Wireless and Mobile Internet: Quo Vadis?

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Self Presentation

TKN

- Chaired Professor of EE&CS at the Technical University of Berlin, heading the Telecommunication Networks Group (TKN)
  - TKN: 2 postdocs/assistant professors + over 20 Ph.D students, Full platform for prototyping: programmable routers, programmable network adapters, open source protocol stacks.
  - Cooperation partners
    in academia: BWRC Berkeley, ENST, NTUA, several German Universities, HHI, GMD
    in industry: Siemens, Ericsson, NEC, Thomson ...

What is our research about? AMICA:Wireless Internet

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- Transport level services (sockets) over wireless!
- Joint optimization of Link and PHY =>Last Hop!
- Multi-hop access.
- Mobility support.
- Multilevel, energy-optimized design.
- Backbone issues: IP over WDM, Path selection
- Methodology: Formalizm + testbed

Self Presentation (continued)

TKN

- Member of senior board of GMD Fokus, Research Institute for Open Communication (180 People in different issues of networking) technically supervising Competence Centres for Internet (GLONE) and Testing Interoperability and Performance (TIP)
  - Research topics GLONE: QoS in internet, traffic engineering, charging and accounting, IP Telephony
  - Research topics TIP: Formal description techniques: MSC++, TTCN++, Methodology for testing: Interoperability, Conformance, Performance

Everything has already
been sayed,
but not everything has been sayed
by each one...

A German saying

hmm, I hope it is not sooo bad...

Overview of the Talk

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- Applications, Enabling technologies, Challenges.
- Options in understanding “Internet”
- Transport: Proxy or not proxy: it is the question..
- Mobility support: at which level?
- Service discovery / Service charging/Authorization
- Design methodology

Types of Applications...

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- Data applications: the strength of internet
- Real- Time applications:
  - Voice: domain of cellular ... ?
  - Video?
  - Distribution services?
- Transaction services - e-commerce...well, not really done in either world... Important...
- Entertainment, device-to-device, all-round support? Tricky applications should be attacked!

Enabling technologies

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- Soft- radio/configurable radio
  - Brings flexible transmission
- Active networking
  - Brings flexible in-network processing
- Middleware
  - Brings flexible service creation/management
- Application generators?
  - Should bring flexible application generation support

Our vision of the access

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- Wireless dominates last hop (s?)
  - Flexible usage of end-devices, (micro) mobility
- Diversity of radio technologies remains-hierarchy not a unique transmission! IP between AP´s
  - Flexible cost/performance optimization
  - Connectivity for negotiation of the proper level
  - Decision policies with respect to location info, and...

Our vision of the access (2)

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- Optical backbone offers enough capacity..
  - Bandwidth economy in backbone not a design goal
- QoS support by traffic segregation rather than reservation
  - Segregation might be of logical type (precedence)
  - Segregation might imply different processing
  - Segregation might be of physical type..different paths

Challenges

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- Spectrum usage organization/optimization- Universal Spectrum Sharing
- Energy consumption vs. energy generation vs. cordless energy supply
- Direct transition from wireless to optical !! We do NOT need the intermediate electrical transmission stage! (note radio on the fiber!).

What is Internet

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- Internet is the global information system that:
  - is logically linked together by a globally unique address space based on the Internet Protocol (IP) or its subsequent extensions
  - is able to support communications using the Transmission Control Protocol/Internet Protocol (TCP/IP) suite or its subsequent extensions and/or other IP-compatible protocols
  - provides, uses or makes accessible either publicly or privately high level services layered on the communication and related infrastructure described herein

  - US Federal Networking Resolution, October 24, 1995

What is Internet- comments

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- Comments to the individual items:
  - Different addressing domains...overlapping in space
  - A unified congestion control =>today the TCP -like congestion control. This is THE precondition to keep internet running. This is the network perspective
  - Applications do NOT care for protocols(like TCP), applications care for the services (APIs). This is the application perspective.
  - The later two do not to have be tightly coupled!!

The Internet, or...

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- Will we have THE INTERNET
  - Brings unified, omnipresent access
- or just Internet Services/Protocols usage in partitioned world (with gateways)
  - Allows for closed solutions...
- Really uniform addressing vs. address translators
  - do we really like the idea of uniform addressing

Proxy...or not....

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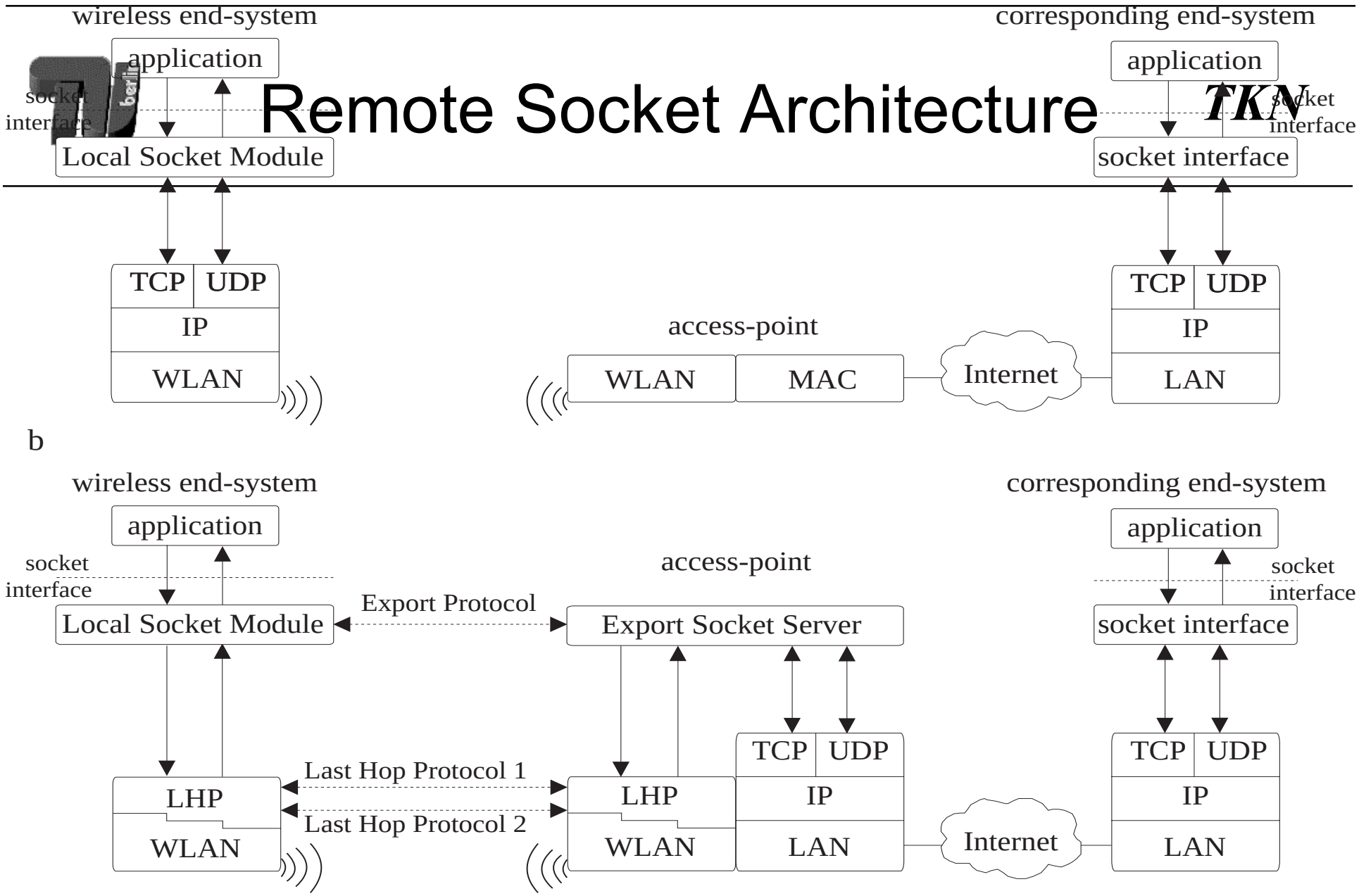
- Classical end-to-end: IP to the end-system
  - Brings full strength of all solutions, but..
  - Inefficiency issues not solved, ongoing research, not a good idea to modify TCP w.r.t. this viewpoint.
- Totally different protocol stack (WAP)
  - Brings optimization toward the wireless (?), but...
  - Different applications necessary....bad idea...
- Intermediate forms:
  - Go for Remote Sockets!

Remote Socket Architecture



Why Proxy?

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- Mainly: to decouple two sides....
  - Main issue: congestion control on internet and pacing of data flow at the wireless
  - Adjust to the actual state of the channel!
- What do we need to achieve it? Better APIs
  - More transparency between the layers...information on:
  - - state of the channel
  - - power level
  - - ???

Mobility Support ..where?

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- Default: mobile IP
  - Efficiency, scaling, speed of handover ?
- Micro-mobility support (cellular...)
  - Increasing the efficiency of local handover
- SIP- based mobility
  - Why not? If SIP?
- Personal Mobility

Mobility ..further issues

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- Mobility in case of proxy-based access
  - State partially within the proxy
  - Cooperating proxies needed
- Interrupting the session: why not?
  - Acceptable in case of multiple applications
- Other Approaches- multicast?
  - If multicast is to be default--different multicast needed..(multiple small groups, third party add/drop) ...ongoing research

Service discovery

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- Considered in “classical” internet
- New dynamics comes with mobility
- Is discovery enough? Or also downloading? EU Mobivas..
- Essential issue...
- Besides: we have to pay for the services.. See my Internet Economy Workshop paper.. ...under www-tkn.ee.tu-berlin.de/publications/talks.html

Flexible environments

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- No “closed environments”
  - with update reserved for manufacturer, that´s bad
- “Open” end systems! (see EU Mobivas)
  - Supporting download of protocols- adjust to the infrastructure of a given provider/technology!
- Programmable network nodes
  - Supporting modifications by the provider! How many of the “active networks” features are needed to support:mobility?proxies? =>BMBF Flexinet.

Methodology...mixture of:

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1. Prototyping/simulation in (still missing) OPEN environments
2. Formal support: time/QoS aspect weak, energy aspect absent