WIRELESS ACCESS FOR THE FUTURE NETWORKED SOCIETY

Erik Dahlman
Senior Expert
Ericsson Research
WIRELESS ACCESS OF TODAY

TODAY ...

The foundation of mobile telephony

1G
NMT
AMPS
TACS

Mobile telephony for everyone

2G
GSM
IS-136
PDC
IS-95

The foundation of mobile broadband

3G
WCDMA/HSPA
cdma2000
TD-SCDMA

The future of mobile broadband

4G
LTE
WIRELESS ACCESS TECHNOLOGY
TODAY ... AND IN THE FUTURE

The foundation of mobile telephony

1G
NMT
AMPS
TACS

Mobile telephony for everyone

2G
GSM
IS-136
PDC
IS-95

The foundation of mobile broadband

3G
WCDMA/HSPA
cdma2000
TD-SCDMA

The future of mobile broadband

4G
LTE

5G

THE NETWORKED SOCIETY
THE NETWORKED SOCIETY

IN THE NEWORKED SOCIETY PEOPLE, KNOWLEDGE, DEVICES, AND INFORMATION ARE NEWORKED FOR THE GROWTH OF SOCIETY, LIFE, AND BUSINESS
Unlimiting access to information and sharing of data anywhere and anytime for anyone and anything

Anything can be connected!
THE NETWORKED SOCIETY

Wireless Connectivity is key
FUTURE WIRELESS ACCESS

KEY CHALLENGES

Massive growth in Traffic Volume

Massive growth in Connected Devices

Wide range of Requirements & Characteristics

- Data rates
- Latency
- Reliability
- Device energy consumption
- Device cost
- ...

Affordable and sustainable
DATA RATES?

How much is enough?

No upper limit!

A few 10 Gbps in specific scenarios

What do I really want?

Essentially everywhere!

A few 100 Mbps generally available

A few 100 Mbps
Communicating Machines

› Very low latency ... *in some cases*
› Very high reliability ... *in some cases*
› Very small payloads ... *in some cases*
› Very good coverage ... *in some cases*
› Very low device cost ... *in some cases*
› Very long battery life ... *in some case*
TRAFFIC CAPACITY

- More spectrum, preferably of high quality
- More dense network infrastructure (including more antennas)
- Smart cooperation between network nodes
Spectrum is key to what we do … and there is never enough!

Today – *Spectrum up to 3.5 GHz*
Up to 2020 – *Extended spectrum availability up to ≈6.5 GHz*
Beyond 2020 – *Extension beyond 10 GHz*

- Large amount of spectrum available ⇒ Further massive increase in traffic capacity
- Potential for very large bandwidths ⇒ Enabler of extreme data rates
- Small wave length ⇒ Enabler for massive antenna solutions
- But still issues to resolve!
NEW WAYS OF USING SPECTRUM

› **Cellular**: Highly coordinated licensed dedicated spectrum
  – Guaranteed availability but potentially inefficient at low load

› **WiFi**: Shared nlicensed spectrum with no coordination/control
  – Efficient at low load but unreliable/in-efficient at high load

**Future**: *Consider a range of spectrum-access means*
  - Licensed but shared
  - …

Complement to dedicated licensed spectrum
DENSE NETWORKS
DENSE NETWORKS
DENSE NETWORKS

Integrated operation
DENSE NETWORKS

Integrated operation
DENSE NETWORKS

› Must ensure simple low-cost deployment!
› Must ensure backhaul availability!
ULTRA-DENSE DEPLOYMENTS

› Orders of \textit{magnitudes denser} than any cellular network of today
› GHz bandwidth at very high frequency bands

› Smooth inter-working with wide-area networks
› Need for flexible backhauling including wireless self-backhaul
WHAT IS 5G?
WHAT IS 5G?

2G could do everything that 1G could do
... and somewhat more
... and somewhat better
WHAT IS 5G?

2G

3G could do everything that 2G could do
... and somewhat more
... and somewhat better

3G

4G

5G

© Ericsson AB 2013 | 2013-05-21 | Page 23
WHAT IS 5G?

4G can do everything that 3G could do
... and somewhat more
... and somewhat better
WHAT IS 5G?

A single new technology that can do everything that 4G can do … and somewhat more … and somewhat better

Or should we consider a different approach this time?
FUTURE RADIO ACCESS – 5G

A set of integrated radio-access technologies jointly enabling the Networked Society

› Evolution of existing radio-access technologies
› New *complementary* technologies

© Ericsson AB 2013 | 2013-05-21 | Page 26
FUTURE RADIO ACCESS

A set of integrated radio-access technologies jointly enabling the Networked Society

- Ultra-reliable communication
- Inter-vehicular / vehicular-to-road communication
- Massive machine communication
- Multi-hop communication
- Device-to-device communication and cooperative devices
- Ultra-dense deployments

- 3.0 GHz
- 30 GHz
- 300 MHz
- UNLICENSED
- DEDICATED LICENSED
- SHARED LICENSED
METIS PROJECT

EU-funded research project on future wireless communication

29 partners / \( \approx 2500 \) man-month / 29 M€

Universities and research institutes

First phase
Usage scenarios & fundamental technology

Second phase (prel.)
More detailed concept development


WRC’12 WRC’15 WRC’19
1000x higher mobile data volumes
10-100x higher number of connected devices
10-100x typical end-user data rates
5x lower latency
10x longer battery life for low-power devices

Develop a concept for future mobile and wireless communications system that supports the connected information society
FUTURE WIRELESS ACCESS

› A key enabler for the Networked Society

› Key challenges
  - Continued traffic growth
  - Massive machine communication with wide range of requirements and characteristics
  - Cost and energy consumption

› Evolution of existing wireless technologies
› New complementary technologies

› Research on ”5G” has started
ERICSSON