



At the heart of Europe's ICT ecosystem

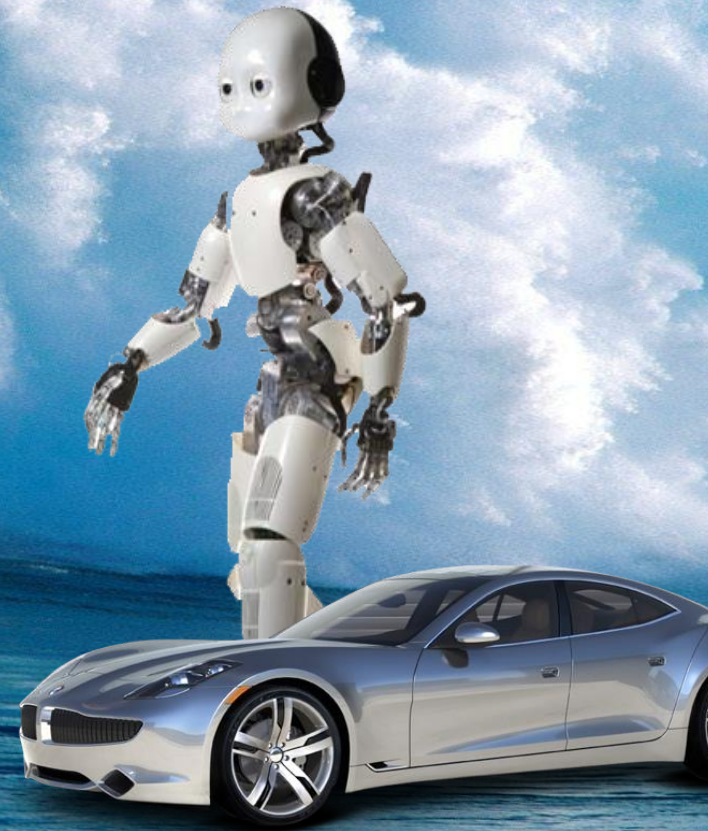
Renato Lombardi VP of European Research Center

Huawei Innovation Day
A BETTER CONNECTED EUROPE



A permanently connected World - where communication and information is merging into ICT

- 5G - era of Hyper Connectivity
 - 1000x capacity vs. LTE
 - ...1 sec to download full HD movie (10Gb)
- Internet of Things
- Big Data, Clouds (Network of Data Centers)
- Software Defined Networks



A connected World - From CT and IT to ICT

- **New** network architectures
- **New** standards
- **Faster** adoption of innovation
- **New** technologies (nano materials,...)
- **New** products, components, processors managing incredibly higher speeds and huge amount of data

H **heavy investments**

L **ong term research**

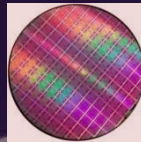
Innovation as the key to competitiveness



From semiconductors to end-to-end networks

- Vertical R&D integration approach
 - Optical components, ASICs, RFIC,...
 - Modules, sub-assemblies, products, solutions
- e2e network approach, from terminals to clouds to create value to our customers

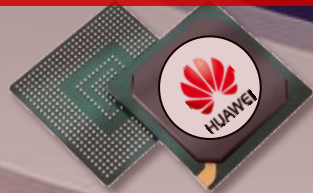
Semiconductors



Optoelectronic Components



Strategic Investments in Europe for the optical core technologies



Modules



Products and Systems



e2e Networks



Huawei's research in Europe – Active Ecosystem



Fundamental Technology and Innovation in Europe

- Strong expertise derived from a diversified and multicultural environment
- Healthy specific technology ecosystems with excellence built on R&D, Innovation and Business
- High value Poles of Excellence in specific technology areas (strong clustering of ICT)



Customer Oriented, Joint Innovation

- Close relationships with European trend-setting operators through Joint Innovation Centers for the creation of next generation global solutions



EU Future Networks Research

- A committed contributor to European industry, shaping international standards, researching key technologies, forming technical partnerships and influencing national and EU regulatory bodies

Huawei Research in Europe – Investment Milestones



Huawei Research in Europe - Locations



Dublin, Cork, Ireland

- OS



Helsinki, Finland

- Terminal OS

Stockholm, Sweden Gothenburg, Lund

- Wireless Technology
- Components

Brussels-Ghent/Louvain-la-neuve, Belgium

- Application Software Architecture
- Components, Silicon-Photonics

Ipswich, UK

- Optoelectronics

Paris, France

- Algorithms, Big Data,
Industrial design

Nice, France

- Image Signal Processing

Milan, Italy

- Microwave
- Optoelectronics

Berlin, Germany

- Standards

Nuremberg, Germany

- Renewable Energy

Munich, Germany

- Antenna
- Future Network
- Hardware and Engineering
- Media Technology
- Terabits Optical Systems
- Software Platforms



Continuous innovation investment in Europe

Extensive cooperation partners in Europe

Keeping pace with leading Industries , universities and institutes Partners



University and Research Institutes collaborations

- Advanced and applied research projects
 - Semiconductors and materials
 - Optical components
 - Signal processing algorithms
 - Cloud network security
 - ...
 - PhD Student programs funding
 - Undergraduate work experience program
- Participation to standardization bodies**
- Participation in EU and national funded programs**

Big data – Networks of Data Centers

Big Data Technology Stack

Decision Support and Automation

Analytics and Discovery

Data Organization and Management

Infrastructure

Applications

- Visualization
- End-to-End management

Data Science

- Discovery: Machine Learning & Data Mining
- Statistical modeling & analysis

Data Engineering

- Stream, DB, NOSQL
- DWH, Analytics
- Map-Reduce, Hadoop

Infrastructure

- Storage & virtualization
- Resource management

Internet of things Network Platform



Sensors and Devices

- Location
- Identity + Policy
- Aggregation
- Security
- Mobility
- Lightweight IPv6



Networks, Computing, Storage

- Scale + Reliability
- Resource orchestration
- Difficult networks
- Privacy + Security
- Service Provider M2M
- ASICS + Software



Data Analytics

- Data Aggregation
- Video Analytics
- Streaming Data
- Data Federation
- Embedded analytics



Control Systems

- Determinism
- Safety
- Latency
- Virtual Machine Control

IoT Platform



Data Center



Intelligent Network



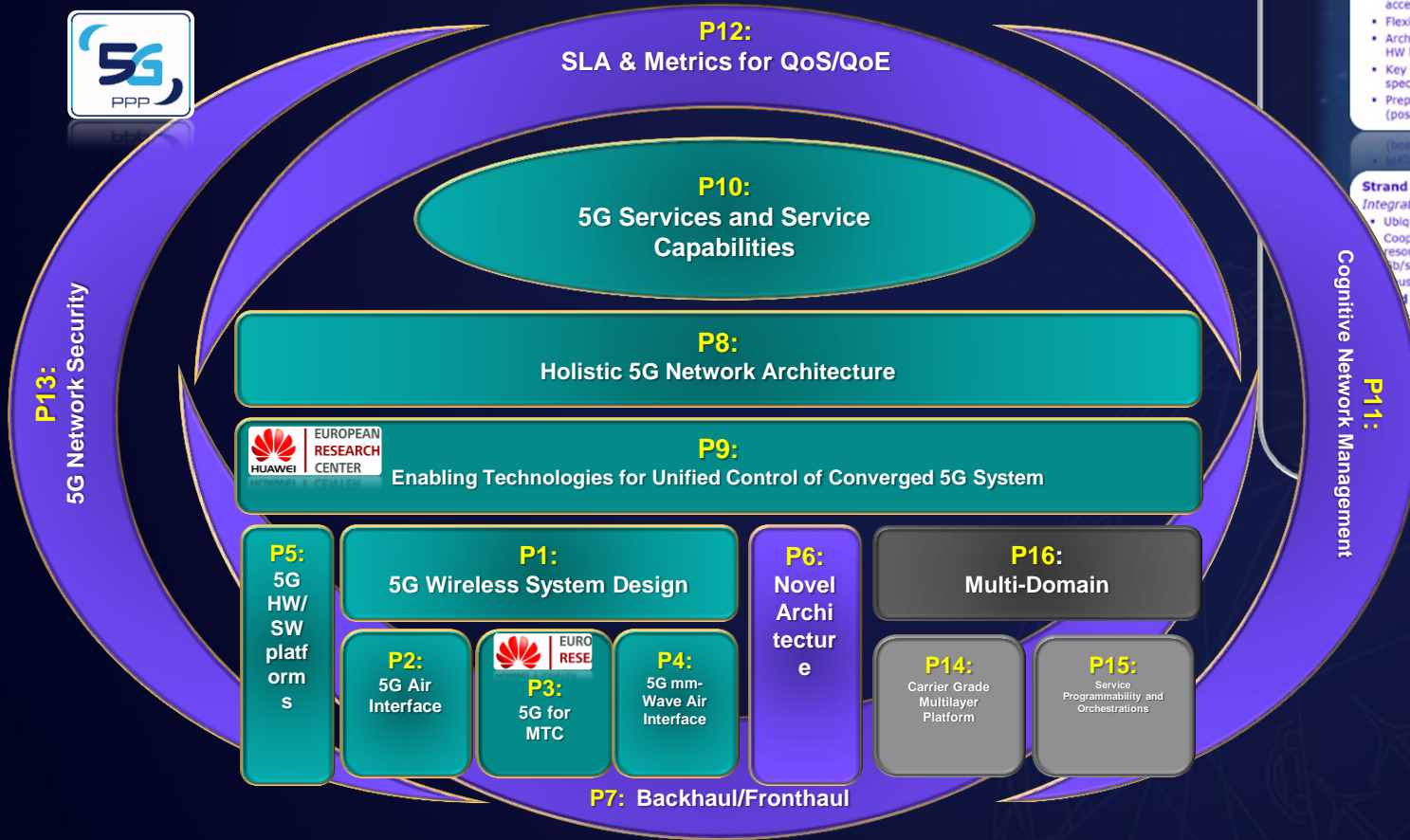
Cloud

Architectures

Horizon 2020 – 5GPPP

5G PPP

Next Generation of Ubiquitous Ultra-High BB network infrastructure which will support the Future Internet (FI)



- H2020: Advanced 5G Network Infrastructure (700M€)
- 5G Public (EU) Private (Industry, SME, Research) Partnership (5G PPP)

Research

Strand Radio network architecture & technologies

- 1000 fold traffic increase, versatile requirements
- Network architecture, new frequency bands, latency;
 - Increased frequency re-use, versatile low-cost radio access infrastructure (10T to > 1Gbps) + low energy
 - Flexible backhaul solutions
 - Architecture for 5G "transceivers" and micro-servers, HW building blocks
 - Key hardware building blocks to support various spectrum usage scenarios
 - Preparing for large scale demonstrators and test-beds (possibly leveraging existing experimental facilities)

Strand Convergence beyond last mile

- Integration, unified control
- Ubiquitous access continuum
 - Cooperative, cognitive fixed and heterogeneous resources, with fixed optical access reaching at least 10 Gb/s
 - Re-use and sharing of functionalities
 - **Network management**
 - Network (SON) and service management (metrics)
 - Autonomic;
 - Multi-domain
- Type of Action: Research and Innovation - Large projects
Budget: € 98 Million

Innovation

Strand Virtualisation and SW Networks

- Flexibility, beyond firmware implementations
- Virtualisation of net.functions, migration
 - Orchestration of resources
 - Flexible backhaul solutions
 - Integration service layers with network layers, reconfigurability
 - Openness, OTT Integration, E2E SLA, third party providers

Type of Action: Innovation - Large projects
Budget: € 25 Million

CSA

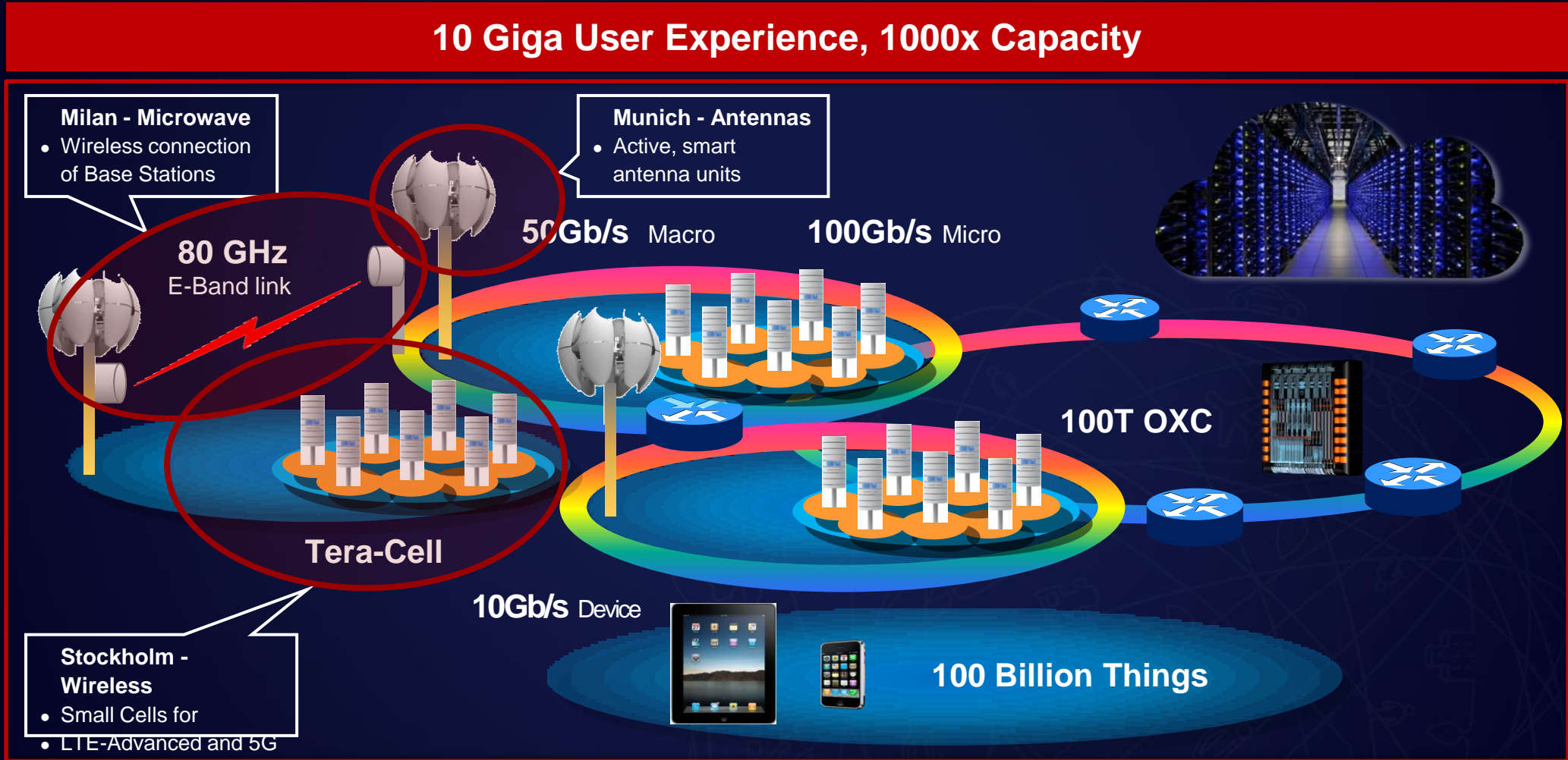
Support Actions

- Coherence and Impact
- Programme integration, analysis of outcomes
 - Societal issues
 - International activities
 - Support to standards
 - Support to policies
 - Web site,
 - Roadmaps, including experimental facilities
- Type of Action: SA - Small projects
Budget: € 2 Million
- NB: International co-operation with countries having bold R&I initiatives in the field (Korea, Japan, US, China) may be considered on a win-win basis.



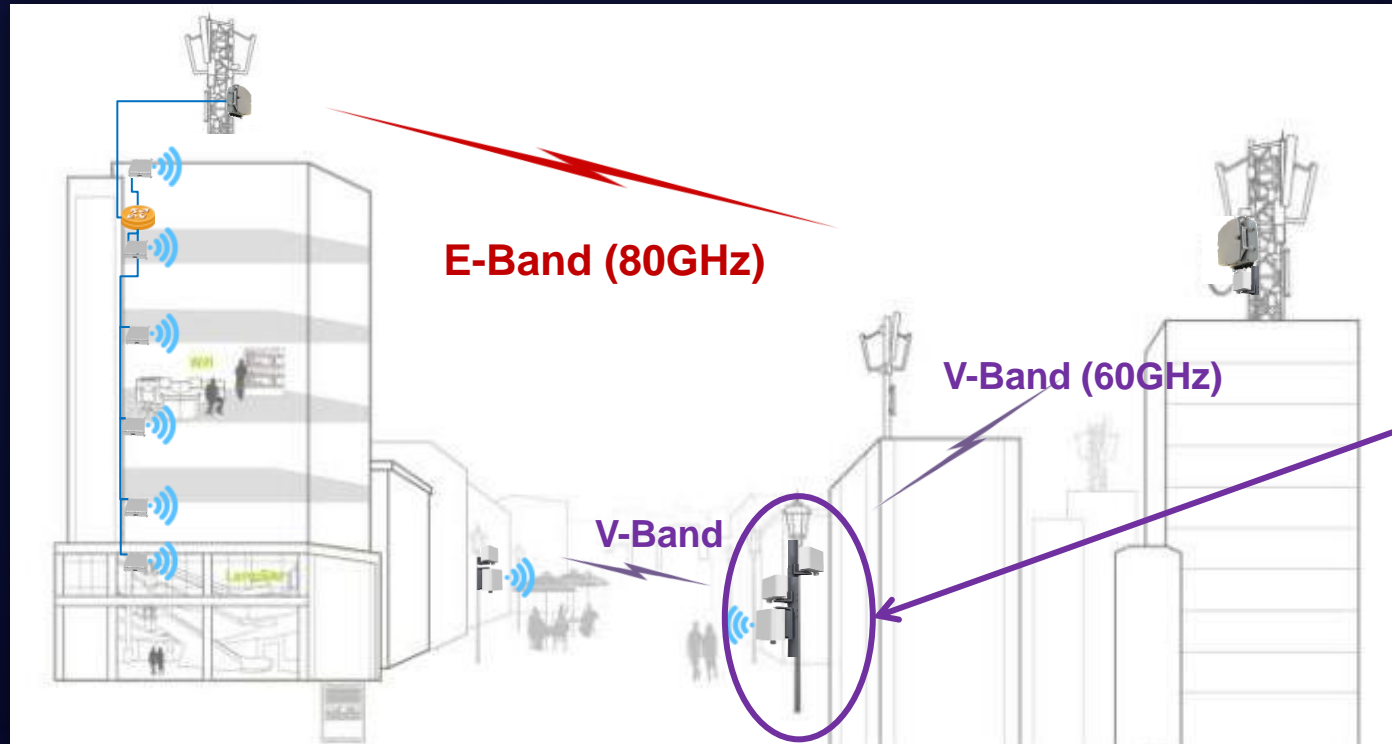
Huawei has committed 600 M\$ in 5G research

5G Wireless Networks



Sweden (Stockholm) – Small Cells

- Massive MIMO and multi antenna nodes
- Operator sharing of street sites and indoor sites
- New solutions for fixed and moving hot spots
- Cost efficient solutions for rural coverage
- Higher frequency bands



Small Cells



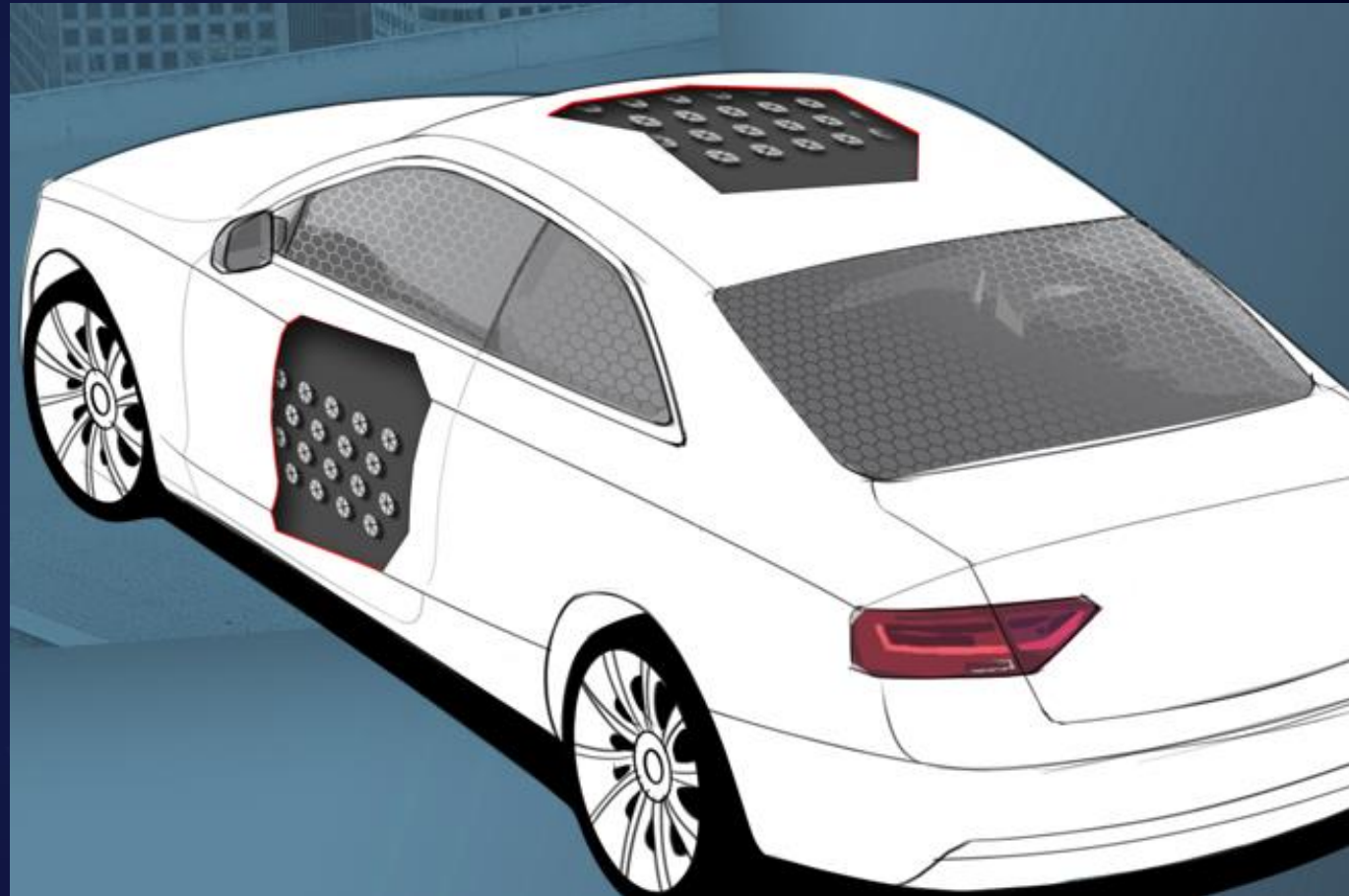
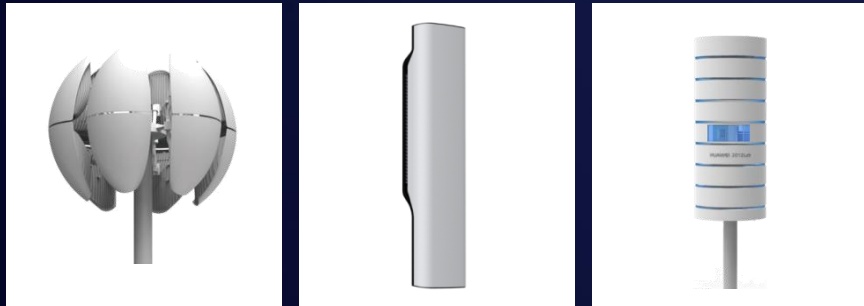
AtomCell



AtomCell

Germany (Munich) - Antenna Systems

- Compact Arrays
- Active Antenna Systems
- Massive MIMO Antennas
- Macro and Micro BS Antenna Technology
- Car integrated antenna arrays for 5G mobility
- Factory 4.0



THANK YOU

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