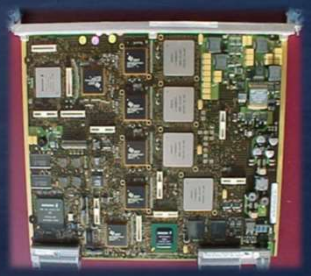
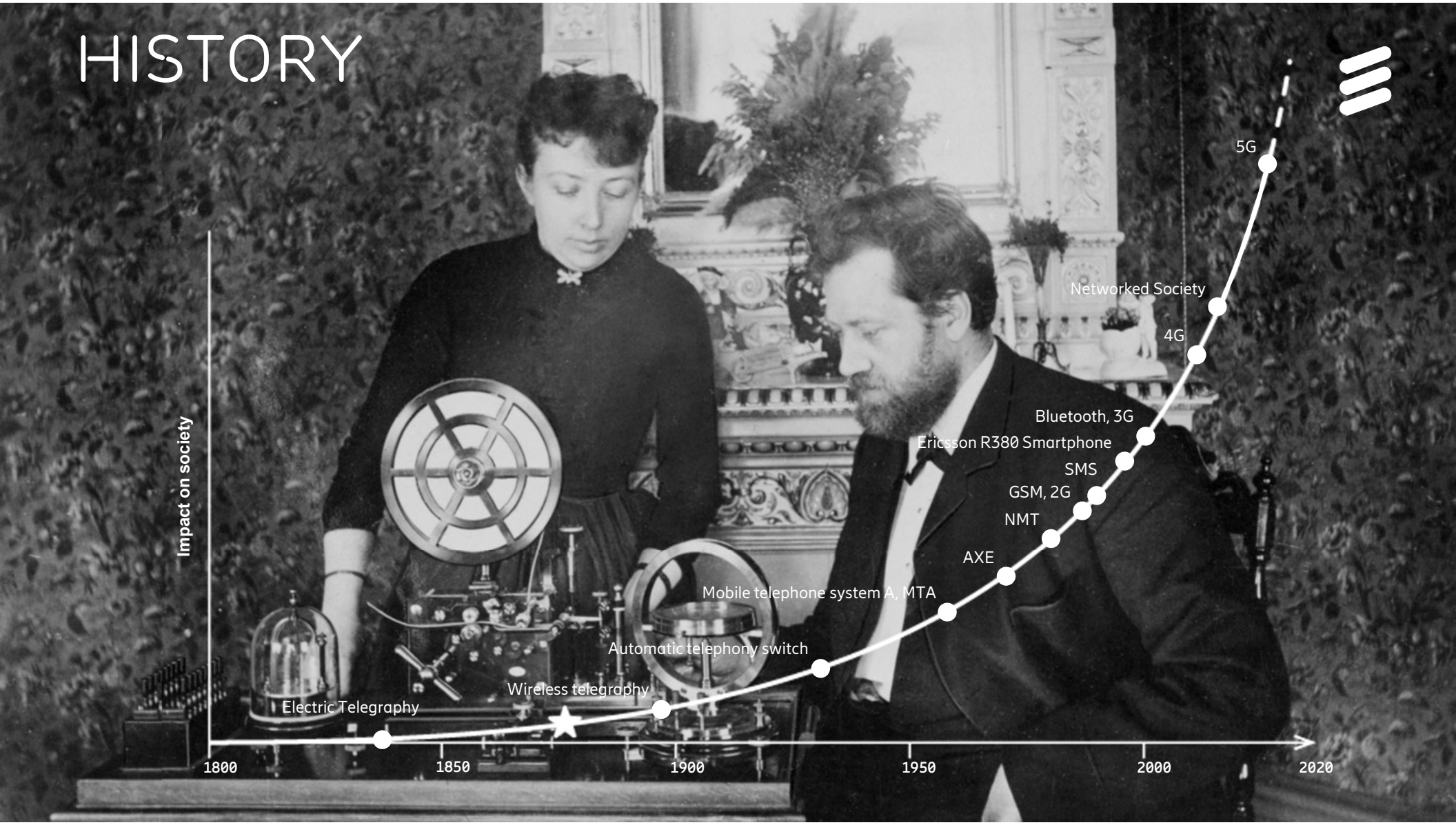
today's presentation

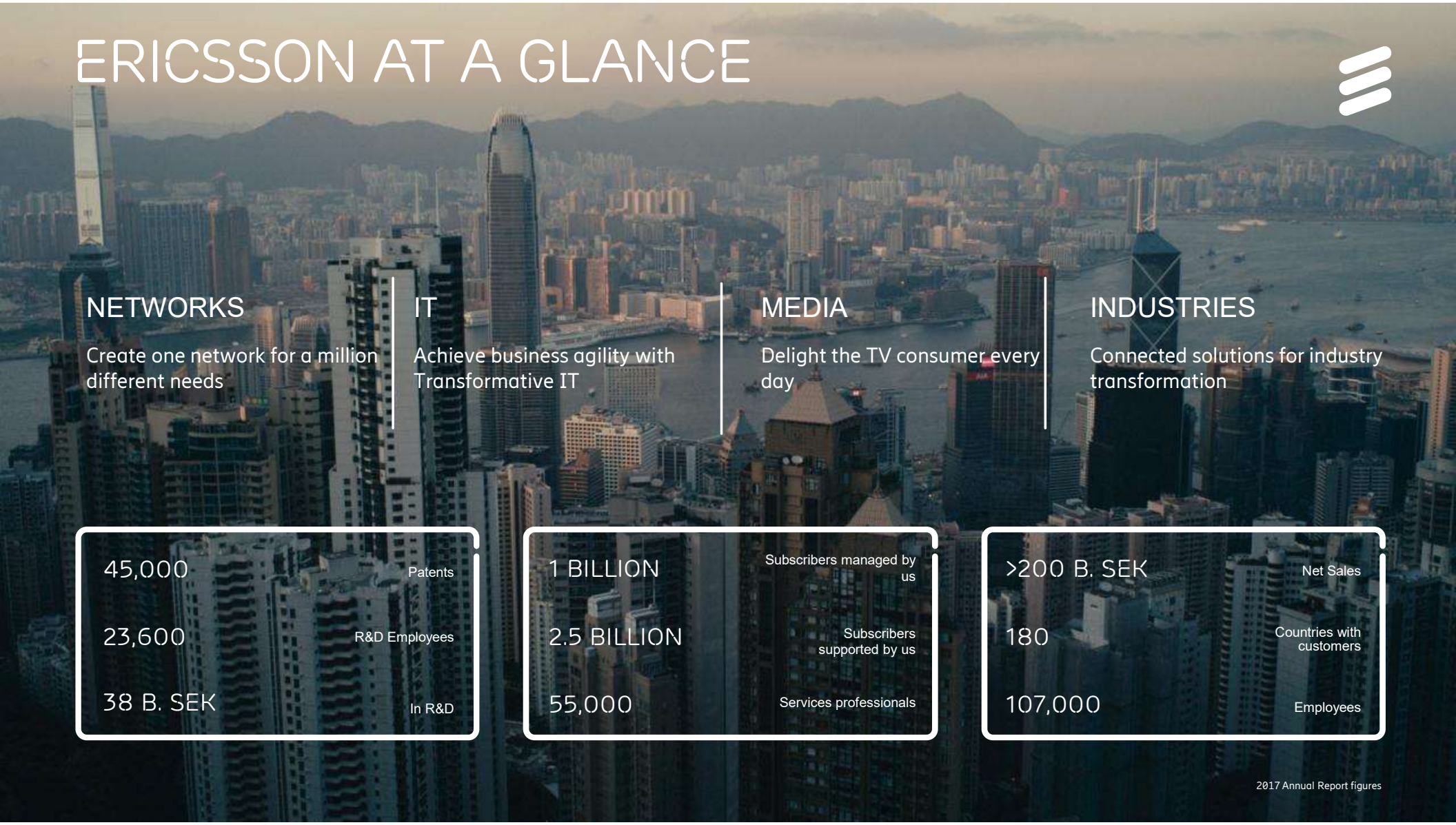
ERICSSON RADIO SYSTEMS




THIS IS
ERICSSON


HISTORY
Impact on society
1800
1850
1900
1950
2000
2020
Electric Telegraphy
Wireless telegraphy
Automatic telephony switch
Mobile telephone system A, MTA
AXE
NMT
GSM, 2G
SMS
Ericsson R380 Smartphone
Bluetooth, 3G
4G
Networked Society
5G

ERICSSON AT A GLANCE



NETWORKS

Create one network for a million different needs

IT

Achieve business agility with Transformative IT

MEDIA

Delight the TV consumer every day

INDUSTRIES

Connected solutions for industry transformation

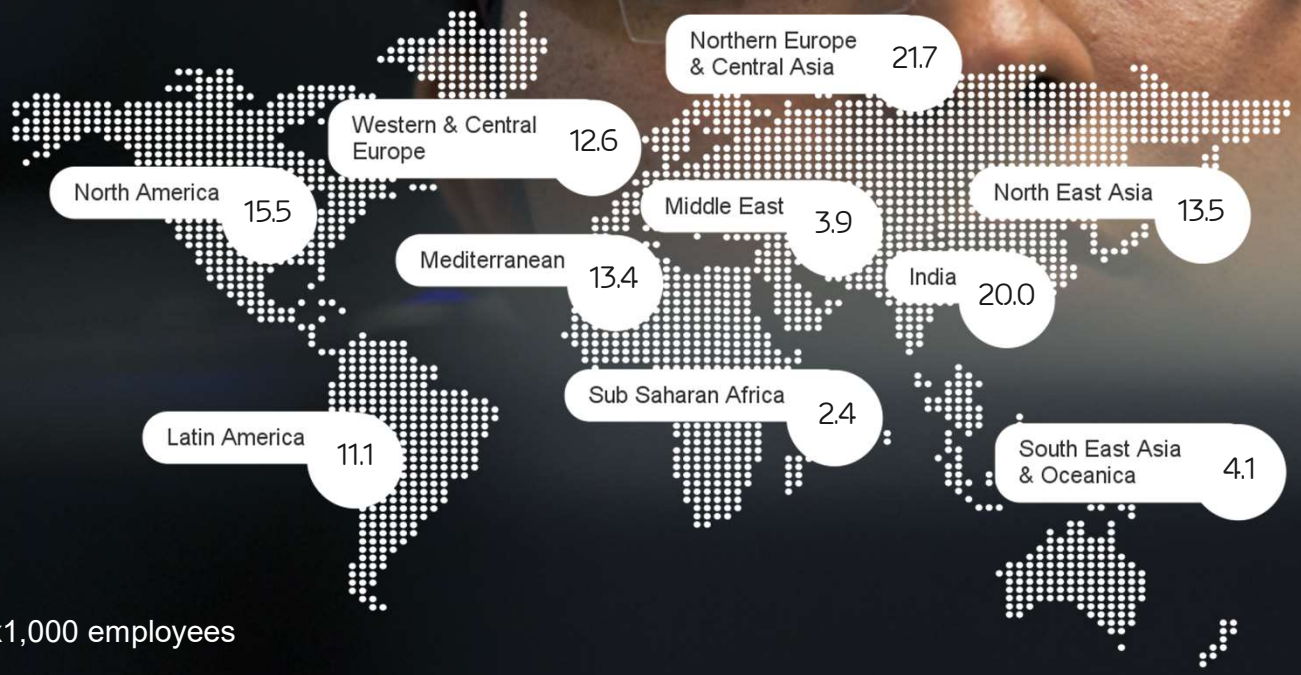
45,000	Patents
23,600	R&D Employees
38 B. SEK	In R&D

1 BILLION	Subscribers managed by us
2.5 BILLION	Subscribers supported by us
55,000	Services professionals

>200 B. SEK	Net Sales
180	Countries with customers
107,000	Employees

2017 Annual Report figures

GLOBAL PRESENCE



x1,000 employees

107,000

employees worldwide

55,000

of our employees are active within Services

23,600

of our employees are dedicated to R&D

Organization

CEO
Börje Ekholm

GROUP FUNCTIONS

Finance & Common Functions – Carl Mellander
Human Resources – MajBritt Arfert
Legal Affairs & Compliance – Xavier Dedullen
Marketing & Corporate Relations – Helena Norrman
Chief Technology Officer – Erik Ekudden

Business Area
Networks
Fredrik Jejdling

Business Area
Digital Services
Jan Karlsson

Business Area
Managed Services
Peter Laurin

Business Area
Technology & Emerging Business
Åsa Tamsons

MEDIA
Media Solutions
Angel Ruiz

Red Bee Media
Chairperson Carl Mellander

Market Areas

North America
Niklas Heuveldop

Europe & Latin America
Arun Bansal

Middle East & Africa
Rafiah Ibrahim

South East Asia, Oceania & India
Nunzio Mirtillo

North East Asia
Chris Houghton

CUSTOMERS


ERICSSON
ERICSSON LUND

Ericsson in Lund

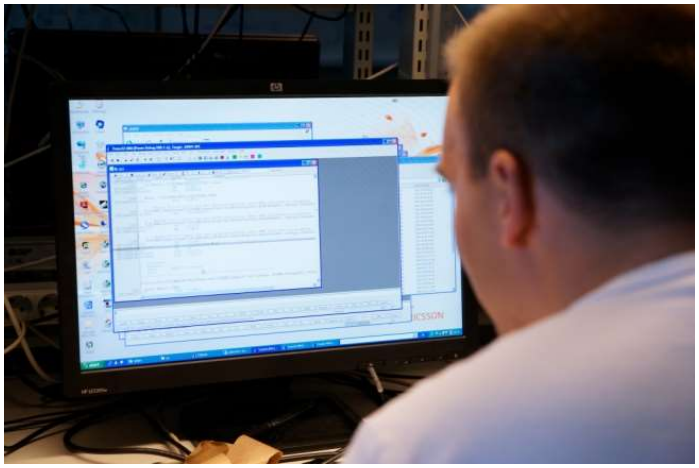
30+ years of experience

A billion devices...

- From GSM to 3G, 4G and now 5G
- Cost, size and energy focus
- Major IPR contribution
- Customer understanding
- 2014 Joined network

Software development

- SW development for LTE and 5G radio network products
- From system design through implementation to test and verification
  - Simulator development
  - L1 – L3 architecture and protocols
  - Radio network functions
  - System performance and energy efficiency



HARDWARE DEVELOPMENT
RADIO PRODUCTS AND VARIANTS

- Competence center for radio and digital system design
  - Radio product system design
  - Schematics design, PCB and validation
  - Product lifetime maintenance
  - Responsible for HF radio products
- Radio IC development for LTE and 5G
  - Schematic design, simulation and layout
  - Validation and characterization in lab
  - Component lifetime maintenance
- Digital IP development
  - System-on-Chip architecture and systemization
  - IP development and verification for ASIC/FPGA
  - Lab validation

FUTURE TECHNOLOGIES AND CONCEPTS

- Concept development and pre-pre studies of new features, standards and technologies
- Standardization of new features and standards
- Research in core technologies for HW and SW
- Testbeds, prototypes and trials to validate and demonstrate new technologies
- Driving the technology strategy work for radio

Ericsson 5G radio testbed

Research

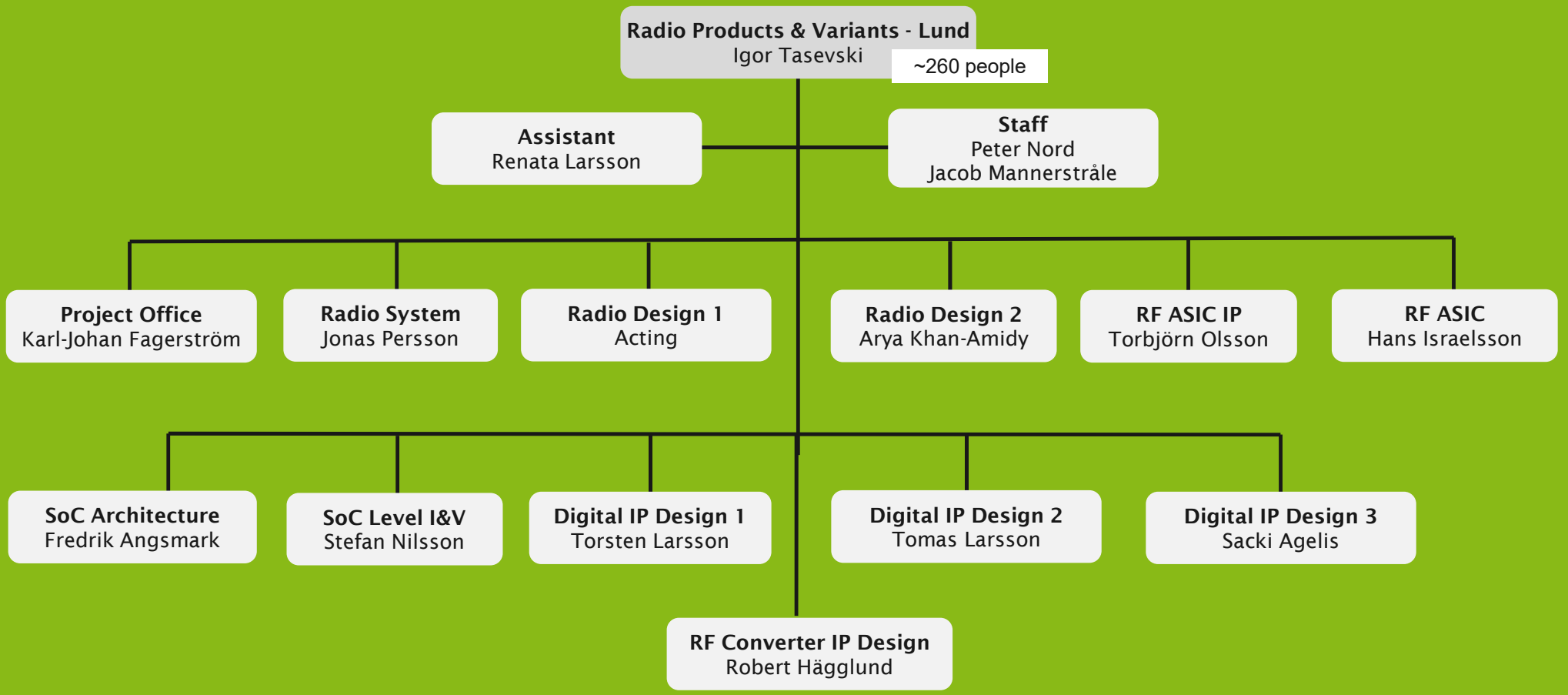
- Radio Access Technology research
  - Signal processing algorithms
  - LTE and 5G concepts and standardization
- Radio IC research
  - Architectures for 5G
  - IP block design
- Cloud research
  - Distributed computing
  - Virtualization – mission critical cloud
- Connectivity research
  - WiFi and Bluetooth standardization
- Security research
  - Trusted computing for infrastructure
  - Identity management

Standardization

— Standards are fundamental for global communication services
— Ericsson in Lund are active in many different telecom and data/IT standardization fora

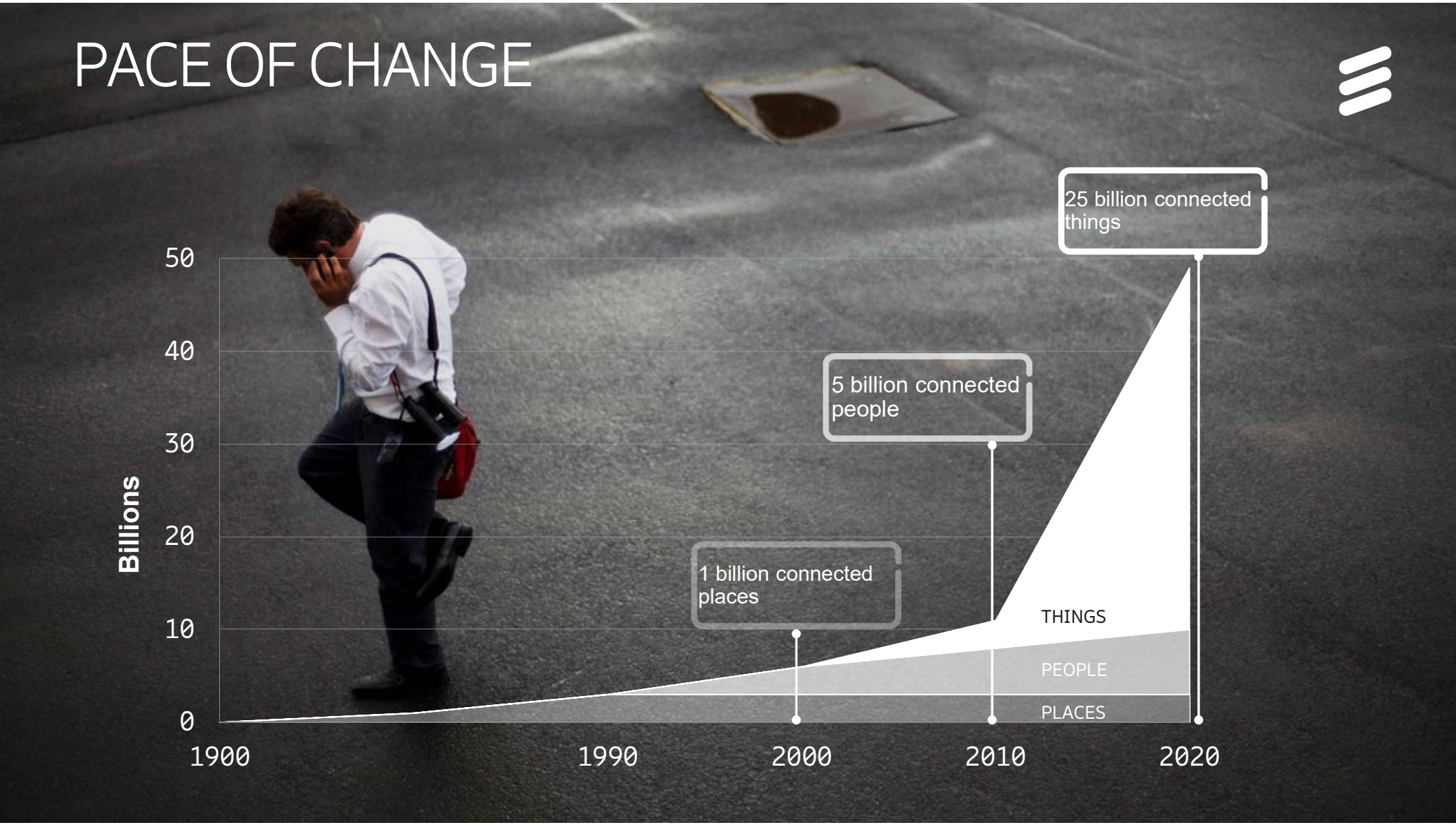
— 3GPP standardization for GSM, WCDMA, LTE and 5G
— Type approval groups GCF / PTCRB
— IEEE WiFi standardization
— Bluetooth standardization in BT SIG

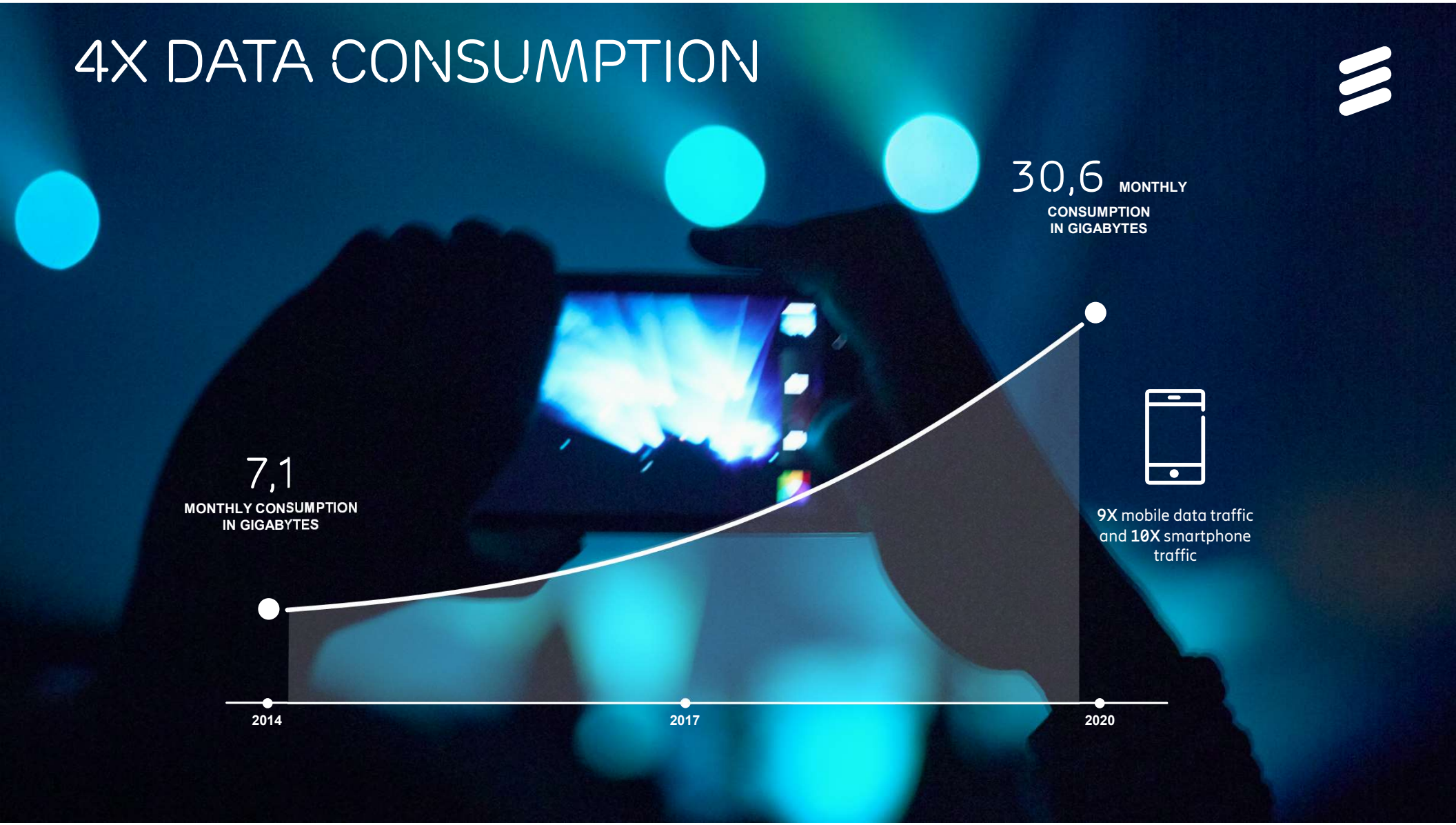
Radio Product and Variants Lund



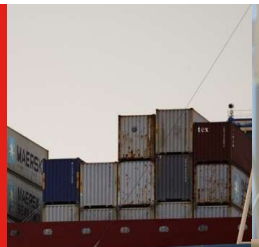

THE
NETWORKED
SOCIETY

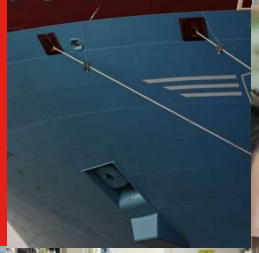
PACE OF CHANGE




4X DATA CONSUMPTION
30,6 MONTHLY CONSUMPTION IN GIGABYTES
7,1 MONTHLY CONSUMPTION IN GIGABYTES
9X mobile data traffic and 10X smartphone traffic
2014
2017
2020












Broadband Experience.
Everywhere, Anytime.

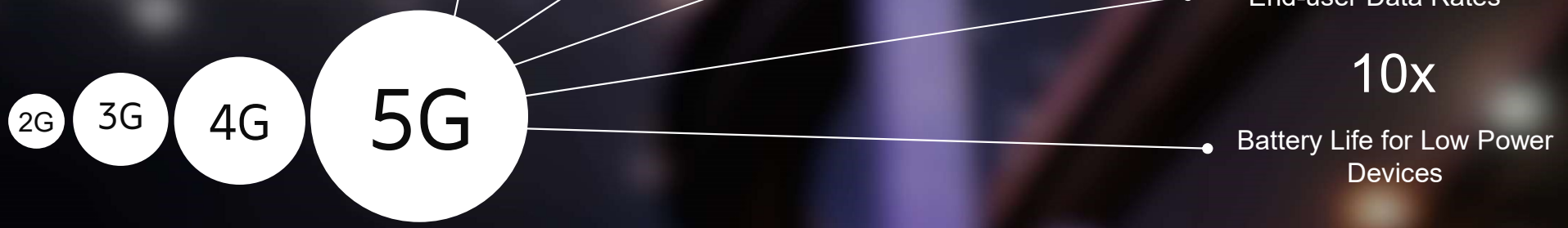
Smart Vehicles,
Transport & Infrastructure

Interaction
Human - IOT

Critical Control of
Remote Devices

Media Everywhere

EVOLUTION TOWARDS 2020



1000x
Mobile Data Volumes

10x-100x
Connected Devices

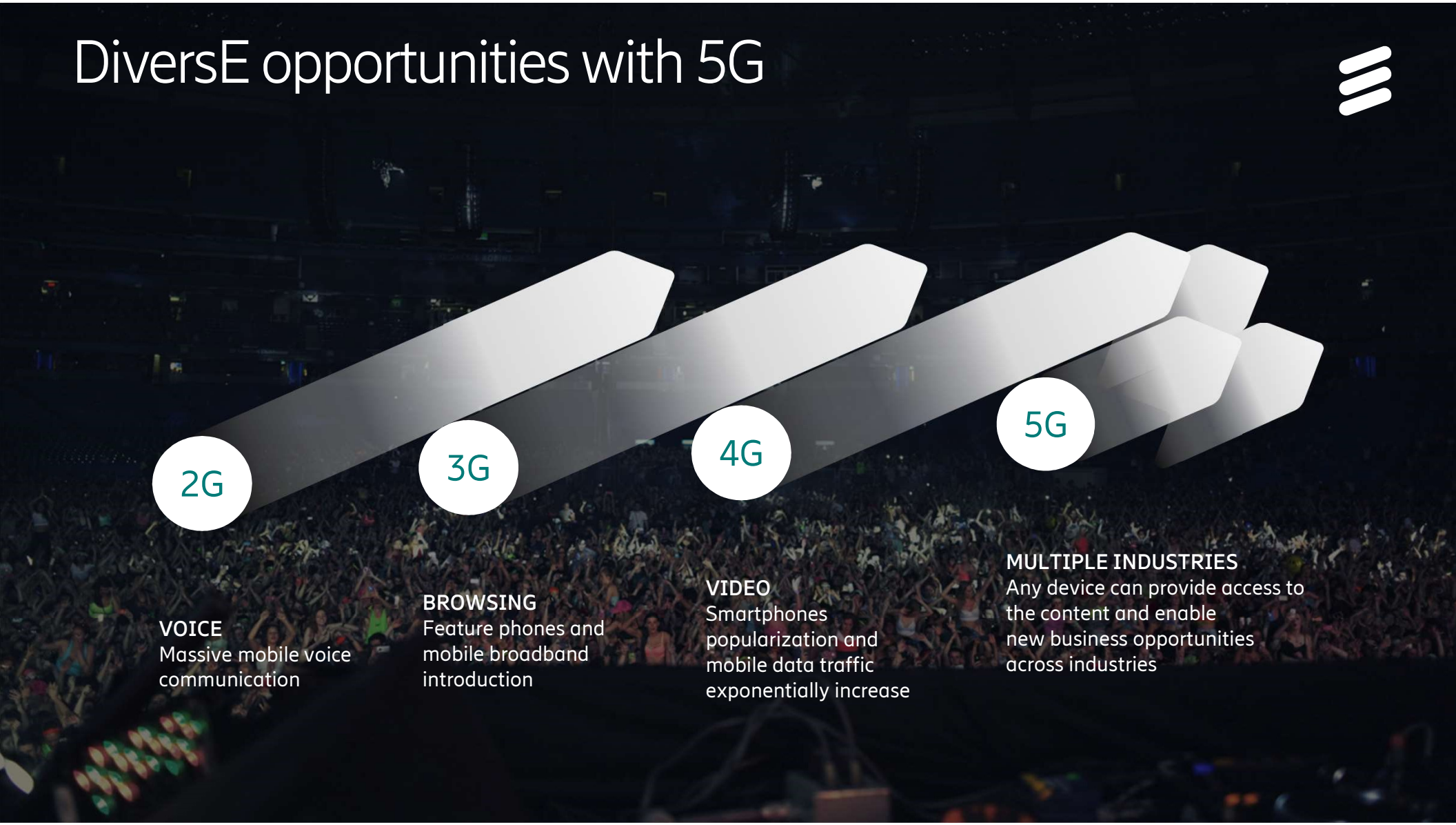
5x
Lower Latency

10x-100x
End-user Data Rates

10x
Battery Life for Low Power Devices

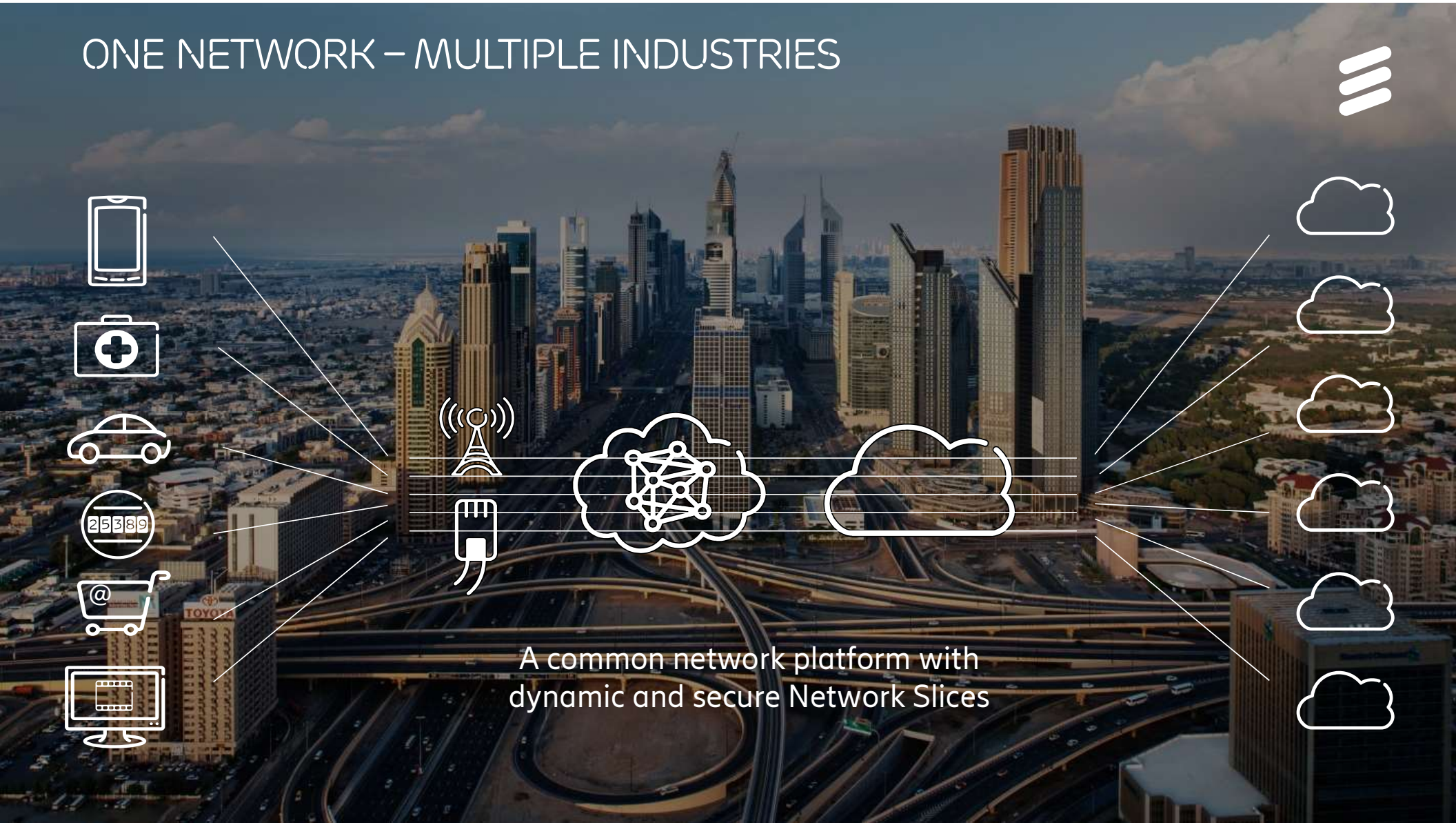
Source: METIS

DiversE opportunities with 5G



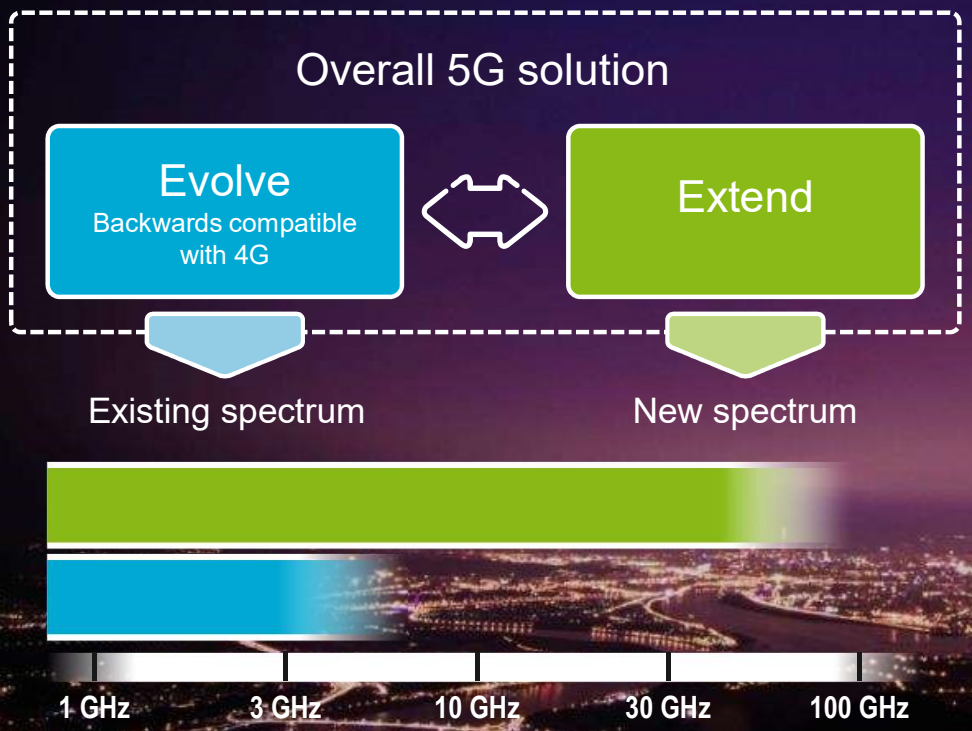

5G AND BEYOND

ONE NETWORK – MULTIPLE INDUSTRIES



A common network platform with
dynamic and secure Network Slices

5G RADIO ACCESS



- Evolution of existing technology adding new RAN technology
- Combined allows rapid switching based on radio conditions
- Gradual migration of new technology into existing spectrum

5g concept on today's networks

4G LTE and LTE-A

- Up to 3GPP Release 12
  - Up to 8x8 MIMO
  - Carrier aggregation up to 1Gbps
- Services
  - VoLTE
  - eMBMS
  - Mid-tier MTC (Cat 0)

LTE-E

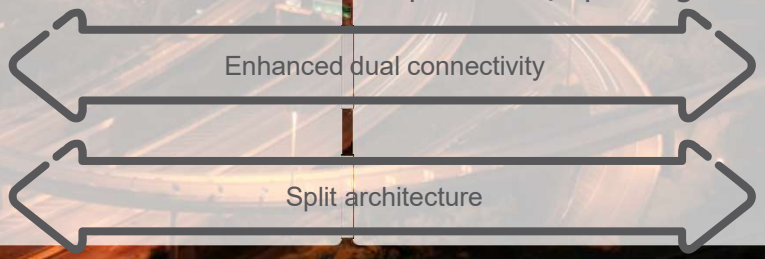
Backward compatible with LTE and LTE-A

- Unlicensed
- Low latency
- Lean design concepts
- Massive MTC (Cat-M, NB-LTE)
- Vehicular (V2X)

5G NR

Not backward compatible with LTE and LTE-A

- High frequency bandwidth
- Large bandwidth
- Massive beamforming/MU-MIMO
- Ultra low latency
- Ultra lean
- Critical MTC
- Migrate over time to low frequency spectrum (replacing LTE-E)



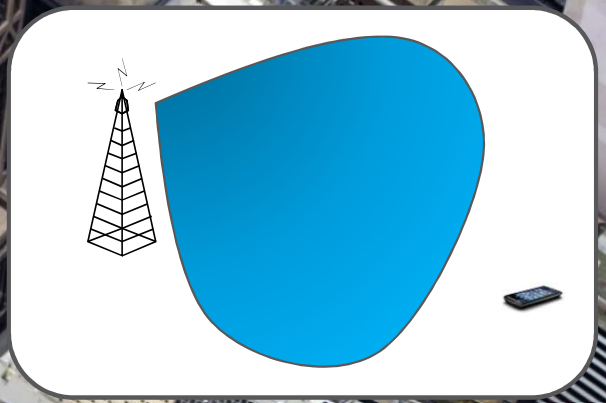

5G
USE CASES
BROADBAND EXPERIENCE
EVERYWHERE, ANYTIME
MEDIA
EVERYWHERE
SMART VEHICLES,
TRANSPORT & INFRASTRUCTURE
CRITICAL CONTROL
OF REMOTE DEVICES
INTERACTION
HUMAN-IOT

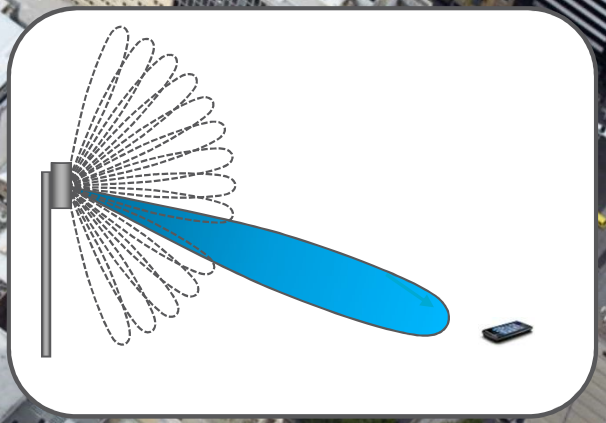

ERICSSON MAKING IT HAPPEN
17
JEWELS


5G TECHNOLOGY
DO NOT
ENTER

BEAMFORMING

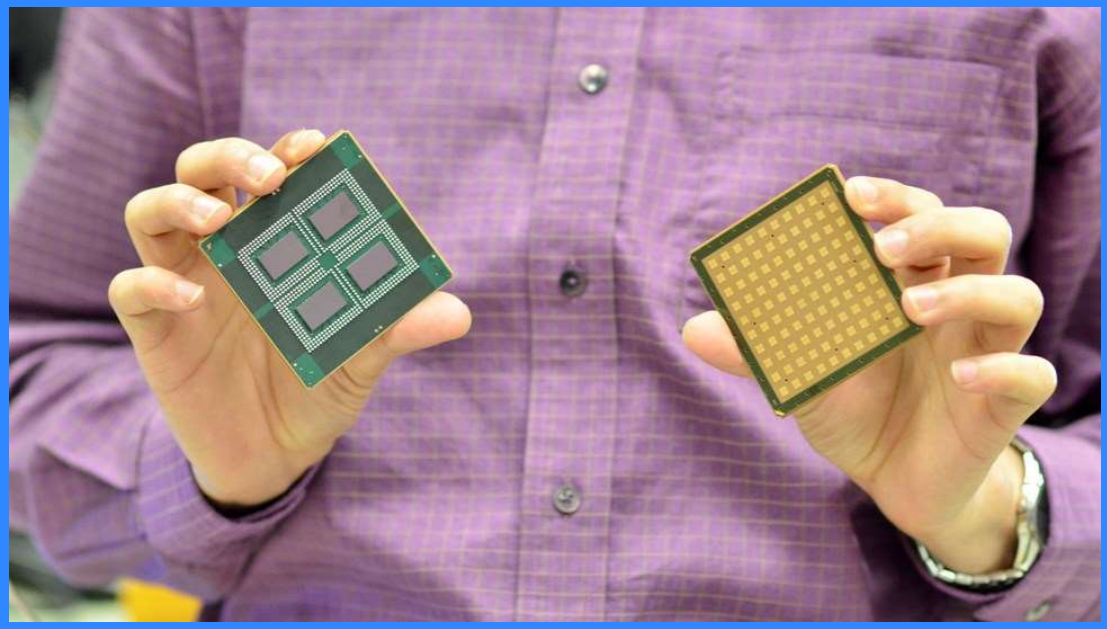
- Traditional base station antennas light a broad beam over its sector
  - Typically 120 degrees beamwidth
  - Good since
    - Simple and robust
    - User stay in the same beam a long time
  - But bad since
    - Only one user served at a time
    - If deployed too densely, a lot of interference created
- Create narrow beams instead – beamforming





HIGH FREQUENCY

- New challenges
  - Size
    - HF gives smaller antennas
  - Power
    - Heat dissipation in small boxes
  - Integration level
    - Allow modular approach
  - Propagation
    - line of sight
  - Testing other the air, OTA



DESIGNING A SYSTEM

Digital ASIC and FPGA

Radio Design and I&V

Radio System

RF IC Design

ARCHITECT SYSTEM

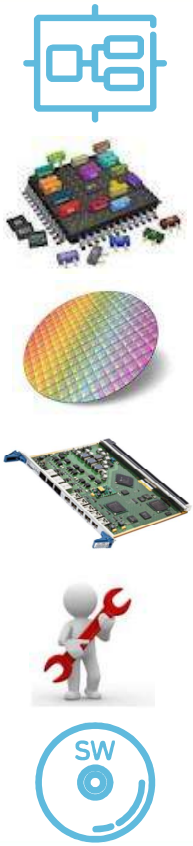
SOC IP CORES D&V

CHIP D&V

BOARD D&V

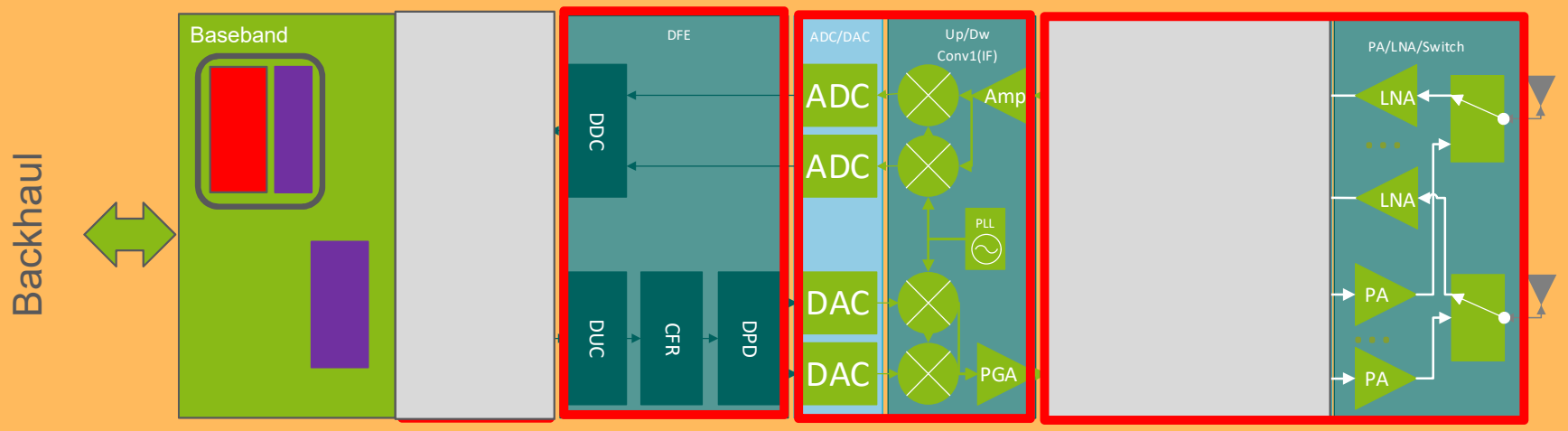
SW TOOLS

PLATFORM & APP



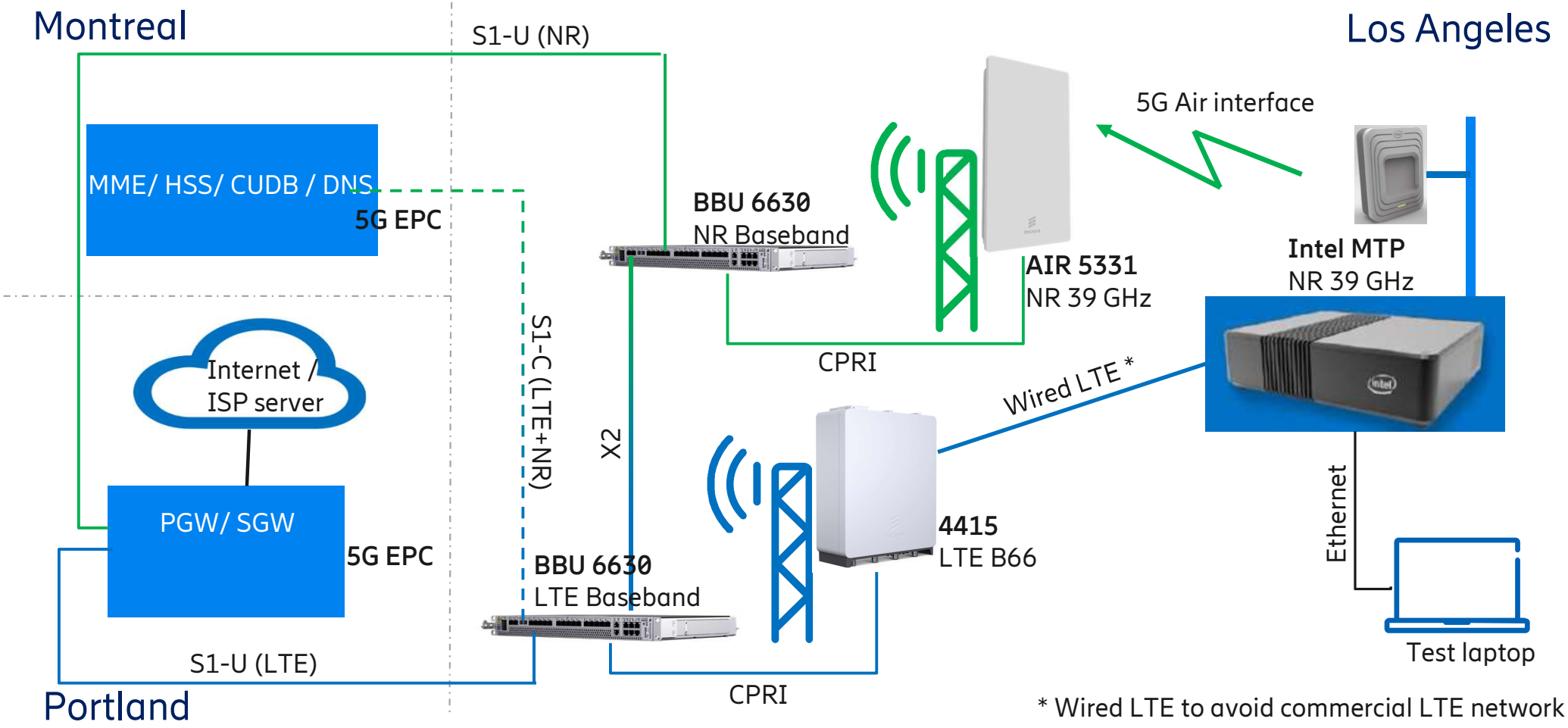
Radio Products & Variants Lund

A RADIO SYSTEM AND THE USAGE OF ASIC & FPGA IN IT

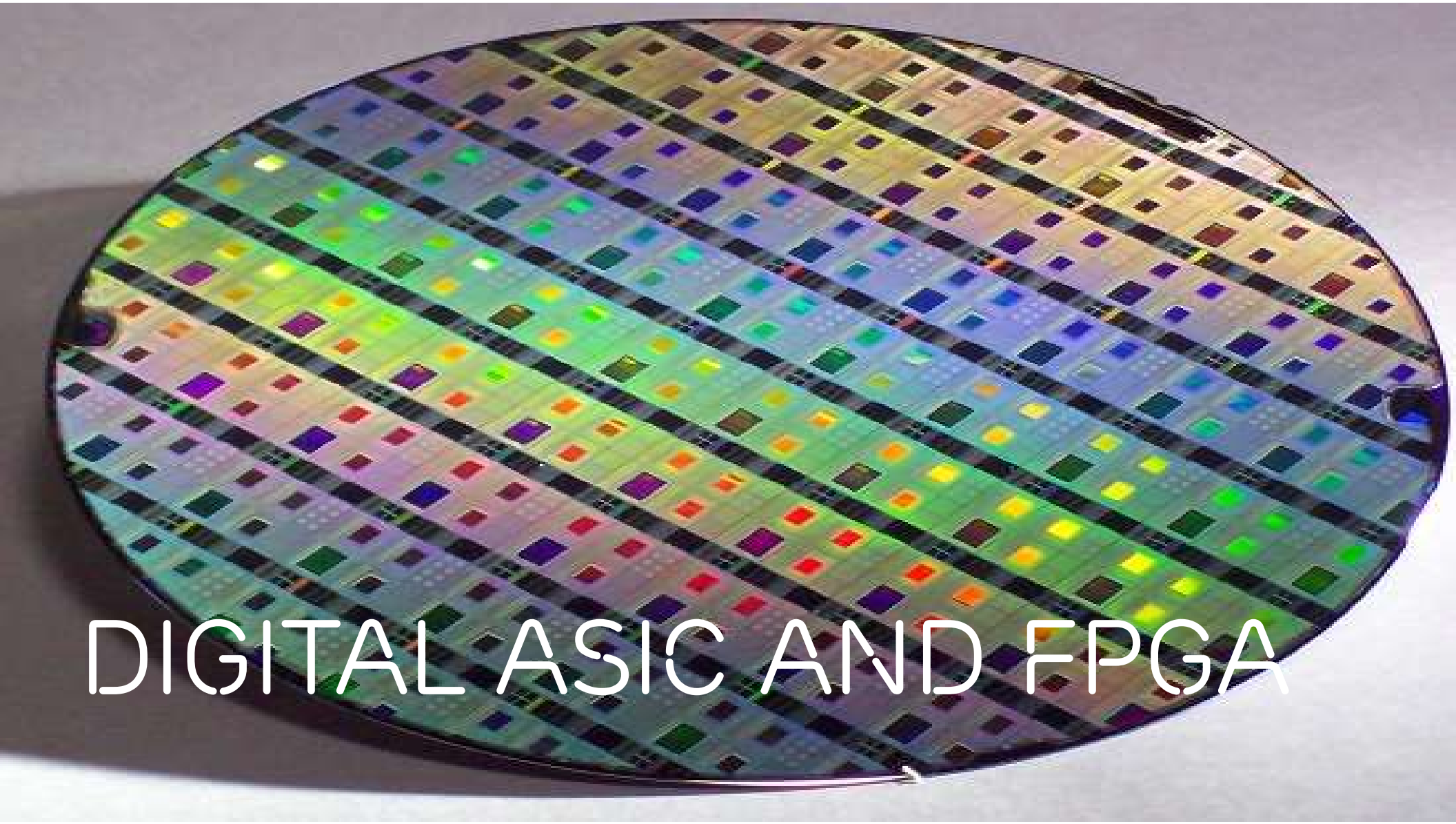


LF(<6GHz) 4G:	BB processing	N/A	Radio ASIC	Transiver	N/A	PA, LNA, SW	Ant
LF(<6GHz) AAS:	BB processing	Ant. ctrl	Radio ASIC	Transiver	N/A	PA, LNA, SW	Ant
1st gen HF	BB processing	Ant. ctrl	Radio ASIC	Transiver	RF IC		Ant

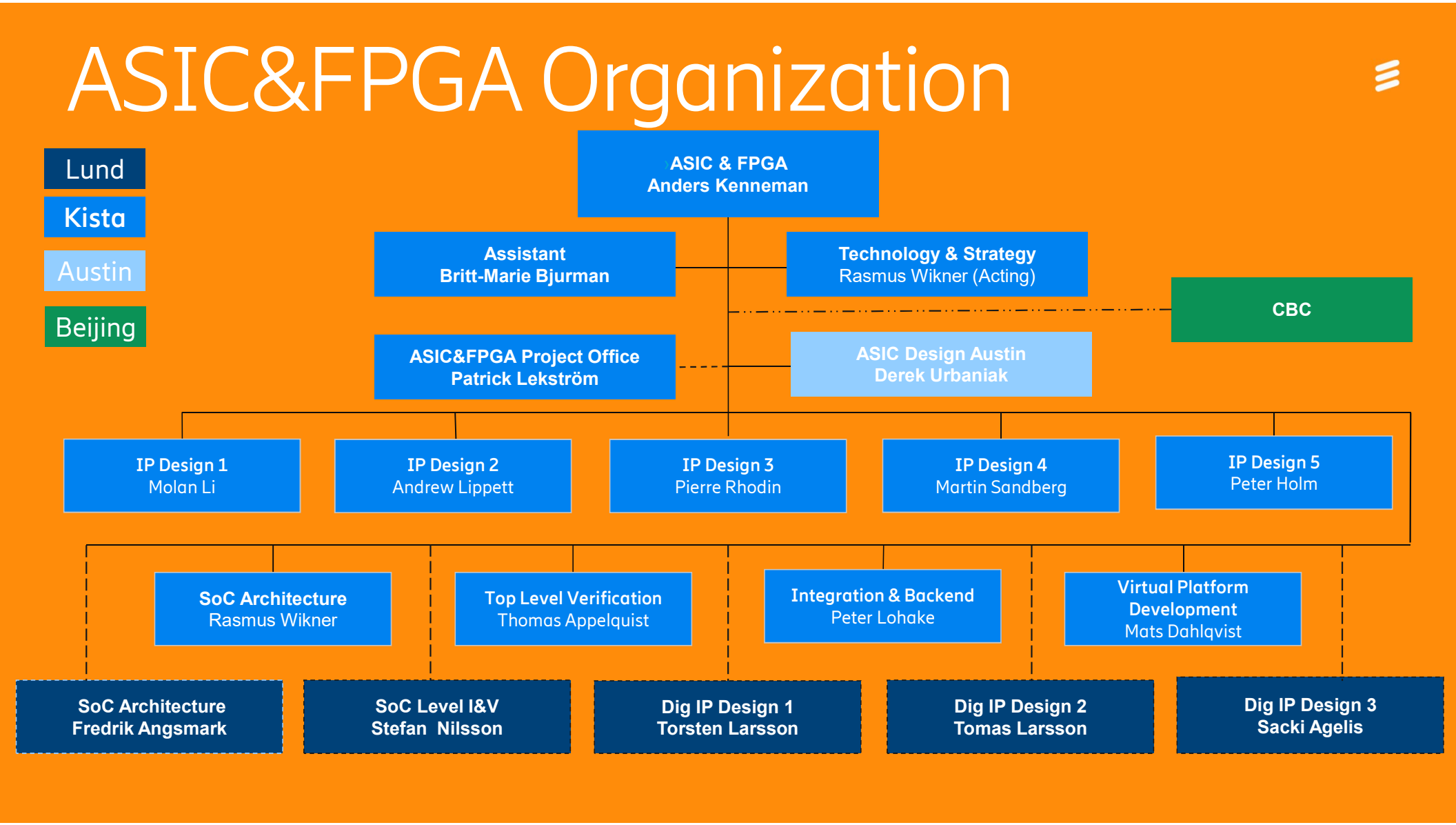
39 GHz demo – MWCA 2018
Architecture overview



* Wired LTE to avoid commercial LTE network


DIGITAL ASIC AND FPGA

ASIC&FPGA Organization



Complexity increase – 5G

- Base stations are becoming significantly more complex, combining both traditional base station complexity with challenges traditionally more dominant in mobile handset development
  - Massive parallel signal processing
  - Small footprint (higher integration)
  - Denser deployment

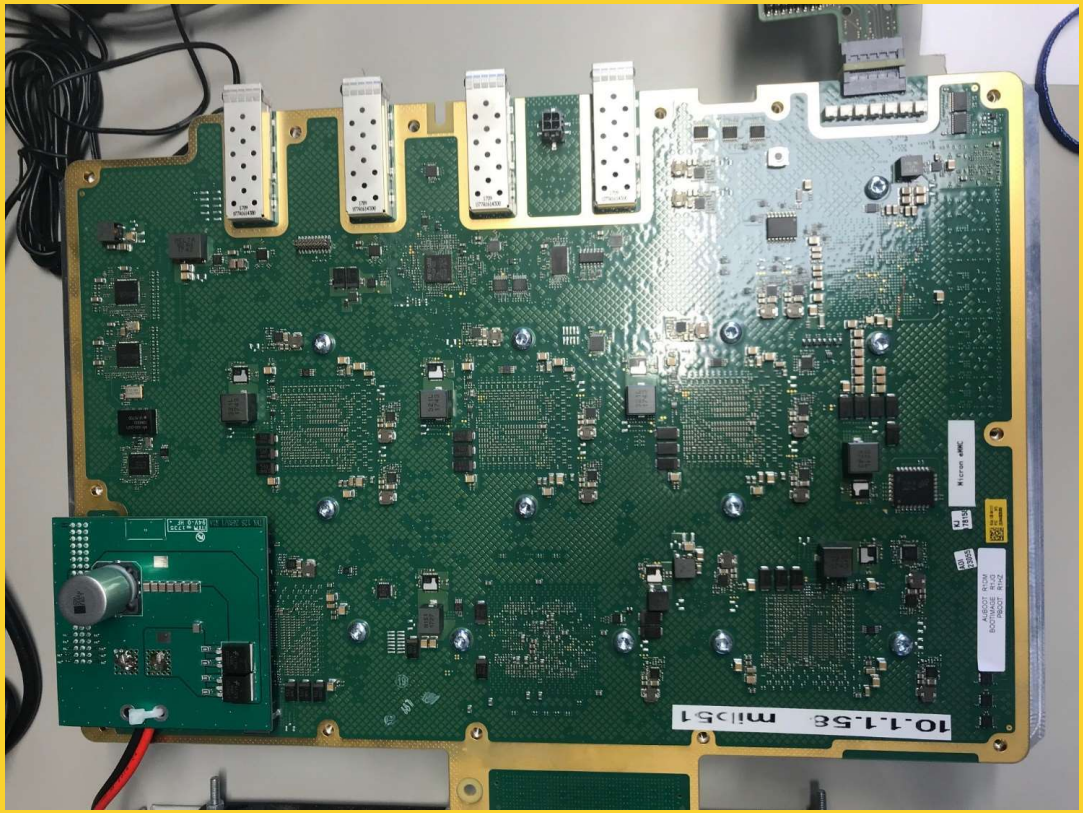
- Developing a base station in the future will require optimization of many more parameters and require differentiation of the products
  - Power
  - Size

- **ASIC and FPGA is the way to manage above challenges!**

Our ASIC products

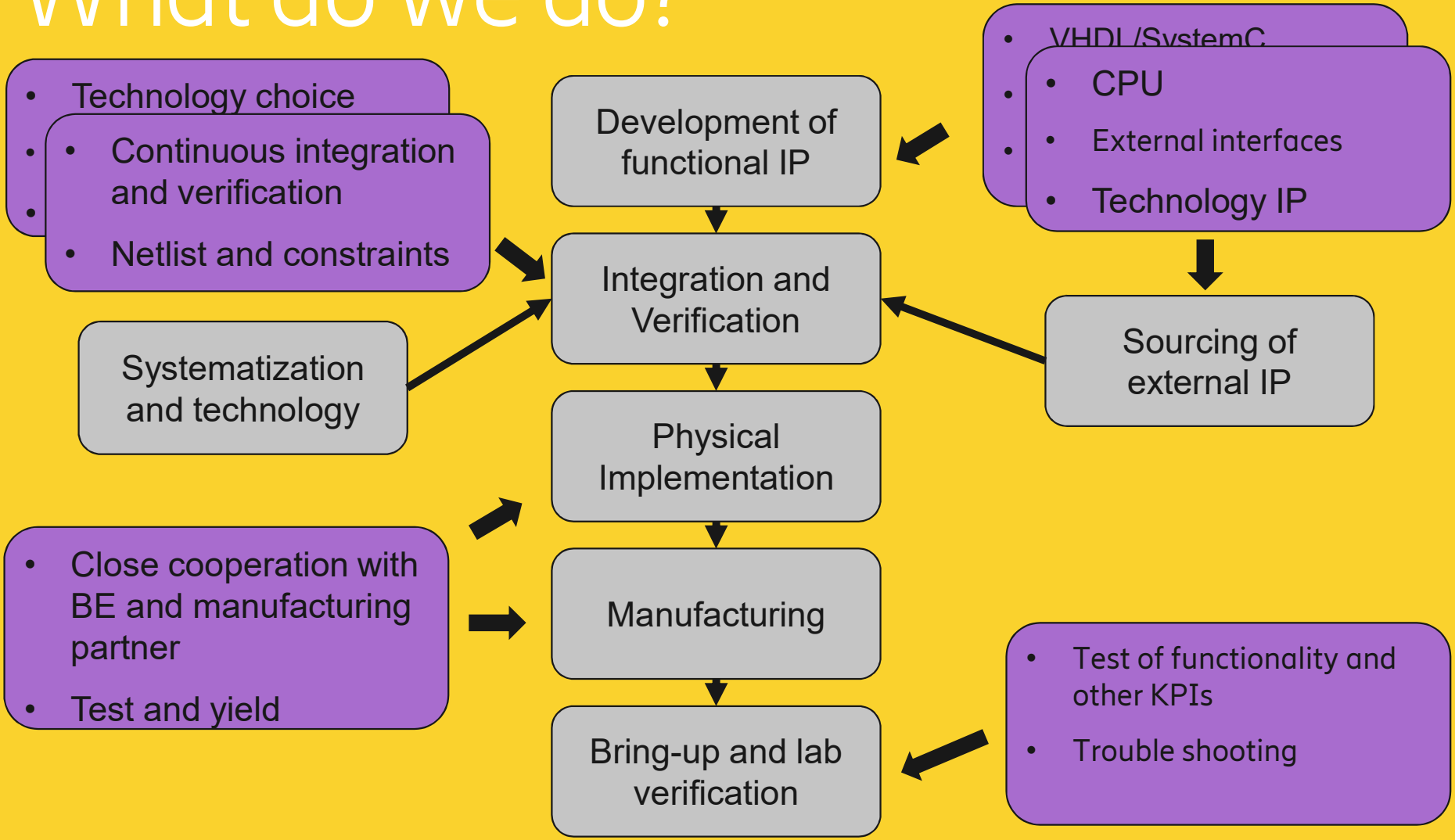
- 100+ mm2
- 7 nm technology
- 200+ Mgates
- Massive Multi-core
- High speed interfaces
- Mix signal
- HF RF 24-43GHz

Our FPGA products



- Largest available FPGAs
- Embedded CPUs
- Embedded ADC/DAC
- Massive parallel interfaces
- Part of Radio products

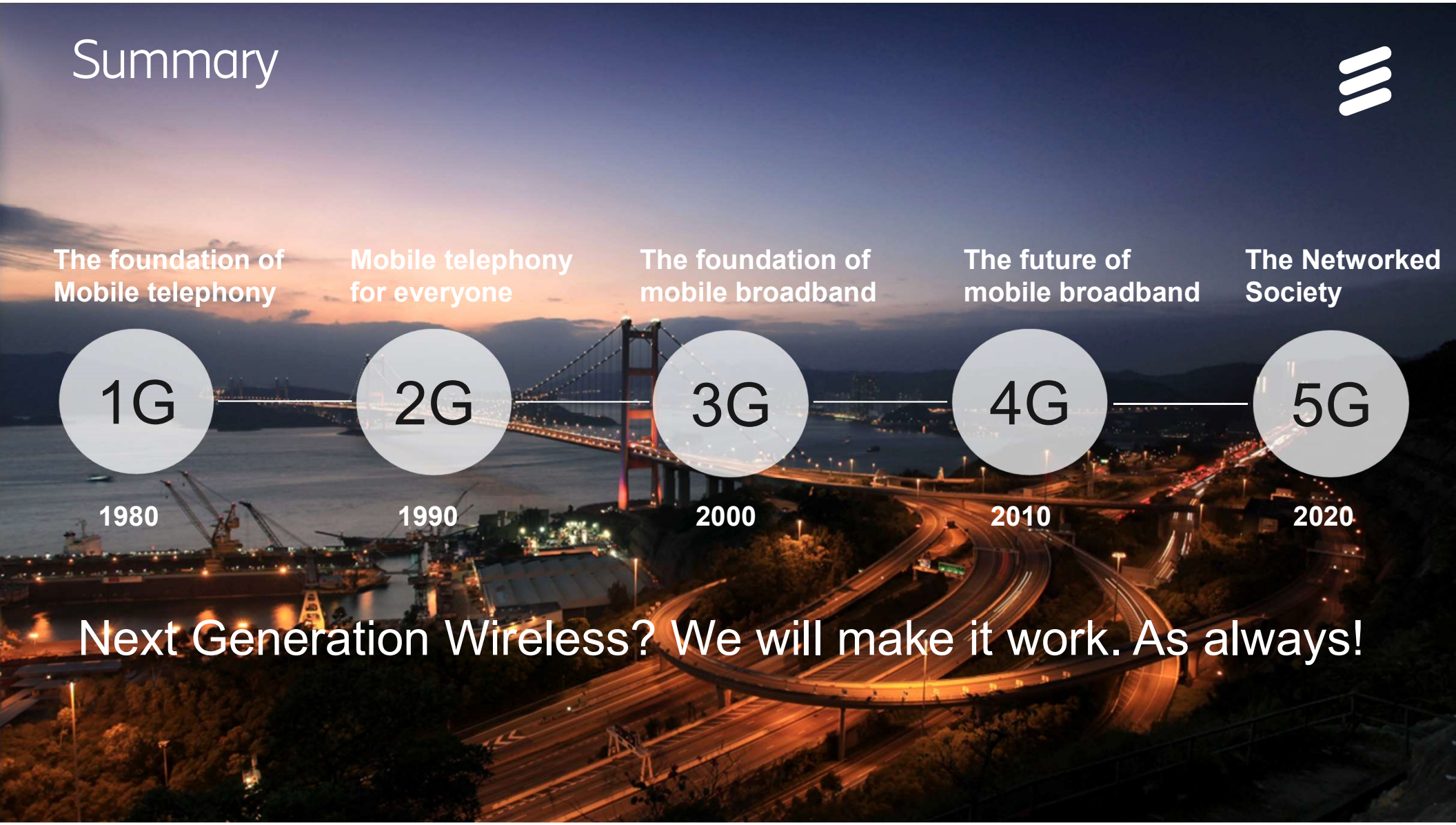
What do we do?


Technology choice
Continuous integration and verification
Netlist and constraints
Systematization and technology
Development of functional IP
Integration and Verification
Physical Implementation
Manufacturing
Bring-up and lab verification
VHDL/SystemC
CPU
External interfaces
Technology IP
Sourcing of external IP
Close cooperation with BE and manufacturing partner
Test and yield
Test of functionality and other KPIs
Trouble shooting

In the forefront!

- Latest ASIC technologies
- Advanced FPGAs
- State of the art EDA tools
- Development of the most advanced functionality for 5G
- Together with Ericsson colleagues at other sites
- Partnering with leading ASIC houses and foundries
- In collaboration with Ericsson 5G product development

Summary

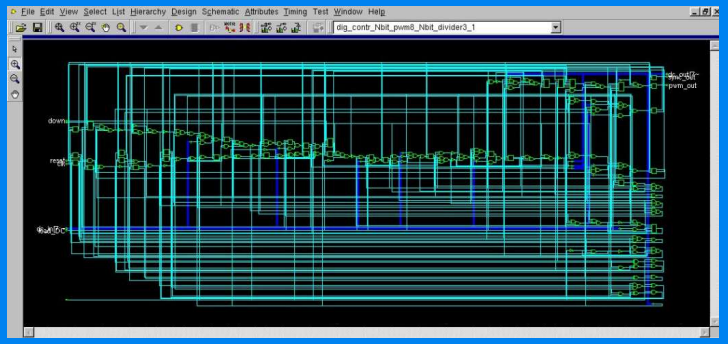


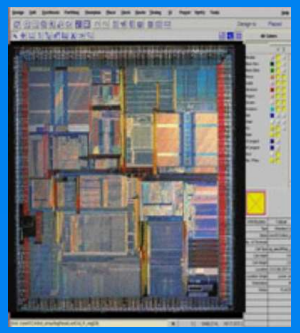
Next Generation Wireless? We will make it work. As always!

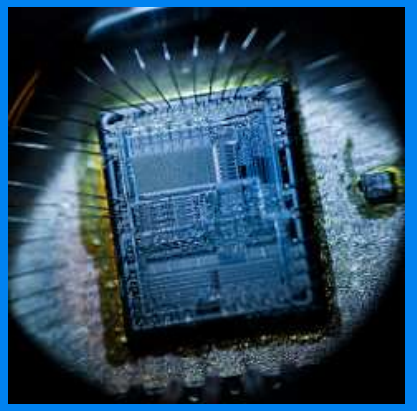
Job opportunities in Lund

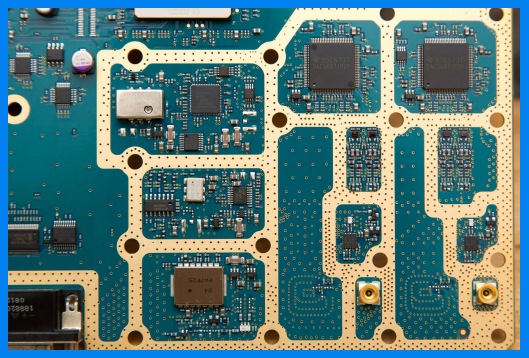
- Summer work
- Master Thesis
- Employment

- All positions are on Ericsson job site and LinkedIn
- We participate in ARKAD










ERICSSON