Seamless integration of heterogeneous wireless network technologies - ?/!

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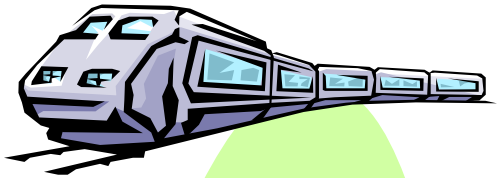
Mobile and wireless services – Always Best Connected

LAN, WLAN
780 kbit/s

GSM 53 kbit/s
Bluetooth 500 kbit/s

GSM/EDGE 384 kbit/s,
WLAN 780 kbit/s

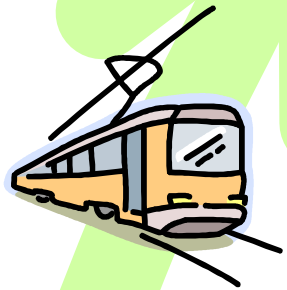
UMTS, GSM
115 kbit/s



GSM 115 kbit/s,
WLAN 11 Mbit/s

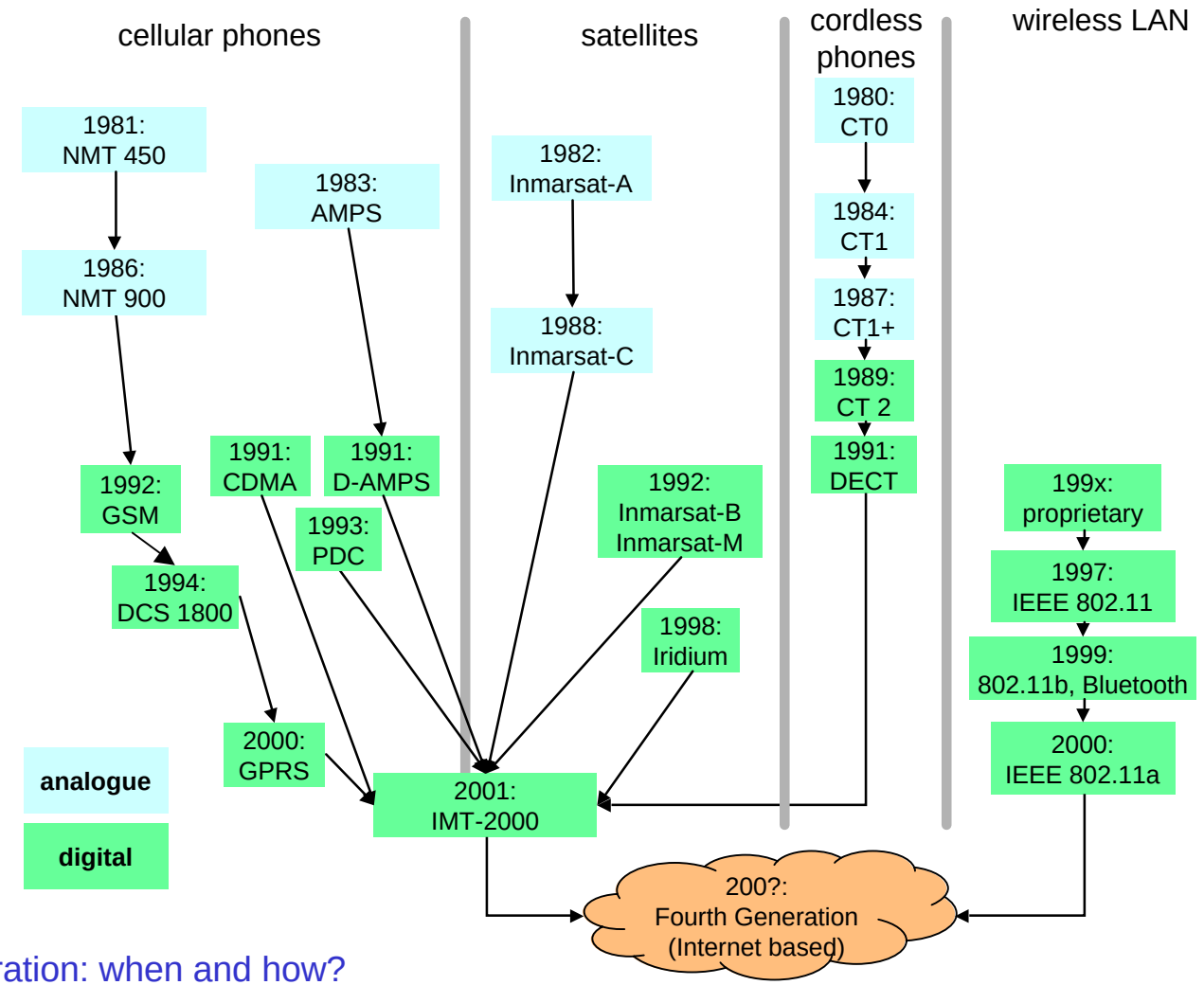
UMTS, GSM
384 kbit/s

LAN
100 Mbit/s,
WLAN
54 Mbit/s



UMTS,
DECT
2 Mbit/s

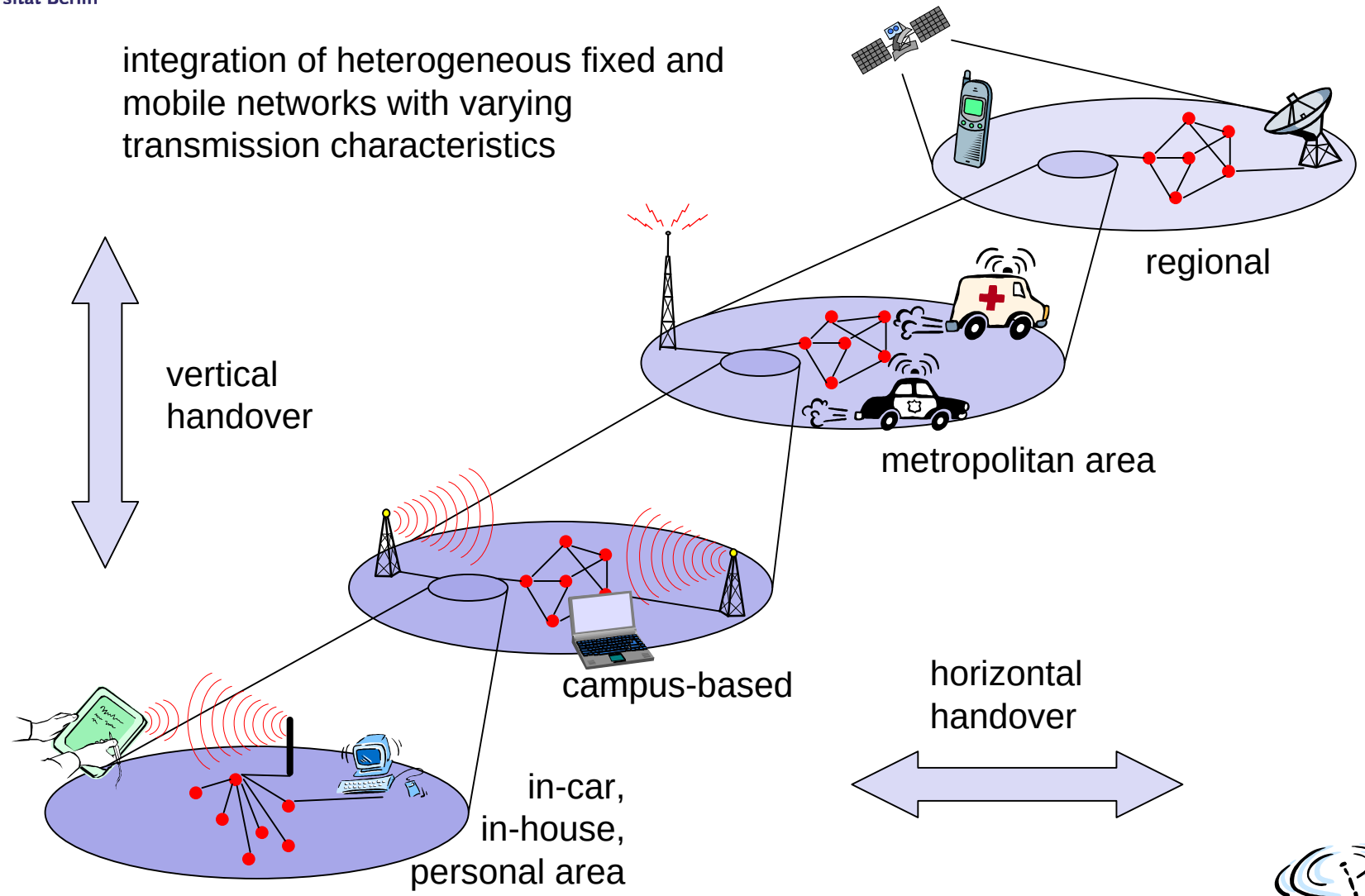
Wireless systems: overview of the development



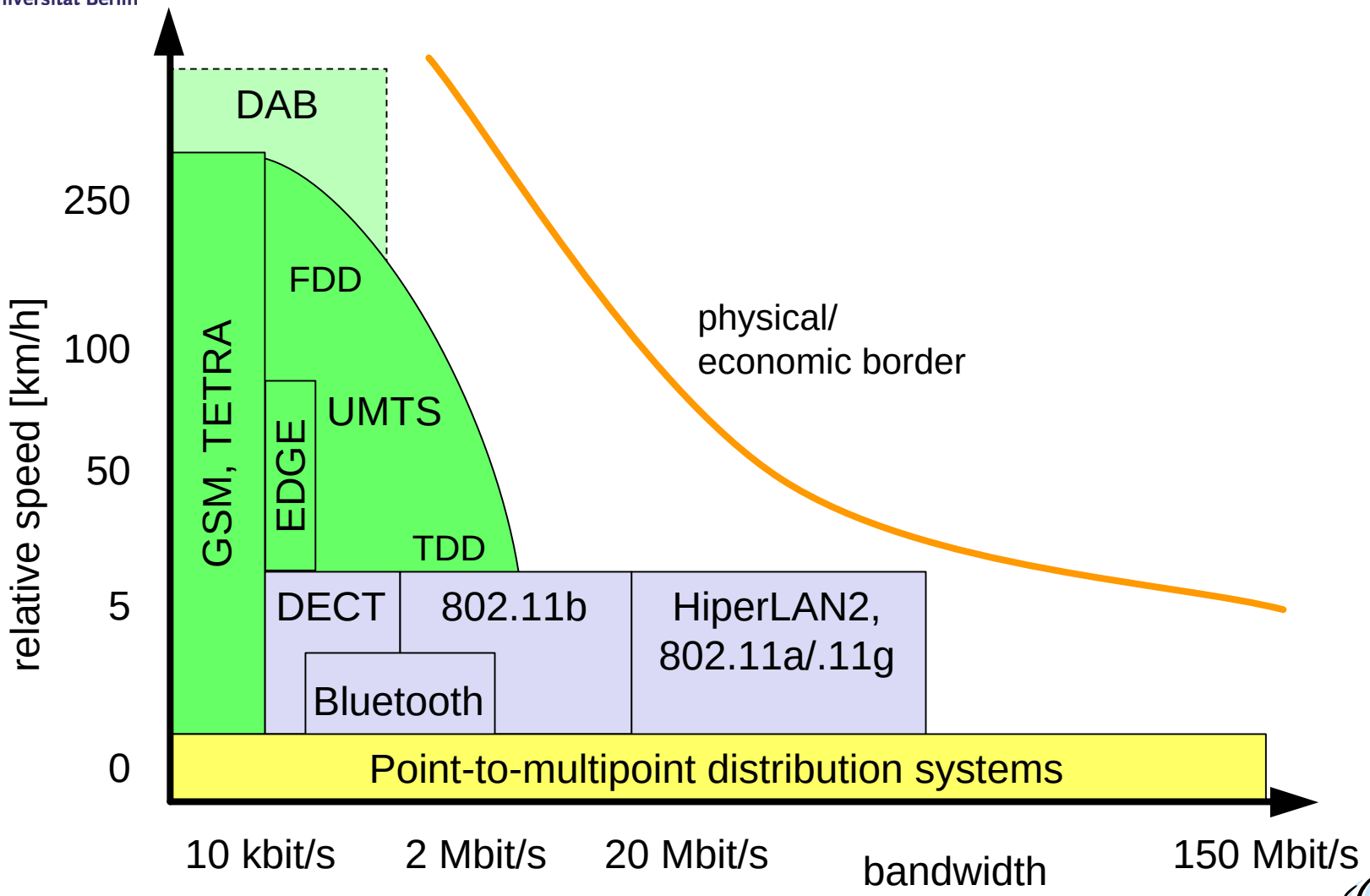
4G – fourth generation: when and how?

Overlay Networks - the global goal (since many years)

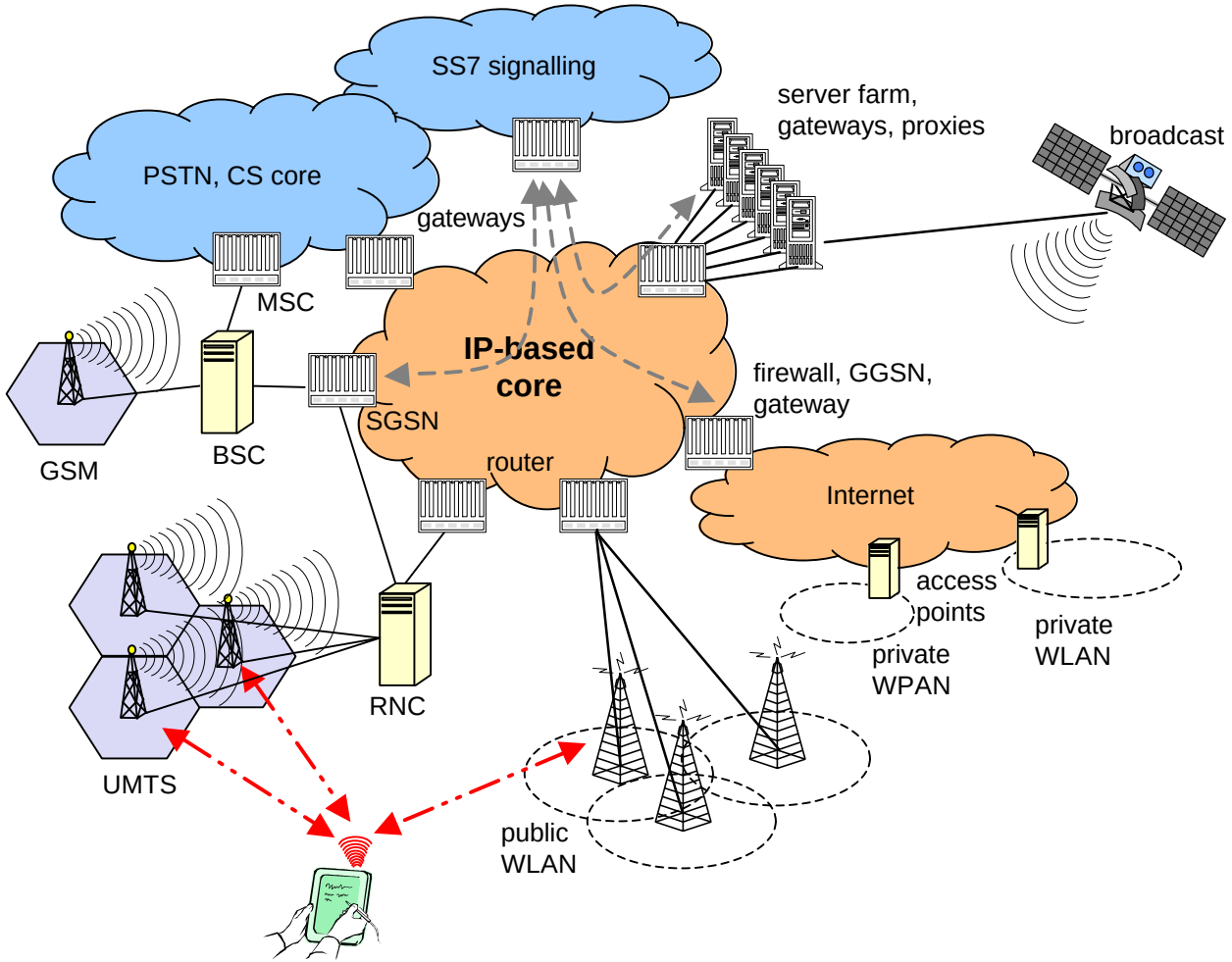
integration of heterogeneous fixed and mobile networks with varying transmission characteristics



Wireless access technologies



Example IP-based 4G/Next G/… network



What helps us to provide seamless services?

Improved radio technology and antennas

- smart antennas, beam forming, multiple-input multiple-output (MIMO)
  - space division multiplex to increase capacity, benefit from multipath
- software defined radios (SDR)
  - use of different air interfaces, download new modulation/coding/...
  - requires a lot of processing power (UMTS RF 10 TIPS = 10000000 MIPS)
- dynamic spectrum allocation
  - spectrum on demand results in higher overall capacity

Core network convergence

- IP-based, quality of service, mobile IP

Simple and open service platform

- intelligence at the edge, not in the network (as with IN)
- more service providers, not network operators only

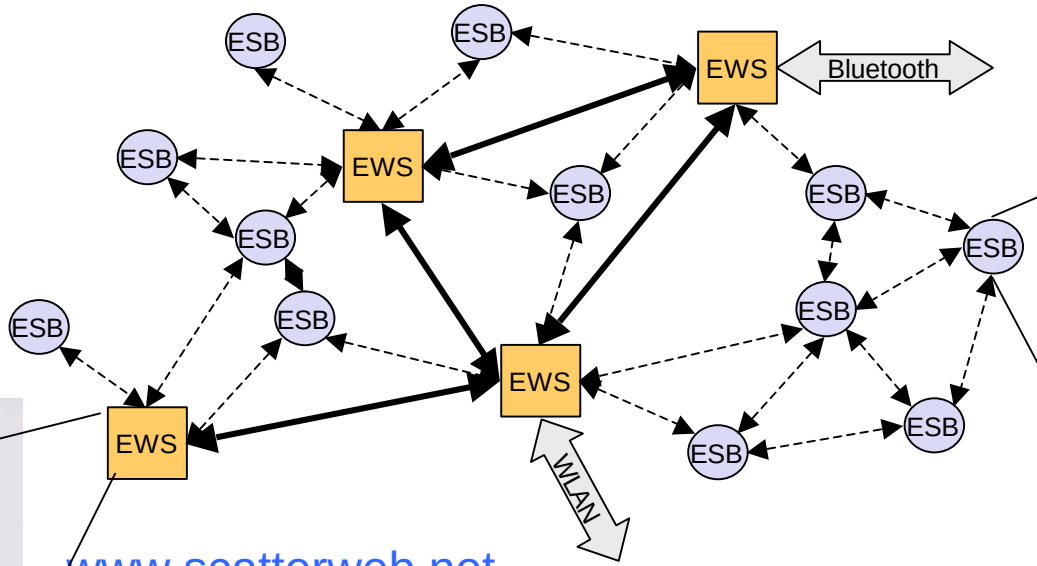
Ad-hoc technologies

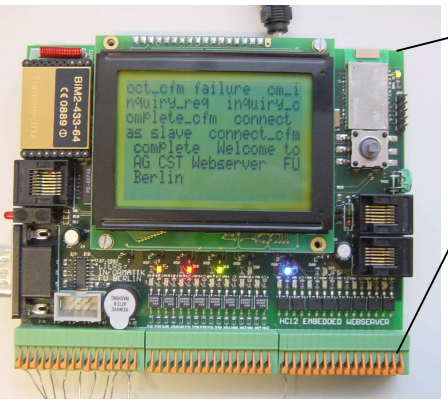
- spontaneous communication, power saving, redundancy

Practical scenarios for mobile ad-hoc networks 1

Only a very few scenarios!

- For „real“, i.e., multi-hop ad-hoc networks (besides military apps.)
- Typically in the area of environmental monitoring, disaster protection and recovery

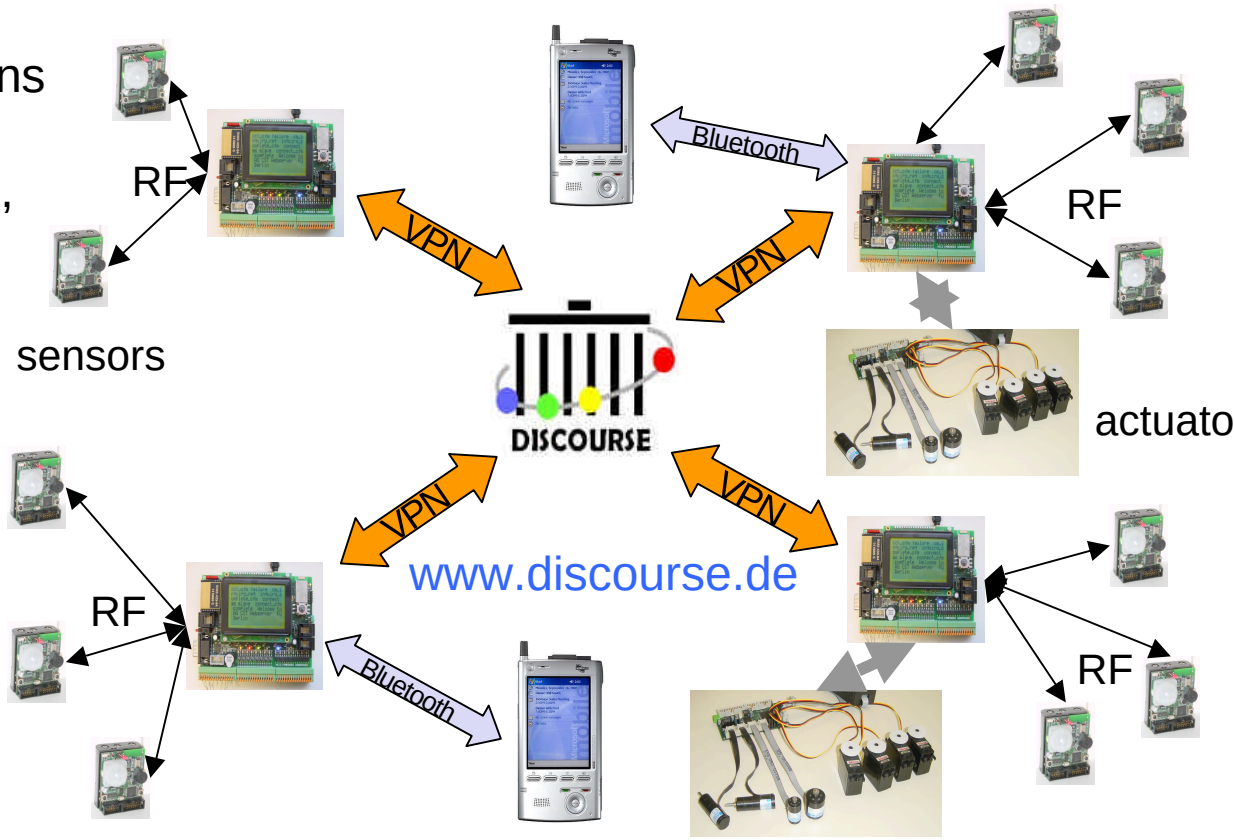




Practical scenarios for mobile ad-hoc networks 2

Many scenarios!

- For ad-hoc connections to infrastructures, ad-hoc service usage, ad-hoc peer-to-peer networking (gaming!)



Be prepared for ad-hoc situations

- Do not rely on infrastructures
- Support ad-hoc usage of services & ad-hoc changes of connectivity

Potential problems

Quality of service

- Today‘s Internet is best-effort
- Integrated services did not work out
- Differentiated services have to prove scalability and manageability
- What about the simplicity of the Internet? DoS attacks on QoS?

Internet protocols are well known…

- …also to attackers, hackers, intruders
  - security by obscurity does not really work, however, closed systems provide some protection

Reliability, maintenance

- Open question if Internet technology is really cheaper as soon as high reliability (99.9999%) is required plus all features are integrated

Missing charging models

- Charging by technical parameters (volume, time) is not reasonable
- Pay-per-application may make much more sense

Killer application? There is no single killer application!

- Choice of services and seamless access to networks determine the success

Services & apps. in future cellular/wireless networks

Voice, voice, voice, …

- Still is and will be for a long time the predominating service

Internet access

- Very convenient for email, search, messaging, …

Combinations

- Use the mobile device as RFID reader, as navigation tool, … (swiss knife)
- …but don‘t try to do everything with it (toolbox)

Gaming, Entertainment

- Do something while waiting

What about security across different systems?

Needed?

Absolutely, but…

Seamlessness ~ Security³

Achievable?

It is not a question of technology!

- Do the operators want it?
  - Yes to protect their own systems, not always if it comes to customers…
- Do users want to pay for it?
  - No, only after something happened
- Do operators want to cooperate?
  - Not always – see GSM black lists

Seamless integration of wireless networks & services

Will it ever happen?

- Yes, from a technical point of view
- No, from a marketing point of view

Should it happen?

- Yes, from a user‘s perspective
  - Smother ride on the wireless Internet
- No, from a user‘s perspective
  - If this ties me to a certain operator, compromises privacy, hides pricing, …

Almost seamless is fine for most applications!

- Think of transport systems (Trains, cars, airplanes, …)
  - Fine if the connection works + handover time is short
- Protects users and systems
  - Try to call your sysadmin with an IP-phone to tell him that the network is down…