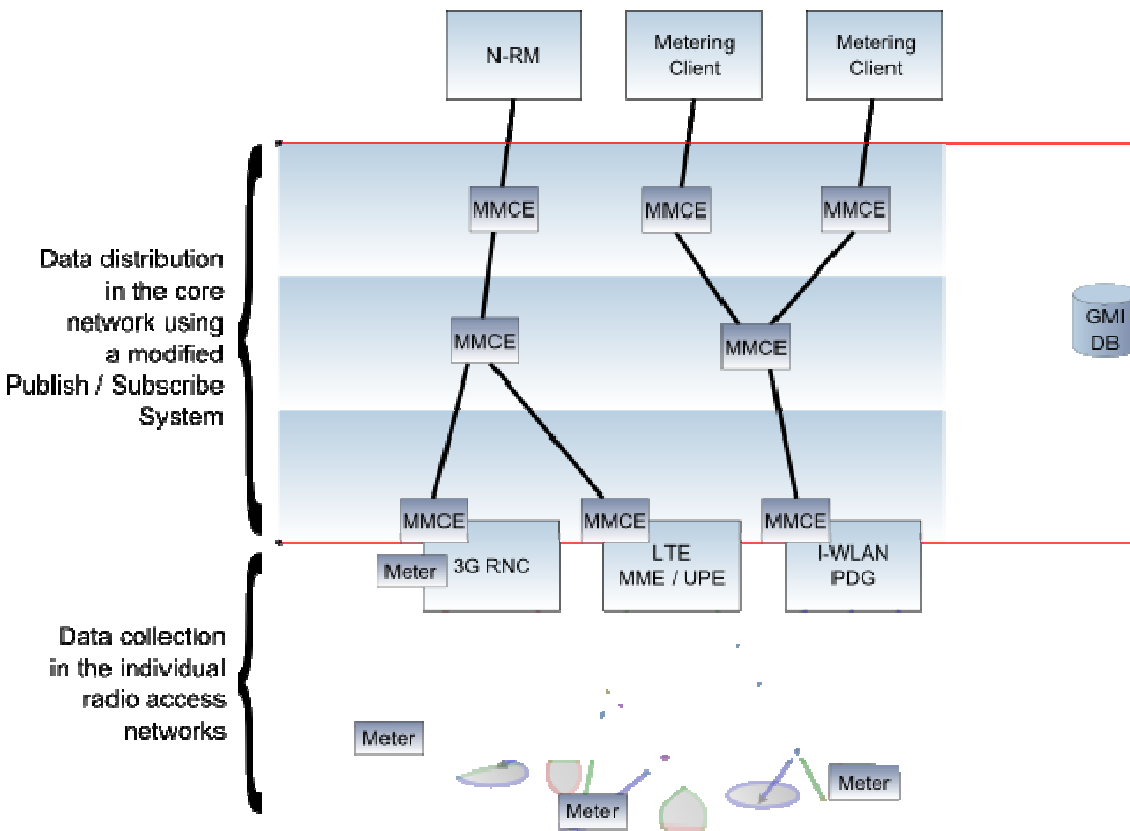
- **M**etering **M**anagement and **C**ollection **E**ntities form the publish / subscribe event service.

❑ Meters

- The actual data sources.

❑ GMI-DB

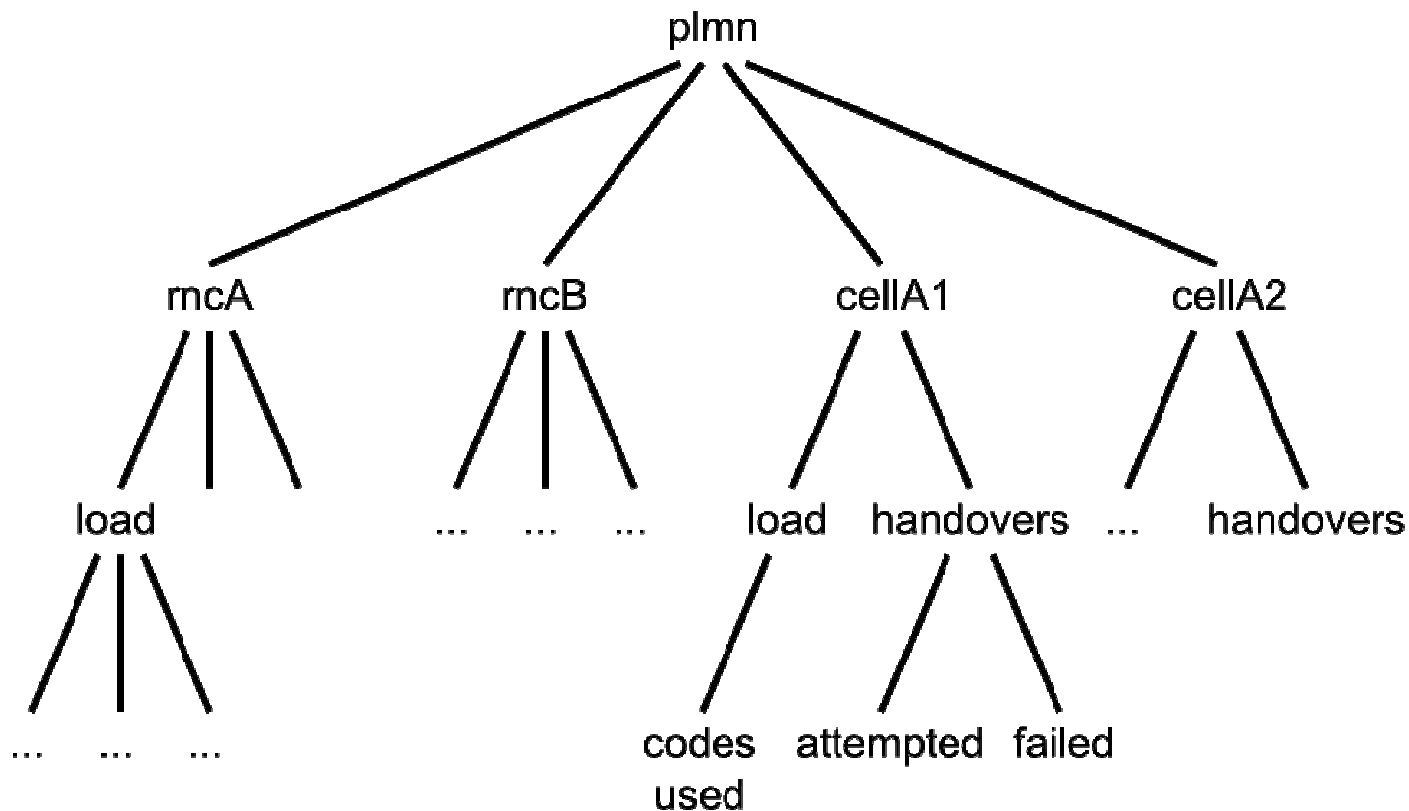
- Lookup-service to find the right MMCE for a subject.





The Subject-Tree

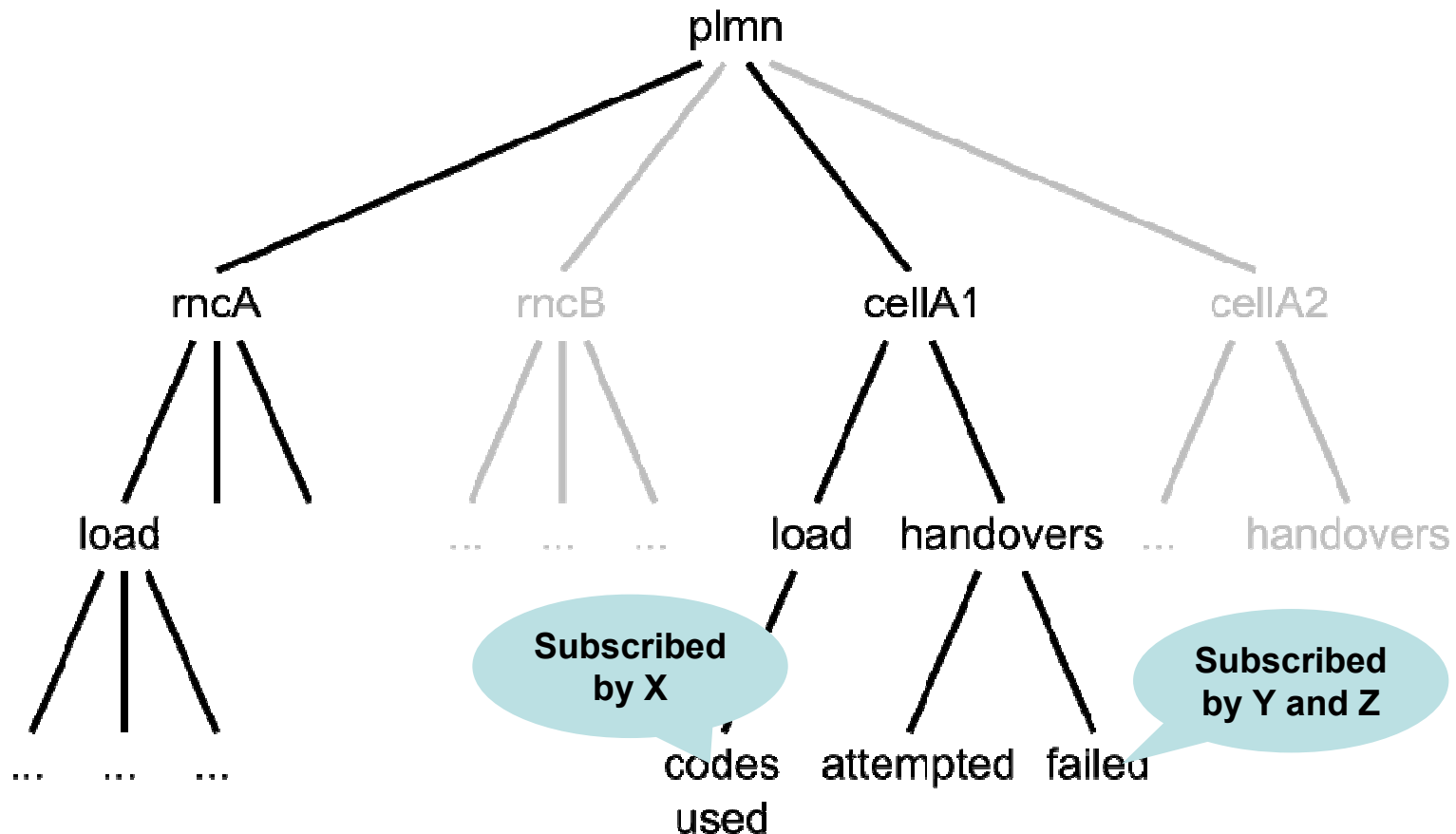
- The GMI-addresses form a tree
 - All subjects that clients might be interested in.
 - Completely known at the GMI-DB.
 - Similar to DNS-Names in 3GPP specifications (TS 23.003).





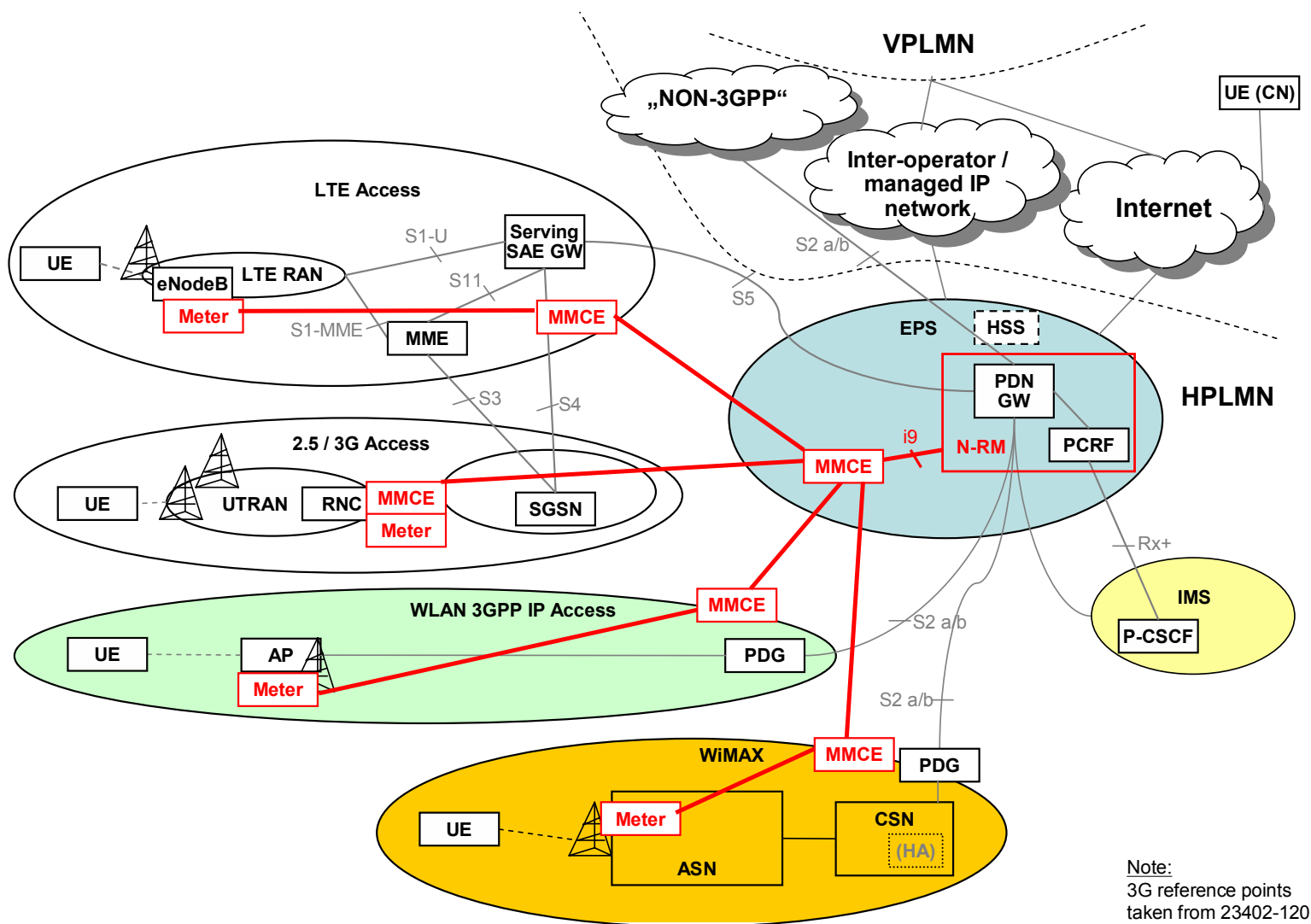
Routing Trees

- Each MMCE contains a routing tree that it is responsible for
 - Consists of parts of the subject tree (not actually a subtree)
 - Annotated with routing information





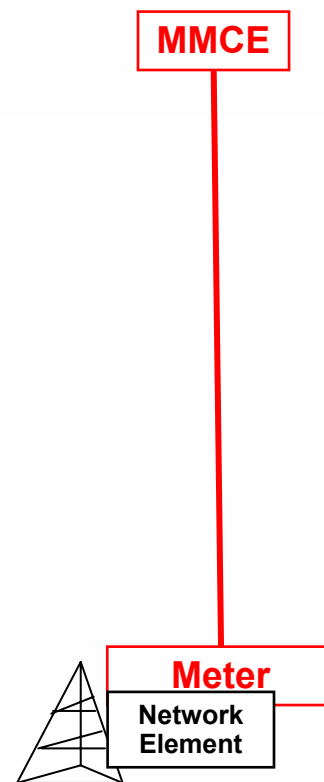
Data from where?





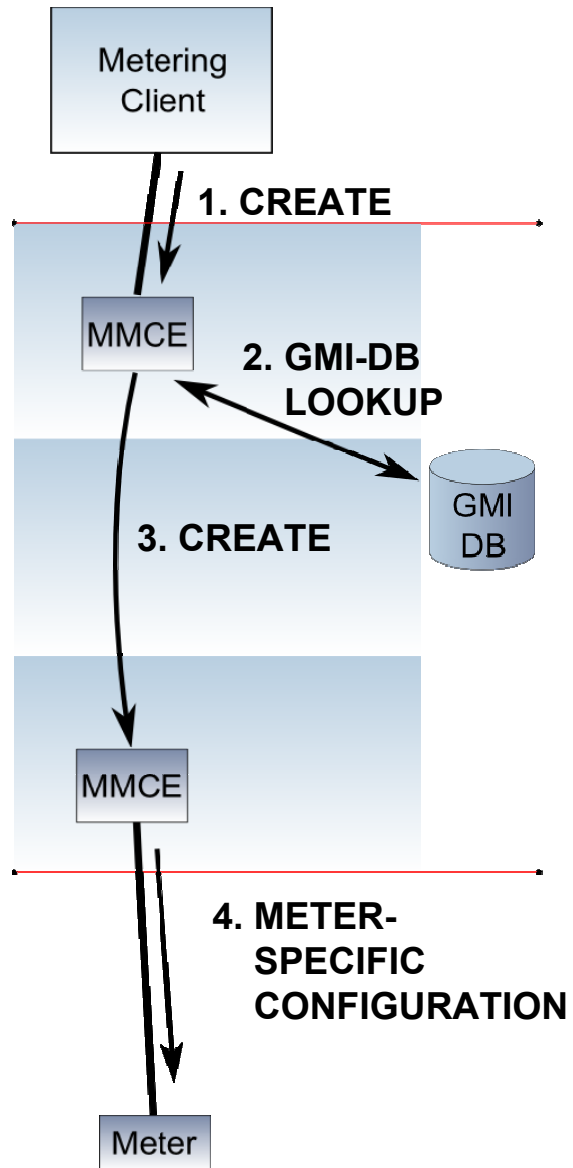
Placing the MMCE above the bottleneck

- ❑ We use a Meter-specific protocol between the lowest MMCE and the Meter.
 - If the meter is a sensor that can be turned ON and OFF and reports integers each seconds while it is ON, this interface will be very simple.
 - It could become more complex if the meter offers more configuration options.
 - We can use efficient protocols like IPFIX to transport the data.
- ❑ The meter only has to care for a single client – the MMCE.
 - No need to send data to multiple destinations.





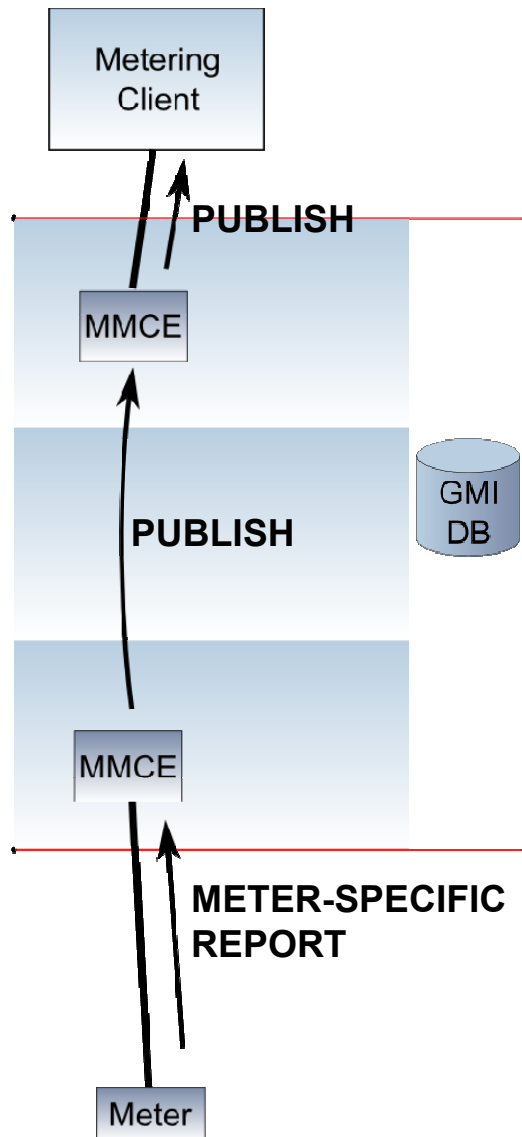
Message Flow: Simple Setup



1. Metering Client wants to subscribe for data.
2. „Home MMCE“ makes a lookup for the data.
 - Equivalent to DNS lookup.
3. „Home MMCE“ subscribes for the data at lower MMCE.
4. Lower MMCE configures the meter to report the requested information.
 - This step is meter-specific.



Message Flow: Data

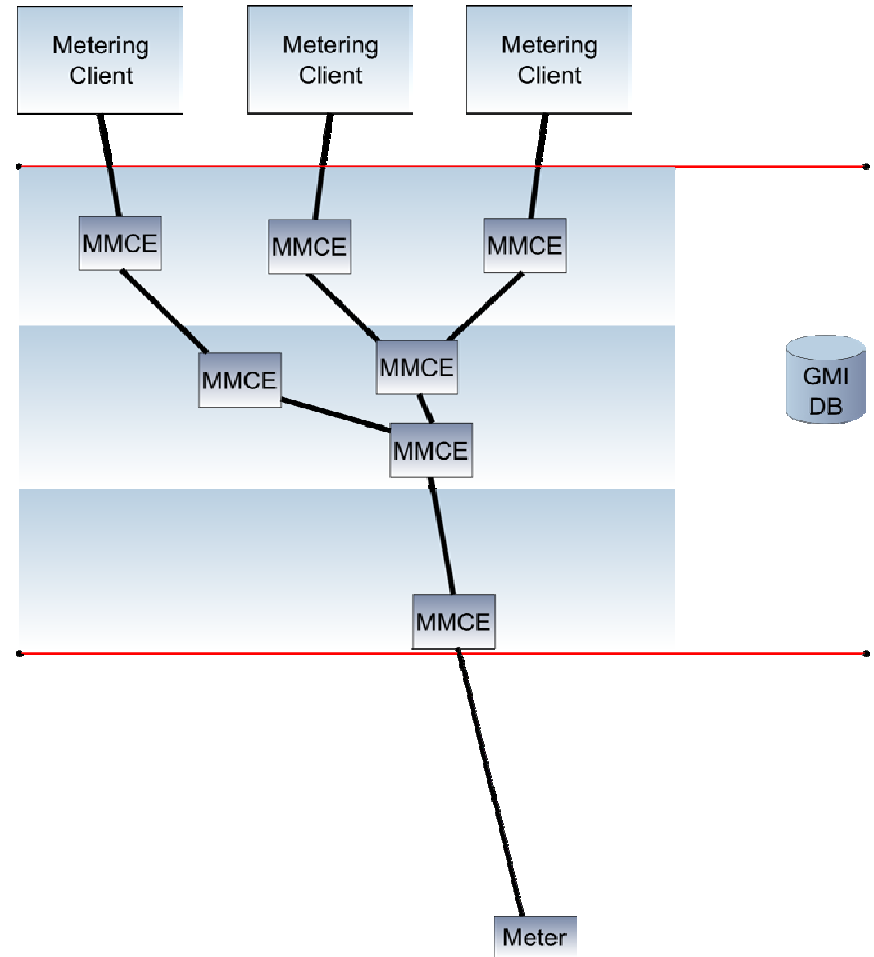


- ❑ Clients can subscribe for:
 - Periodic reports
 - Triggered reports that fire when a threshold has been crossed or when a certain event (i.e. a handover of a specific user) occurs.
 - A direct request / reply scheme is also supported.



Advanced Features (see the paper for details)

- ❑ Building up distribution trees if several clients subscribe for the same data.
- ❑ Caching
- ❑ Hooks – places in the subject tree for data that moves frequently.
- ❑ Special MMCEs that process data and/or add abstraction from technical details.
- ❑ Generic Meter Configuration– GMI messages can be used as a transport medium for complicated meter configuration (i.e. for flow-based measurements)



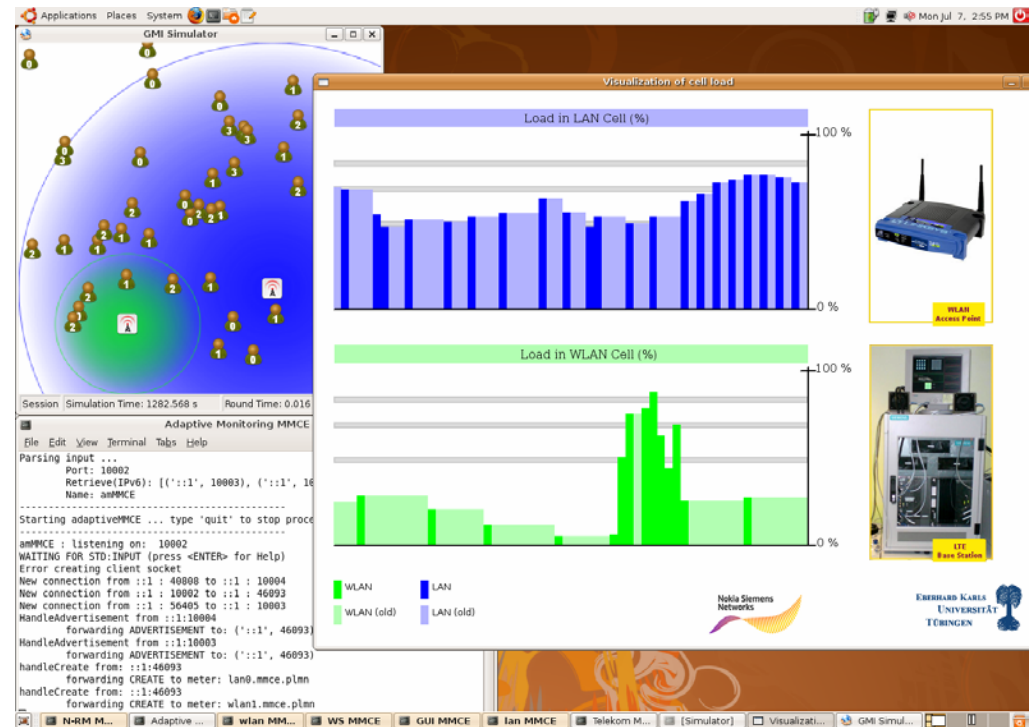


Implementation

- ❑ GMI was implemented and presented as a part of the whole SYMPATHIE demonstrator on the BMBF status seminar in June 2008.

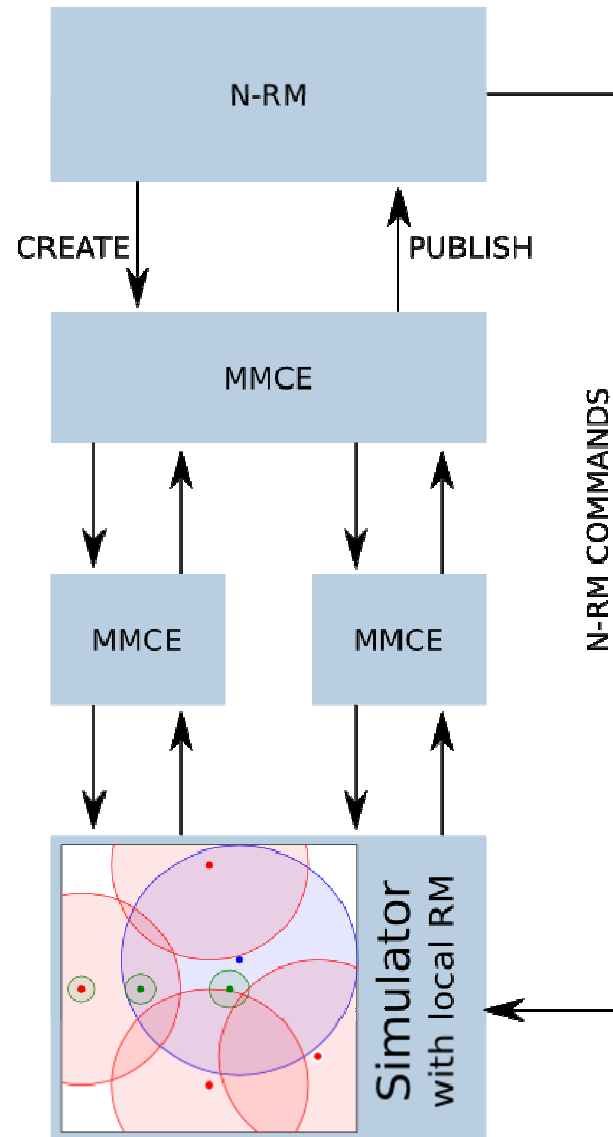
The SYMPATHIE demonstrator included:

- ❑ 1 prototype LTE base station
- ❑ 2 prototype LTE terminals
- ❑ WLAN as the second RAN
- ❑ Decision Engines on UE and Core Network sides
- ❑ Flow Management based on Mobile IP
- ❑ GMI





Outlook: Detailed Evaluation





Conclusion

- ❑ Heterogeneous access management needs timely data for its decisions.
- ❑ We designed a flexible publish/subscribe system, which provides this data.
- ❑ The system is scalable
 - Distributed publish/subscribe approach, no single bottleneck.
 - The GMI-DB is currently a central entity, but can also be distributed.
- ❑ Currently are testing the GMI in an emulated environment which includes simulated users and a network-side decision engine.
- ❑ First results show that the flexibility and configurability greatly helps making better decisions while producing less overhead.