Panel Discussion "on The Impact on Research Policy and Technical Developments in Europe due to the Internet-of-Things and other Technologies within Horizon 2020"

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Making Bits Fly

Birthplace of mp3

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Panellist intro
CV

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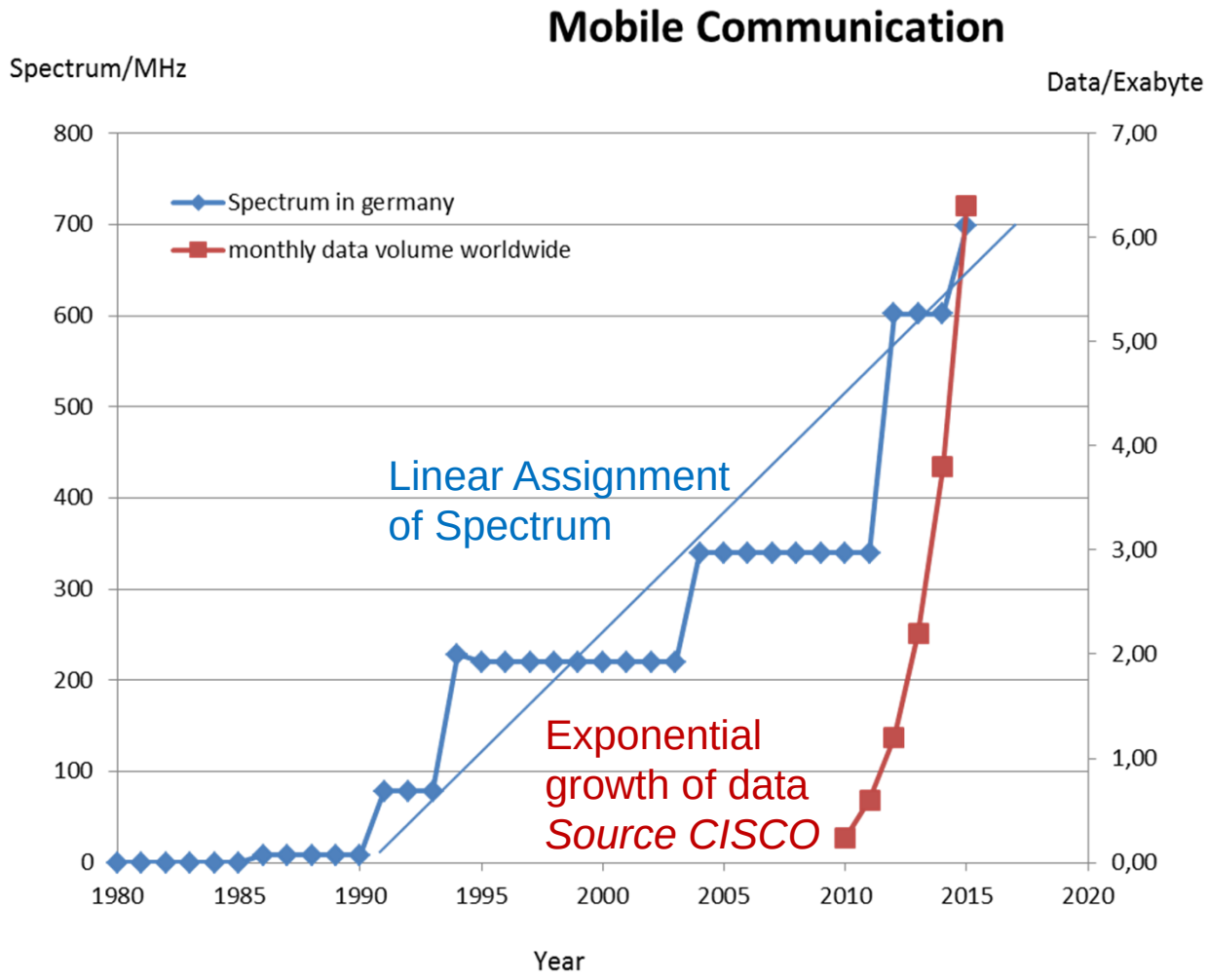
Prof. Dr.-Ing. Georg Fischer (born 1965)

1986-1992	Study of Electrical Engineering at RWTH Aachen, Focus on Communications, Microwave/RF, Radio Technology, Field Theory
1993-1996	Research assistant at University of Paderborn Fachgebiet Nachrichtentechnik, Prof. Dr. Wido Kumm
1997	Dr.-Ing., Thesis „Adaptive Antenna Arrays for mobile satellite reception“ 12 GHz Phased Array with adaptive Beam Steering
1996-2008	Lucent, later Alcatel-Lucent, Bell Labs Research, Research on Basestation RF Microwave Technology
	2000 Bell Labs DMTS (Distinguished Member of Technical Staff)
	2001 Bell Labs CMTS (Consulting Member of Technical Staff)
	Chairman of ETSI SMG2 WPB EDGE, EU COST actions 245/260, …
2001-2007	Part time Lecturer at FAU University of Erlangen-Nürnberg
April 2008	FAU University of Erlangen-Nürnberg, Prof. for Electronics Engineering Microwave Technology for communication and sensing
	Chairman of ETSI STF386 on cognitive spectrum management for PMSE
	Reviewer for the EU, DFG, Helmholtz Society, BMBF, NSERC, IWT, …

The Communication challenge

Wireless ICT ever growing



How to fill the gap coming up?

It is impossible to satisfy exponential data traffic growth by assigning spectrum linearly! → New Microwave solutions needed

Solutions for the Future

Where to obtain the necessary gains?

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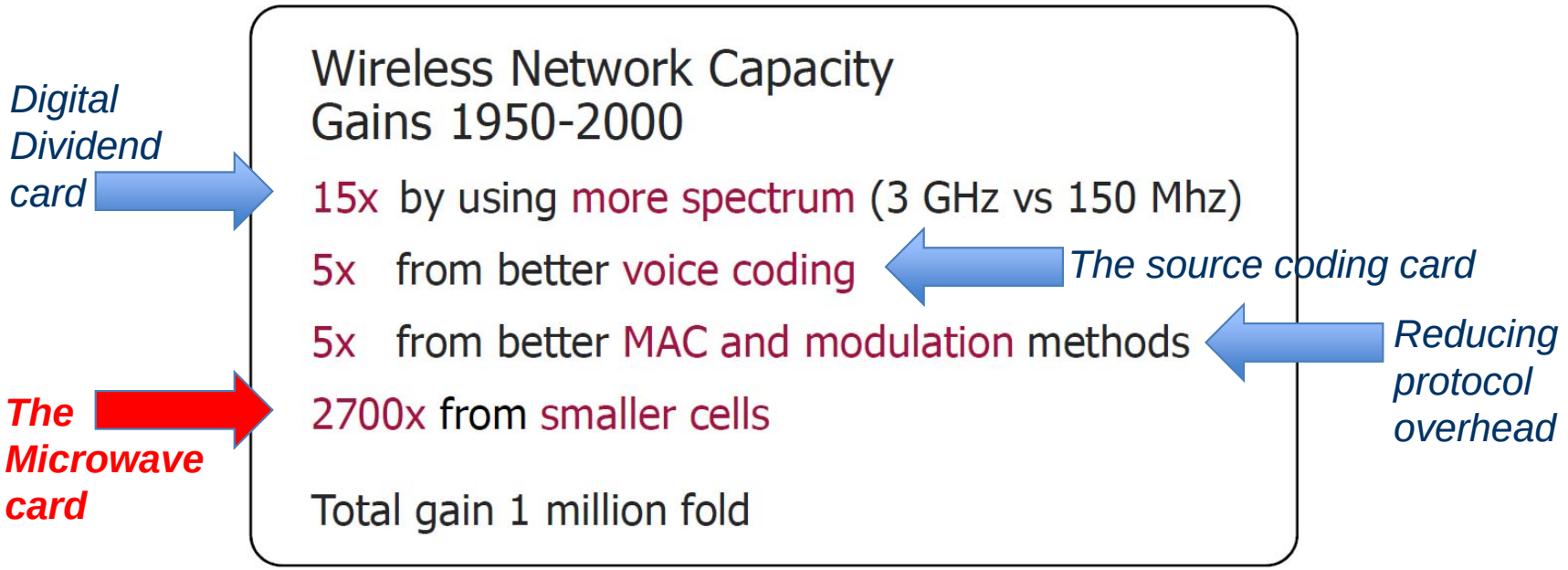
Historic Capacity Gains in Wireless Networks



Source: William Webb, Ofcom.

Basestation technology is key for serving exponential traffic growth: Massive MIMO, 5G, Power Amplifier, Transceiver, filter, frequency agility, broadband, mm-wave backhauling

→ Microwave vital for success of wireless networks

Solutions for the Future
Small Cell Solution

76% of smart phone users watch and share videos.* Of that group:

- 78% do so in a store
- 50% in coffee shops
- 49% at the airport

Source: Alcatel-Lucent

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OSI Communication layer mode…how we learned this at University…

The system

Layer	Abbr.	Name	Task	Examples
7		Application layer	Accessed by user	File transfer, terminal emulation, web browsing
6		Presentation Layer		
5		Session Layer		
4		Transport Layer		
3	MAC	Medium Access Control / Network layer		
2	RLC	Radio Link Control / Data Link Layer	Control of transfer medium	LAP-Dm
1	PHY	Physical Layer	Interface and access to transmission media	Modulation, Power versus time

Layer 0 the Microwave Modules and Components!
Layer -1 the Microwave device technology and device physics!

We missed the lower layers…no new systems without new underlying microwave device and module technology!

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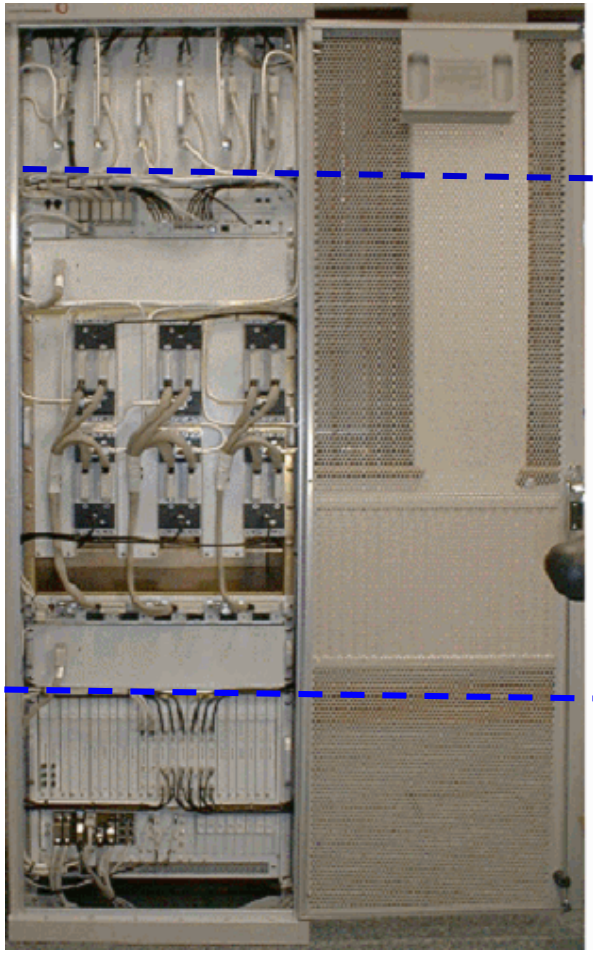
Microwave

- 75% form factor
- Doesn't follow Moore's law
- Innovation at architectural level necessary

Digital

- 25% form factor
- Follows Moore's law
- 14 nm CMOS helps



25% form factor
Coaxial resonators
(12 filter für 3 sector
4 branch MIMO)

50% form factor
PA and cooling
(12 PAs für 3 sector
4 branch MIMO)

Source Alcatel-Lucent

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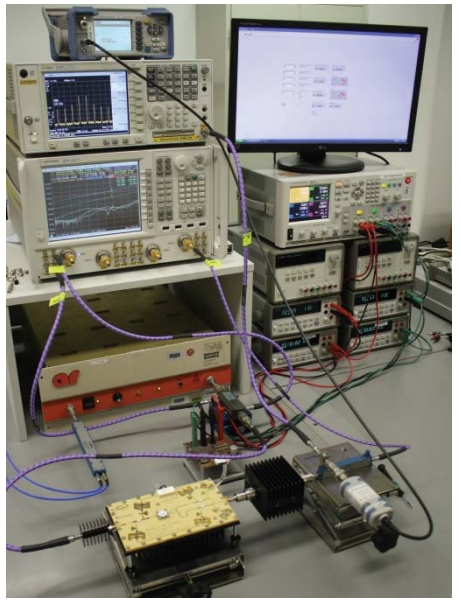
New Architectures for wireless communication rely on Microwave innovation

- Massive MIMO (Multi-Antennas) relies on Massive Hardware, efficient implementation of Massive MIMO needed → Microwave hardware challenges
- Efficient Power amplifiers, Massive number of transceiver and antenna branches
- Analogue and Microwaves don't follow Moore's law of the digital world, it works really different…
- More heavily loaded networks, more interference, More broadband,…
- We are already at the Shannon bound (theoretical limit in information theory), the only screw left is to go MIMO and network densification

But Microwaves not only for ICT…



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Other areas of microwaves

- Microwaves for Sensor Technology
- Radar, sensing the environment, consumer Radar in every Phone !?!
- Radar for safety, see e.g. car radar
- Microwaves for CPS / industry 4.0 / IoT – sensing the environment
- Microwaves for agriculture & food, e.g. sensing plants and food quality, drying
- Microwaves for life science and health, for medical sensors, cell detection, metabolism sensors, personalized medicine, P^4-medicine, aging society

Industrial Radar Sensor by Innosent

Industry 4.0

Blood sensor at LTE

Microwaves for the Future
Recommendations

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Europe has to keep its strong competence in Microwaves

- Evolve this further and shape the upcoming challenges
- Funding for R&D in Europe is necessary from the fundamental research to pilot introduction

Technology Access

- Large Firms are not interested in small ramp up quantities by SMEs and Universities
- Empower SMEs and university by providing access to advanced Microwave Electronics

Maintaining the innovation Strength of SME in Europe

- SMEs need reliable access to newest technology locally in Europe
- It cannot be taken from other regions

Microwave chip and module Design

- Support for the whole supply chain with new innovative Microwave Electronics solutions
- Reduction of Risks, cover complete eco system

Securing High level of Education with Engineers and Technicians

- Competence cannot be built up quickly
- Sustainability in educational systems, no ups and downs following market hypes

See also VDE position paper on „Hidden Electronics“