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Auditing and Charging in the A^x Architecture

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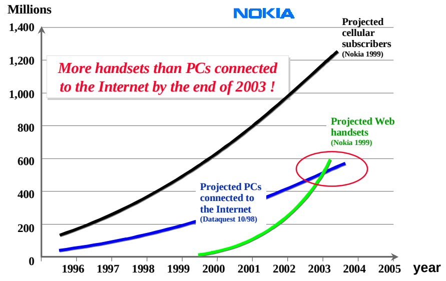
– Introduction
– Scenario and Problems
– A^x Architecture: Auditing and Charging
– Conclusions

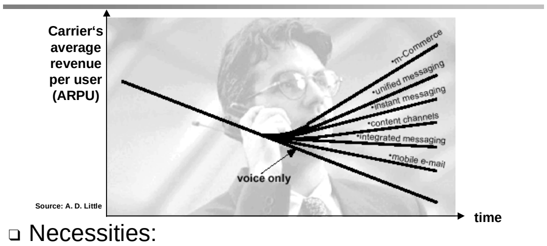
Mobility Growth – Subscribers, Handsets



More handsets than PCs connected to the Internet by the end of 2003 !

Be careful on any projected extrapolations!

Erosion and Opportunities

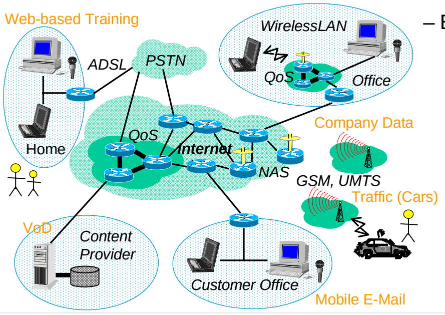


Source: A. D. Little

❑ Necessities:
– Careful definition of services: cost-sensitive.
– Service differentiation: reliability, QoS, pricing.
– Service support: mobility, secure access, auditing.

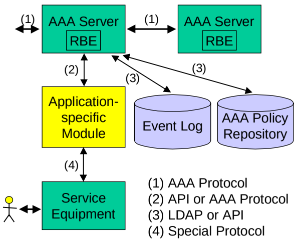
Scenario and Problems

Technology and Application Scenario



– Ensure:
- Mobility:
  – Privacy
  – User identity
- Charging:
  – Payment
  – Auditing
- To charge:
  – Access
  – QoS
  – Content

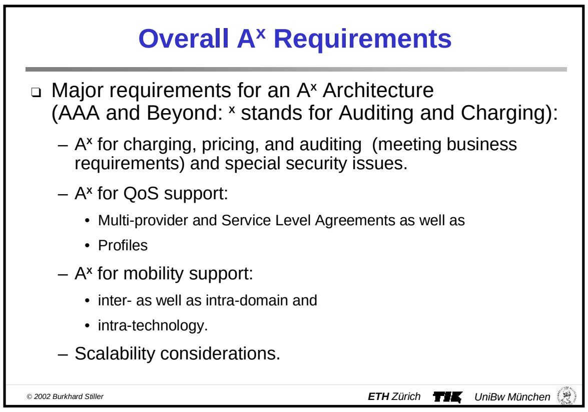
AAA Architecture and Weaknesses



(1) AAA Protocol
(2) API or AAA Protocol
(3) LDAP or API
(4) Special Protocol

AAA	Authentication, Authorization, Accounting
LDAP	Light-weight Directory Access Protocol
RBE	Rule-based Engine

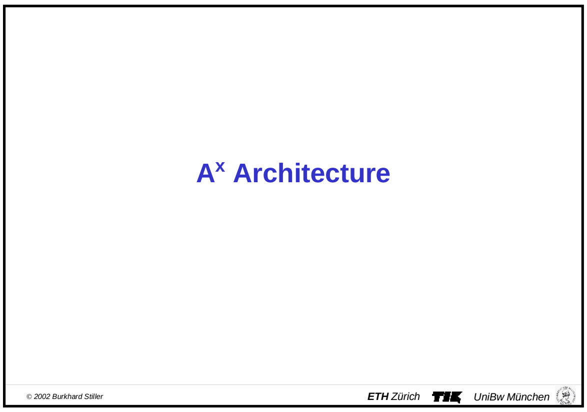
- Policy decision and policy enforcement not separated:
  – AAA Server decides on authorization, but enforces accounting.
- Difficult enhancements:
  – Enforcement located in the AAA server or the Application-specific module.
- AAA applied to transport, but not content, charging, and auditing.
- QoS support not provided.



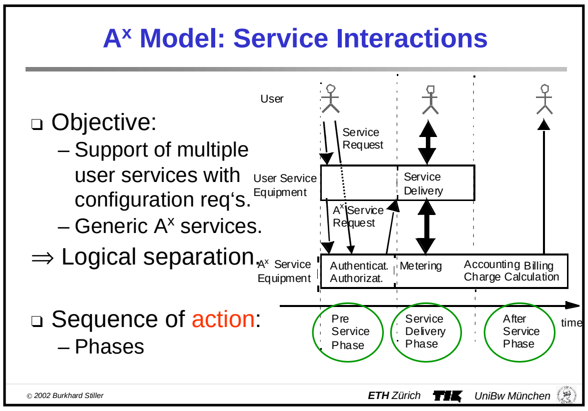
Overall A^x Requirements

❑ Major requirements for an A^x Architecture (AAA and Beyond: ^{x} stands for Auditing and Charging):

- A^x for charging, pricing, and auditing (meeting business requirements) and special security issues.
- A^x for QoS support:
  - Multi-provider and Service Level Agreements as well as
  - Profiles
- A^x for mobility support:
  - inter- as well as intra-domain and
  - intra-technology.
- Scalability considerations.



A^x Architecture



A^x Model: Service Interactions

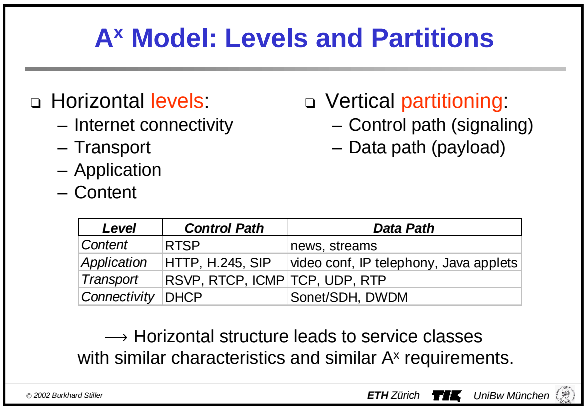
❑ Objective:

- Support of multiple user services with configuration req‘s.
- Generic A^x services.

⇒ Logical separation.

❑ Sequence of action:

- Phases



A^x Model: Levels and Partitions

❑ Horizontal levels:

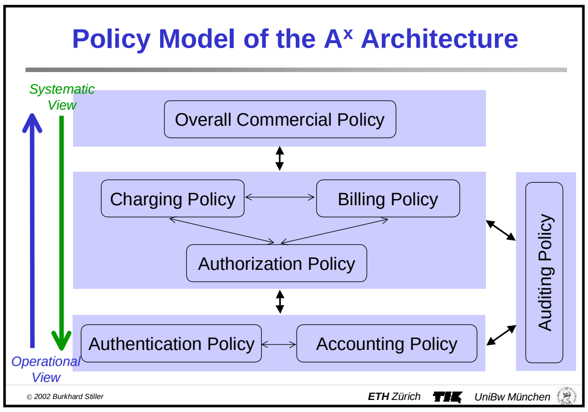
- Internet connectivity
- Transport
- Application
- Content

❑ Vertical partitioning:

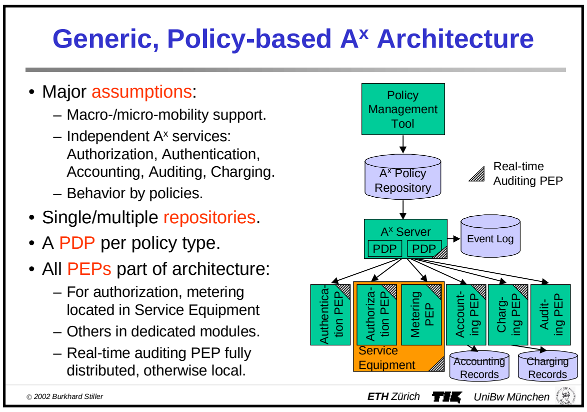
- Control path (signaling)
- Data path (payload)

Level	*Control Path*	*Data Path*
Content	RTSP	news, streams
Application	HTTP, H.245, SIP	video conf, IP telephony, Java applets
Transport	RSVP, RTCP, ICMP	TCP, UDP, RTP
Connectivity	DHCP	Sonet/SDH, DWDM

⟶ Horizontal structure leads to service classes with similar characteristics and similar A^x requirements.



Policy Model of the A^x Architecture



Generic, Policy-based A^x Architecture

- Major assumptions:
  - Macro-/micro-mobility support.
  - Independent A^x services: Authorization, Authentication, Accounting, Auditing, Charging.
  - Behavior by policies.
- Single/multiple repositories.
- A PDP per policy type.
- All PEPs part of architecture:
  - For authorization, metering located in Service Equipment
  - Others in dedicated modules.
  - Real-time auditing PEP fully distributed, otherwise local.

A^x Auditing

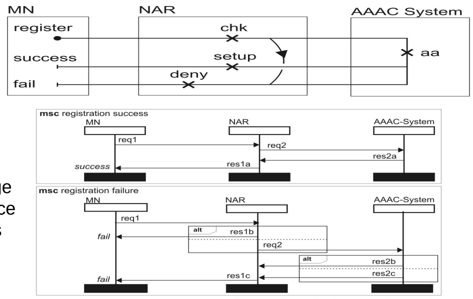
Definition — Auditing

- ❑ Auditing is the process of examining information on a provided service to check, whether the service has been provided correctly or the contractual negotiated parameters have been met.
- ❑ Logging of events and actions is based on information transmitted in messages between A^x entities.
- ❑ A^x support services:
  - – Provider – Provider: A^x, Service Compliance
  - – Provider – User: Mobile Network Access, A^x, Service Compliance
  - – Provider security: Attack, Misuse, Bugs

From Use Case Maps to Message Sequence Charts

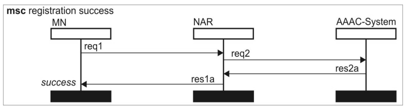
Use Case Maps

Message Sequence Charts



Note: Once a *fail* is reached, the message exchange is aborted

Messages — Example of an A^x Service



ID	Message	Parameters
req1	MN Authentication Request (MNARq)	NAI; Credentials
req2	Access Router Request (ARR.f)	Session Id; Host Information; User Information
res2a	Access Router Answer (ARA)	Result Code; Session Information
res1a	MN Access Response (MNARp)	Keys; Profile Sub-Set; Session Information

Message Formalization — Sample

```
NAR : instance
        in MNARq from MN
                MNARq : message
                Mobile Node Authentication Request, MN
                (
(10)                    <CAAP-Header: CHAP_CODE=2>
(11)                    {Challenge}
(12)                    {NAI}
(13)                    {MIPv6-Mobile-Node-Address}
(14)                    [MIPv6-Home-Agent-Address]
(15)                    [MIP-Binding-Update]*
(16)                    {MN-DH-PV}
(17)                    <MN-MAC>
(18)                    [AVP]*
                )
                endmessage
endinstance
```

Parameter References

Diameter AVPs or similar

Sample Log Entry

- ❑ Action:
  “AAAC.h has granted MN access and send an ARA message back to AAAC.f.”

```
event; logger; from; to;
time[hrs:ms:date]; session-id, result-
code, origin-host, session-timeout
```

… etc. …

Sample:
ara_sent; aaach::123; aaach::123; nar::121;
2000:0020:08162002; ses01, res2000,
fe80::201::fec:a072, 2010:0000:08162002

Main Auditing and Logging Policies

– P1:= A valid request should not be turned down.

– P2:= An invalid request should be rejected.

– P3:= The active entity, taking an action is responsible for logging this action, not the entity experiencing the event triggered.

– L6:= Whenever a log entry is made, the actual time the reported action took place must be logged.

Logging and Auditing Mechanisms

❑ Centralized main log:
  – mySQL or similar

❑ One Auditor per main task:
  – E.g., per process (Registration, Flow Termination)

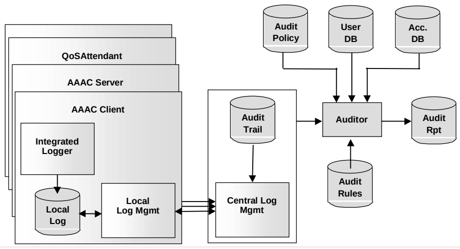
❑ Local DBs store individual log entries.

❑ Main log entries with embedded SQL code

❑ White-Box logging:
  – Different logging levels implemented in A^x entities
  – Dynamically control of logging levels

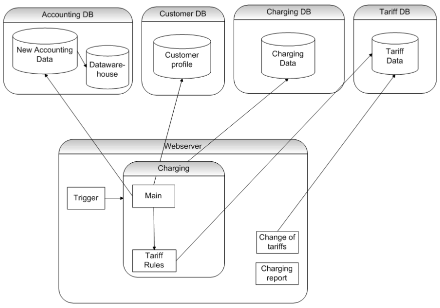
Auditing Framework

❑ Addressing service level guarantees and violation conditions.

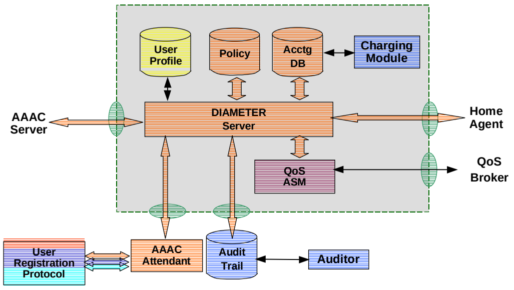


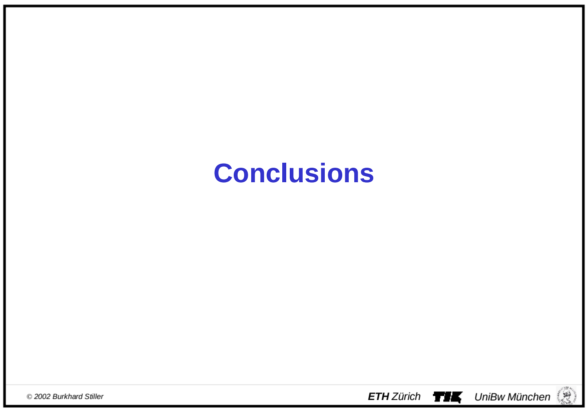
A^x Charging

Charging Databases

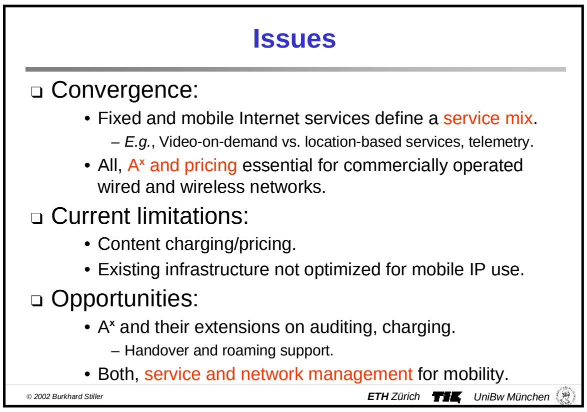


A^x Instantiation — IST MobyDick Project



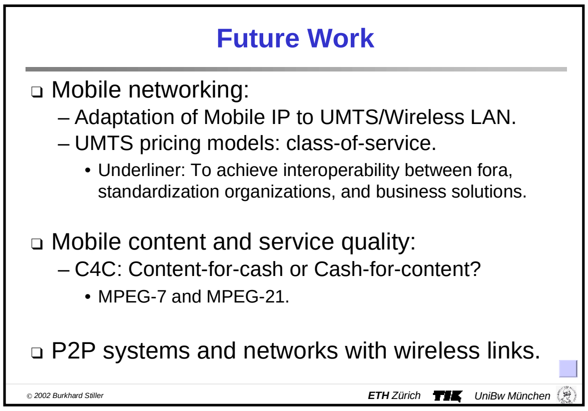


Conclusions



Issues

- ❑ Convergence:
  - Fixed and mobile Internet services define a service mix.
    - *E.g.*, Video-on-demand vs. location-based services, telemetry.
  - All, A^x and pricing essential for commercially operated wired and wireless networks.
- ❑ Current limitations:
  - Content charging/pricing.
  - Existing infrastructure not optimized for mobile IP use.
- ❑ Opportunities:
  - A^x and their extensions on auditing, charging.
    - Handover and roaming support.
  - Both, service and network management for mobility.



Future Work

- ❑ Mobile networking:
  - Adaptation of Mobile IP to UMTS/Wireless LAN.
  - UMTS pricing models: class-of-service.
    - Underliner: To achieve interoperability between fora, standardization organizations, and business solutions.
- ❑ Mobile content and service quality:
  - C4C: Content-for-cash or Cash-for-content?
    - MPEG-7 and MPEG-21.
- ❑ P2P systems and networks with wireless links.

Thank you for your attention.

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