

5G Impact on Telecom Infrastructure 2019

Market and Technology
Report 2019

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ABOUT THE AUTHORS

Biographies & contacts



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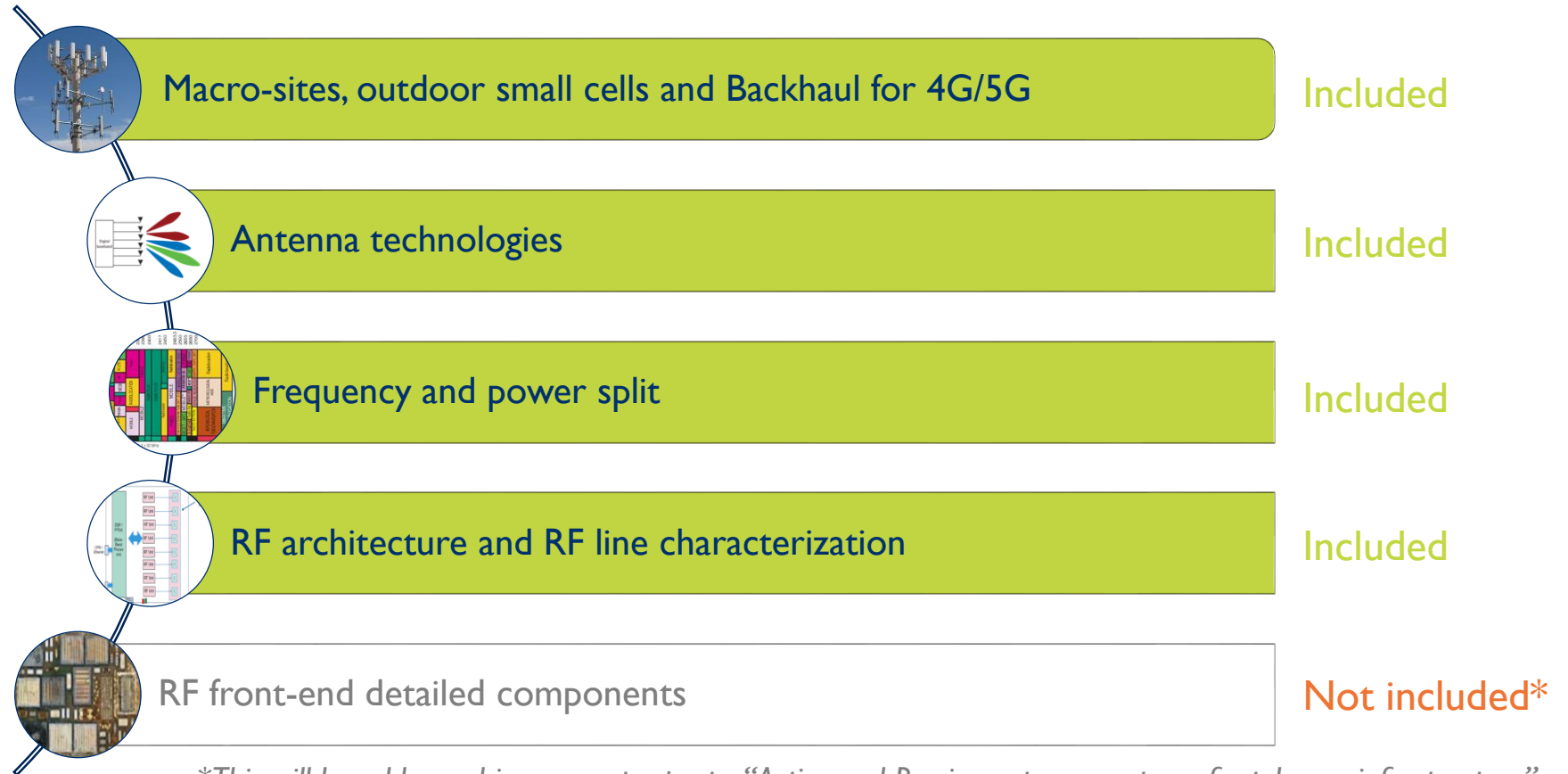
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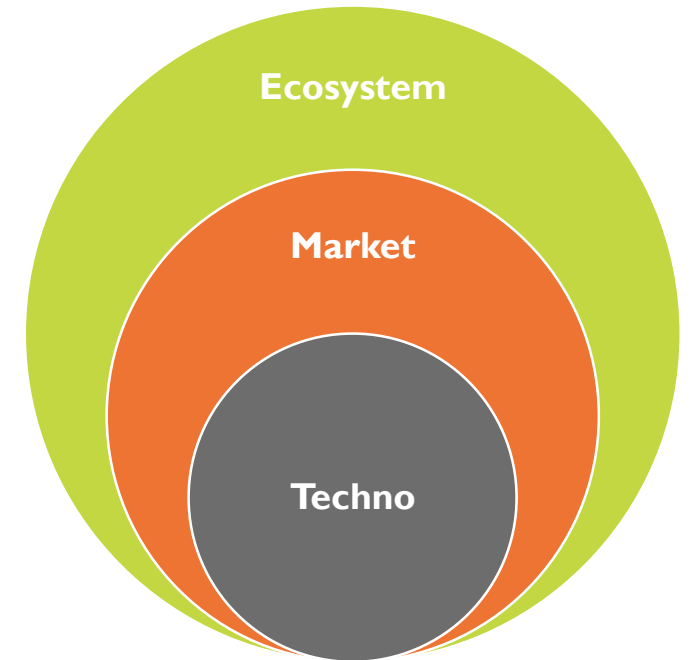
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The report covers the global RF infrastructure market for 4G/5G down to RF lines level.



**This will be addressed in our next report : “Active and Passive antenna systems for telecom infrastructure”*

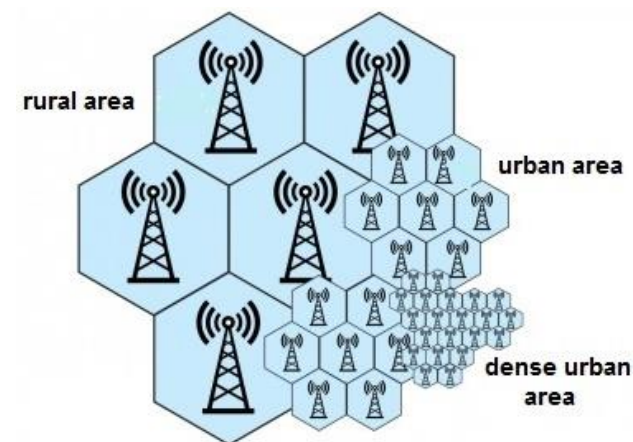
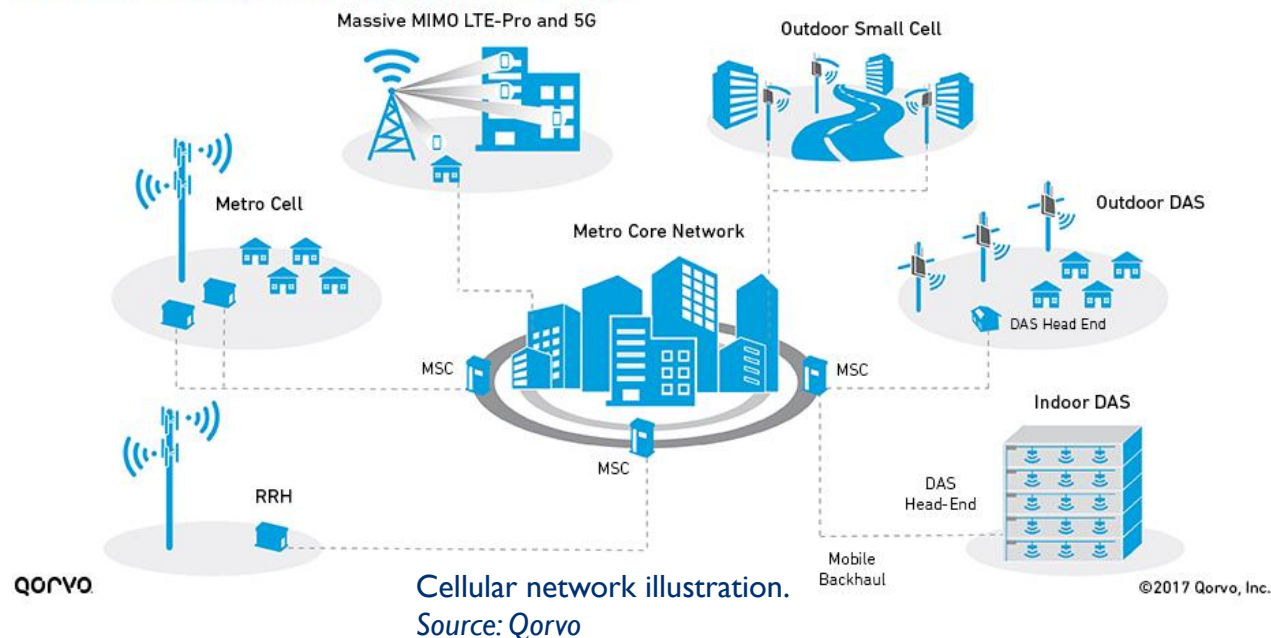
- Provide an overview of the 4G/5G telecom infrastructure market
- Analyze geographical trends regarding 5G adoption and antenna technology / frequency band choices
- Outline market evolution from macro antenna systems to individual RF lines, split in frequency and power level
- Offer a comprehensive approach of the technologies encompassing 5G, from modulation to signal beamforming
- Explain the difference between antenna systems and their role in 5G component characteristics definitions



DEFINITIONS

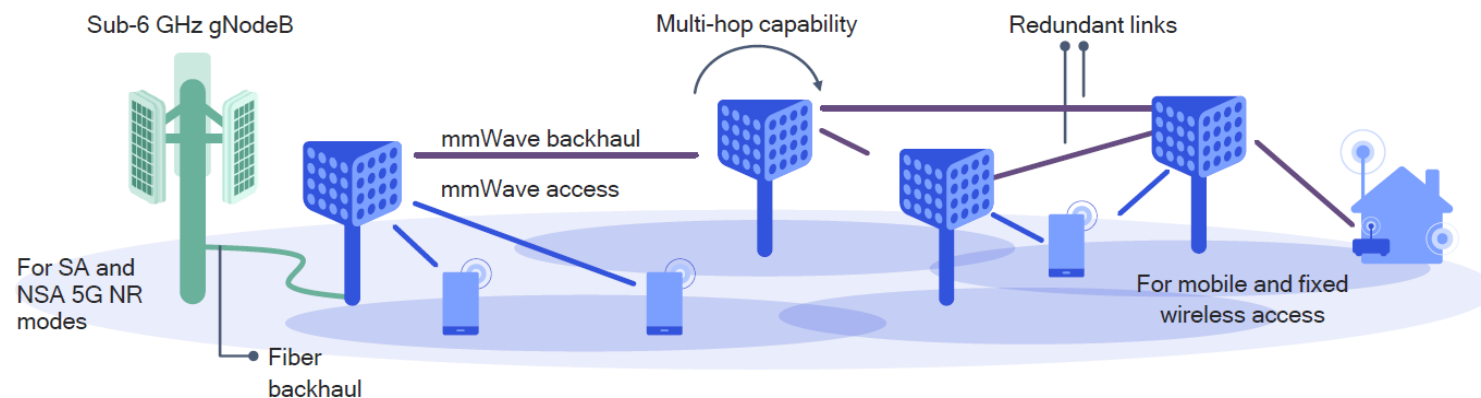
What is the “cellular network”?

Wireless Infrastructure: A Heterogeneous Network



Simplified vision of macro-site coverage
Source: Tnuda Center

5G sub-6 macro cell and mmWave small cells network illustration.
Source: Qualcomm



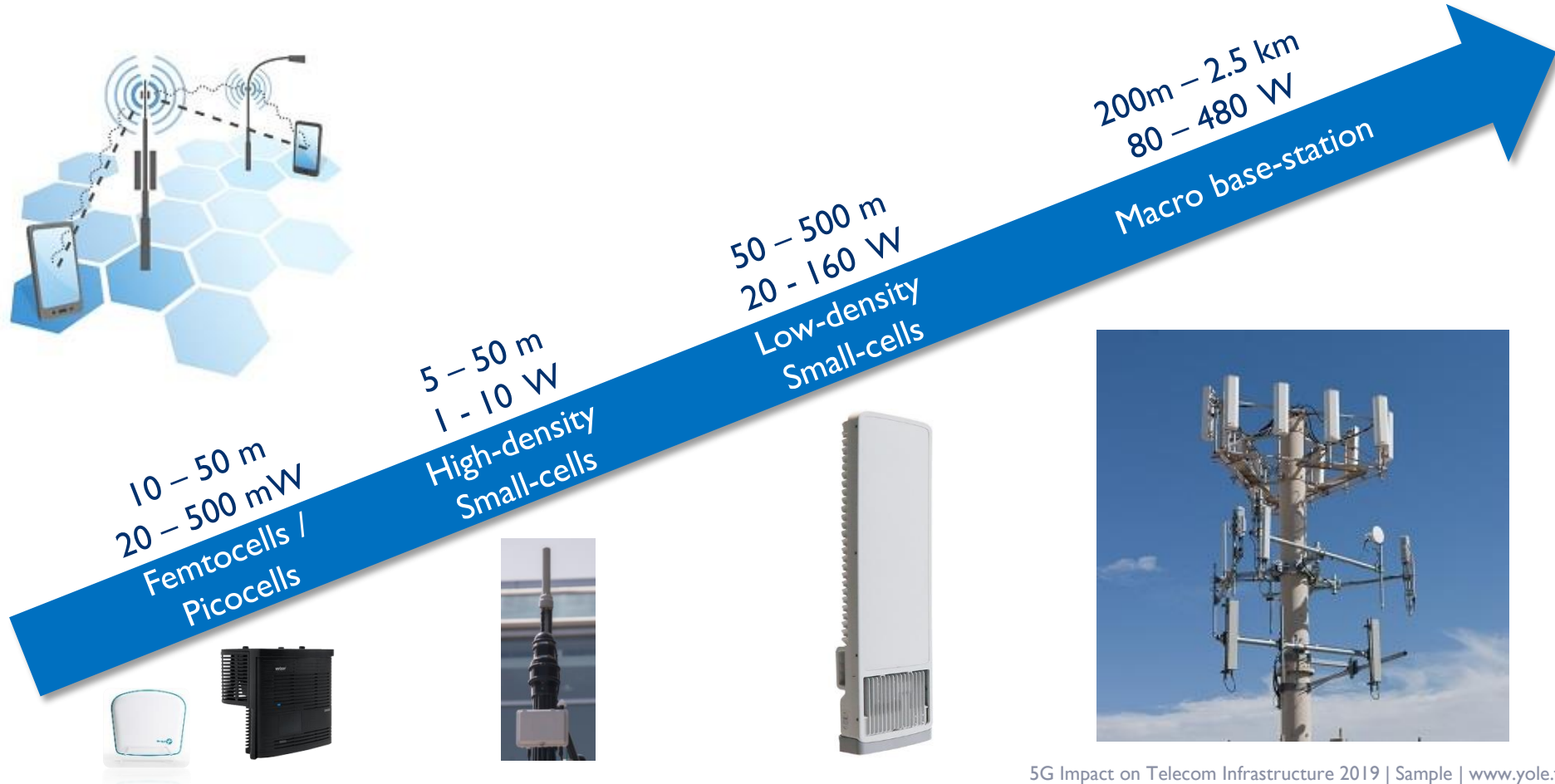
Cellular networks are the collection of cell areas of different sizes.

DEFINITIONS

Cellular network structure

- Cellular networks get their name from the arrangement of the covered zones into cells. Cells can be any shape or any size, but depending on the geographical topology of the cell, the base station will emit more or less power.
- One trend is at densifying the network using small cells, while upgrading already existing macro-sites.

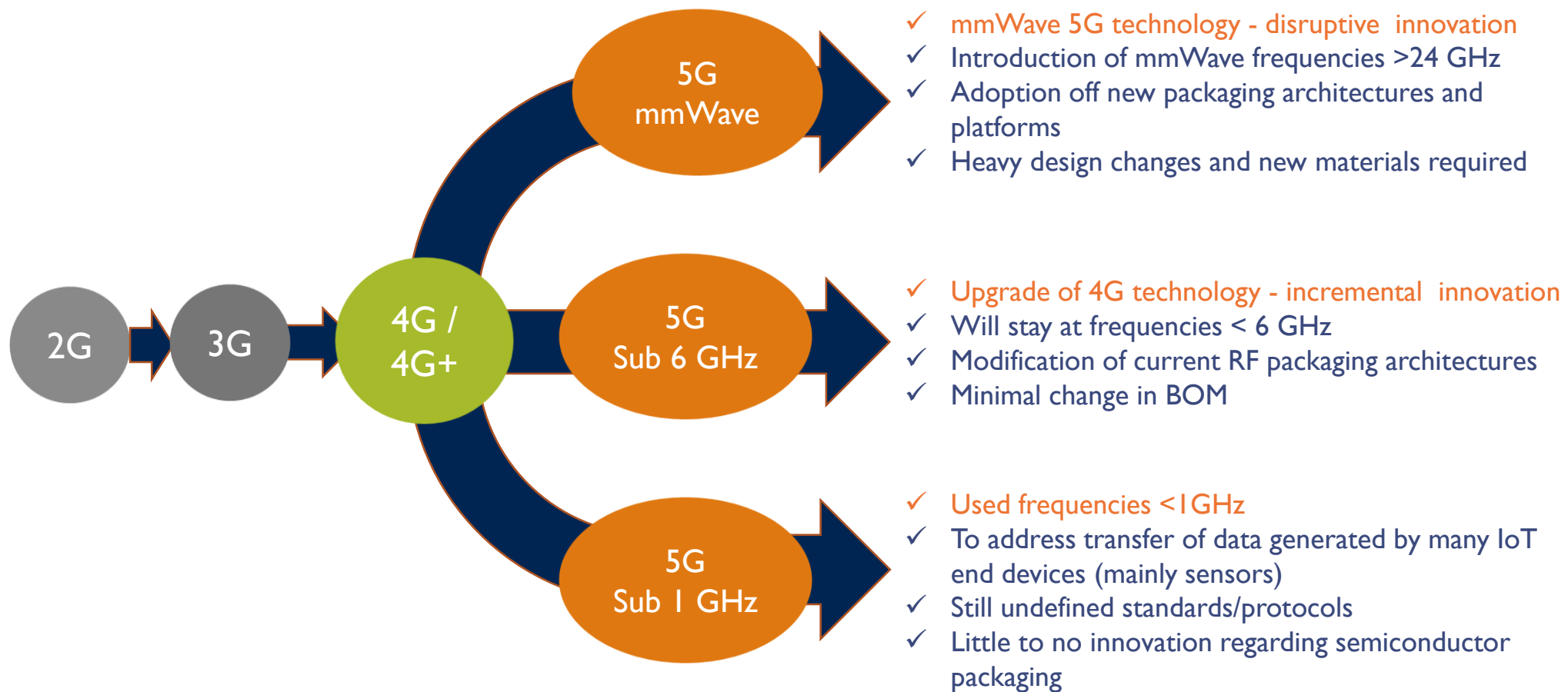
Different cell types with structures emitting at different power levels are used in a cellular network.



DEFINITIONS

Three frequency ranges to address 5G

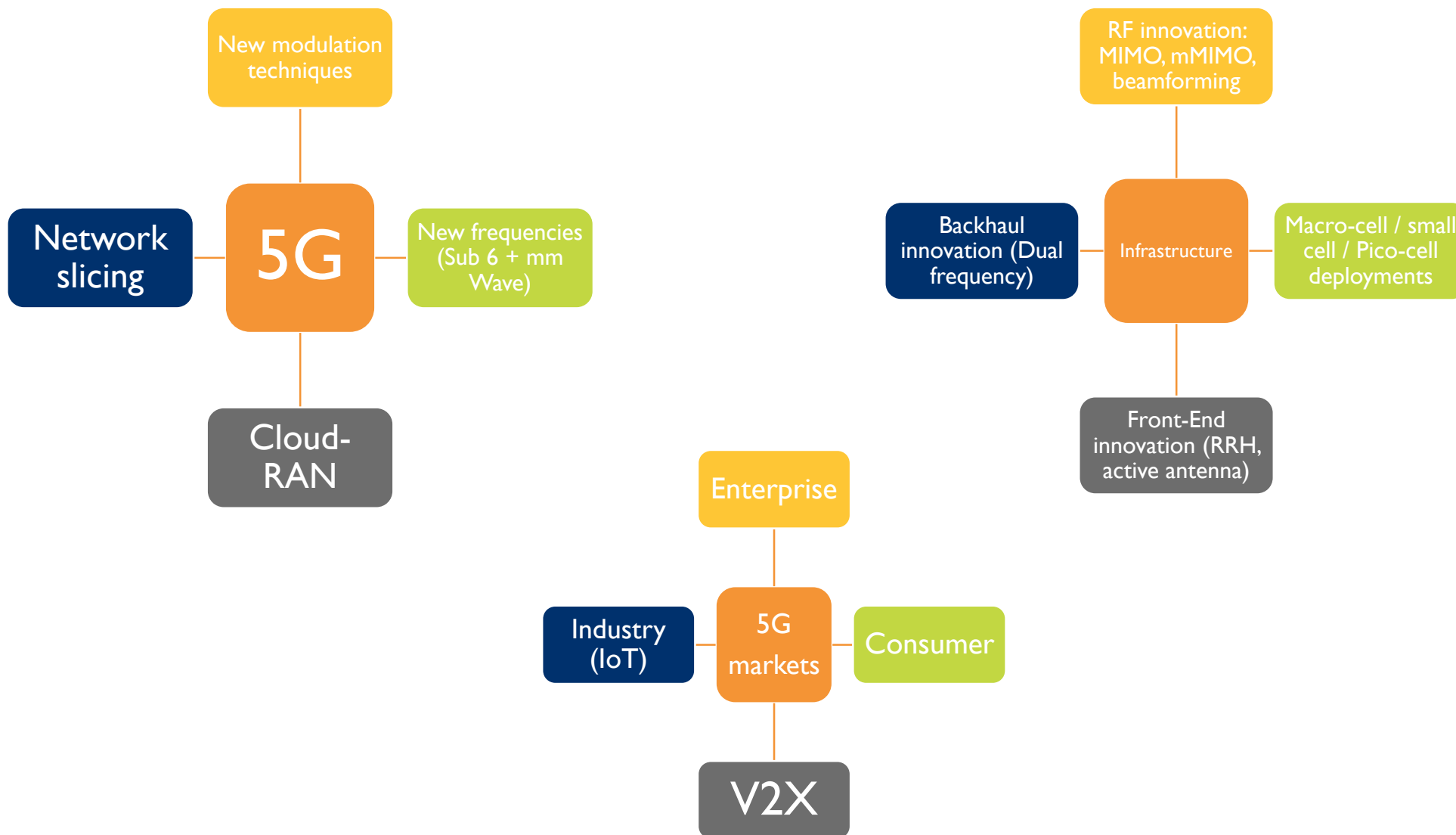
Advances in 4G in sub 6 GHz range (labeled 5G Sub 6 GHz) will go in parallel with 5G mmWave developments.



DEFINITIONS

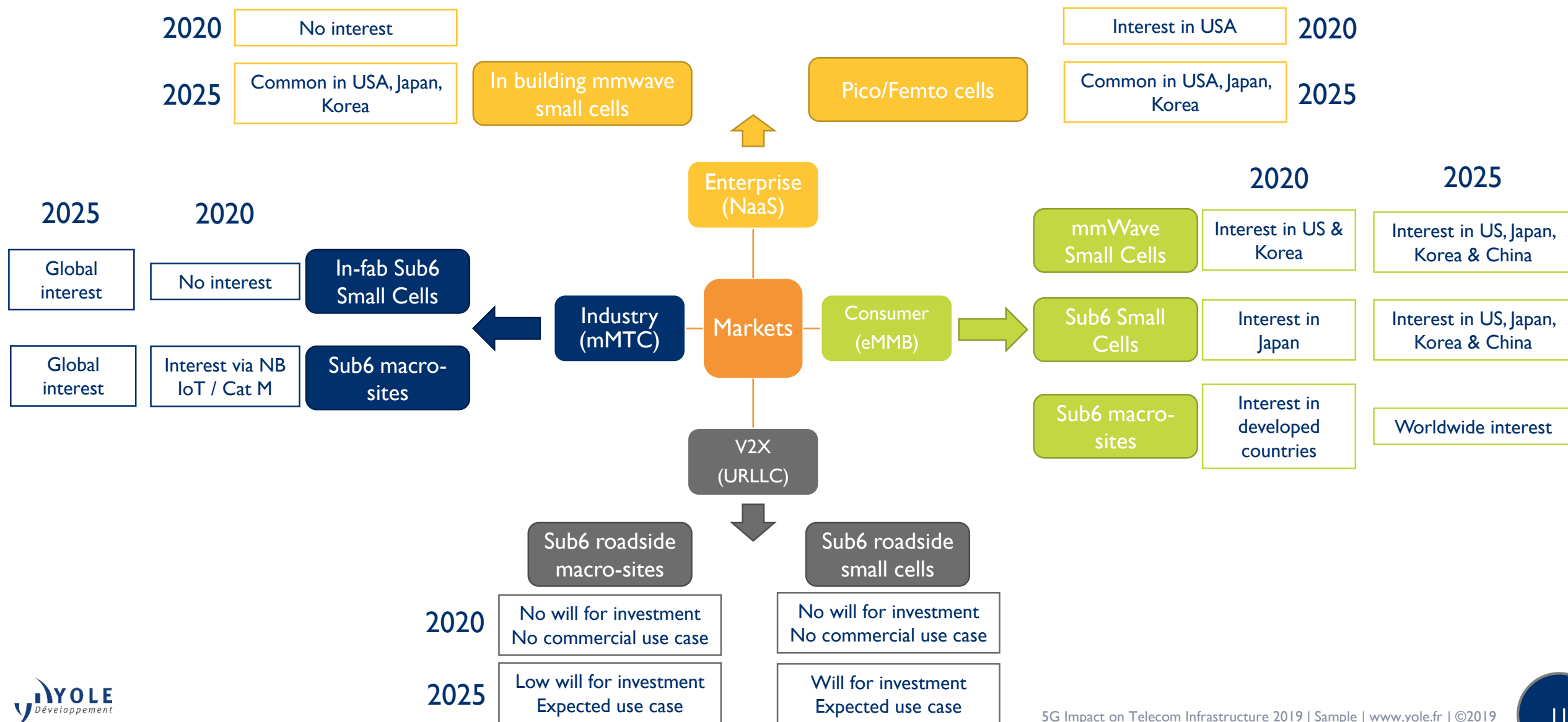
How does 5G relate to infrastructure?

5G for infrastructure is divided in three different blocks.



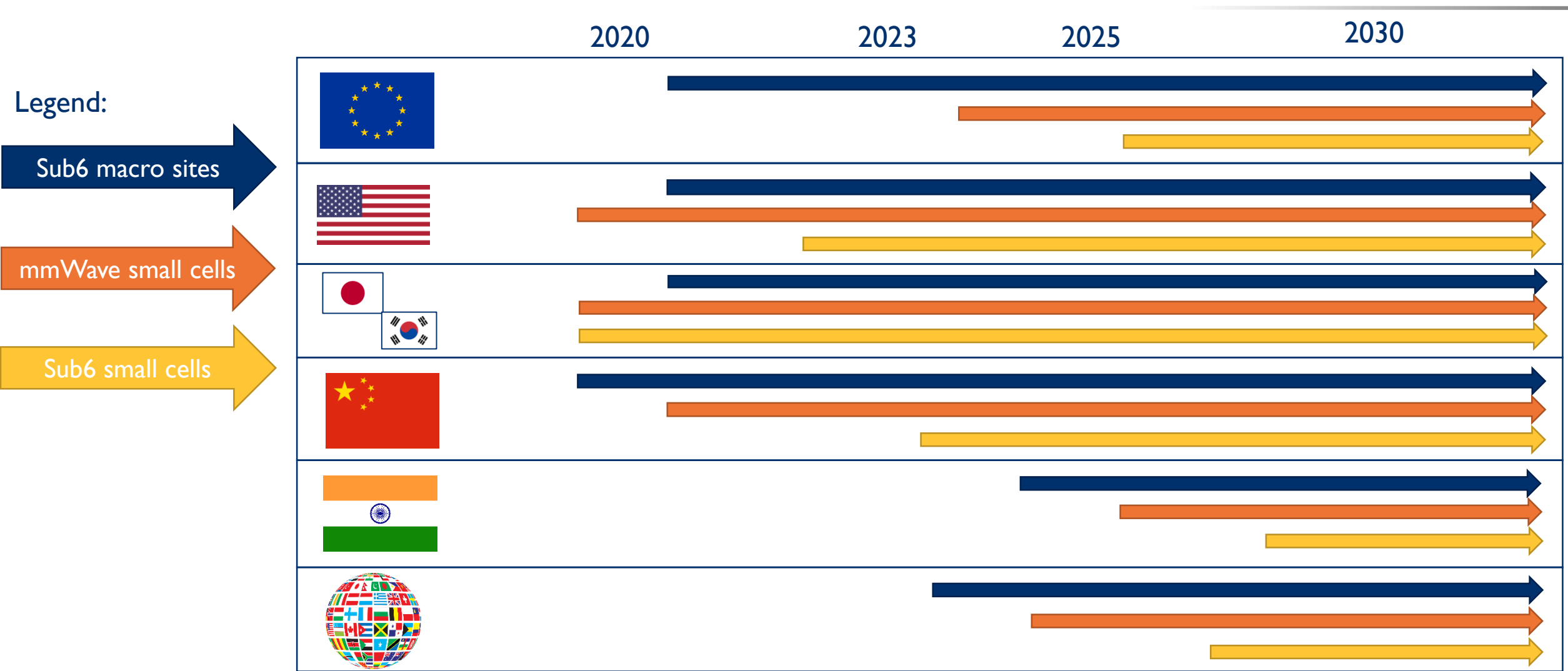
MARKET TRENDS

What are 5G commercial use cases?



MARKET TRENDS

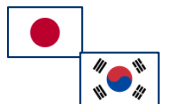
5G deployment region by region



MARKET TRENDS

Infrastructure provider positioning

Infrastructure players positioning depends on technology and on location.



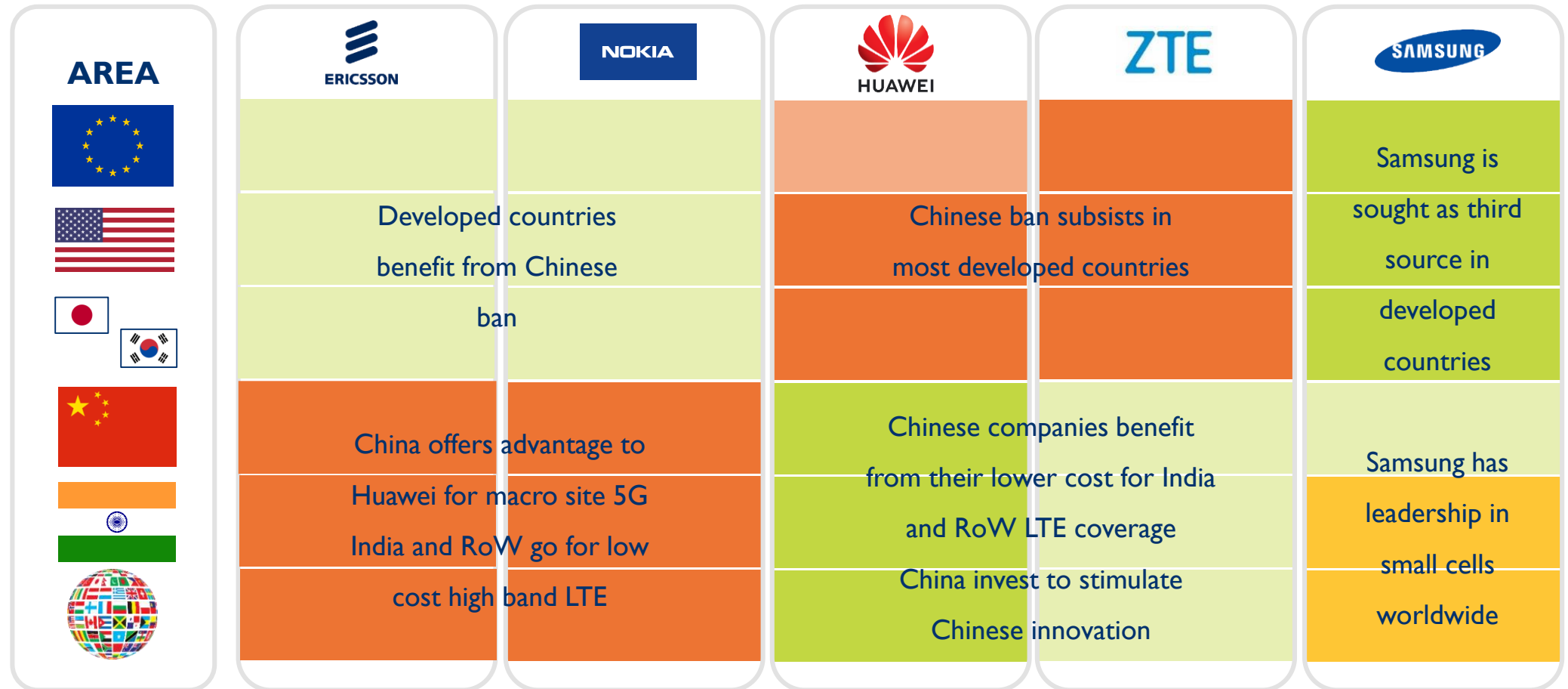
Volumes and interest level



MARKET SHARES & SUPPLY CHAIN

Telecom infrastructure players market evolution.

Huawei will compensate Chinese ban losses by LTE deployments in developing markets.
Samsung will rise as direct competitor.



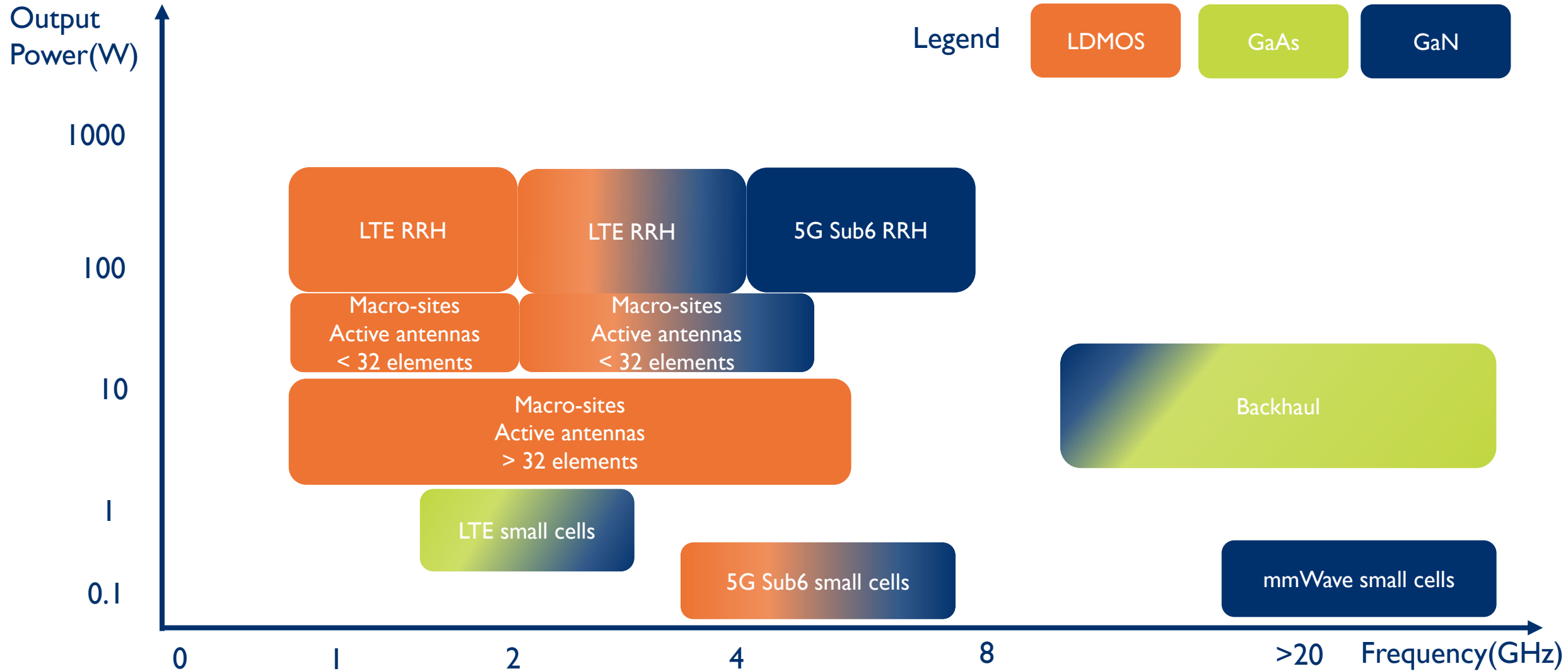
2018-2025 global
market share evolution



Market penetration
evolution

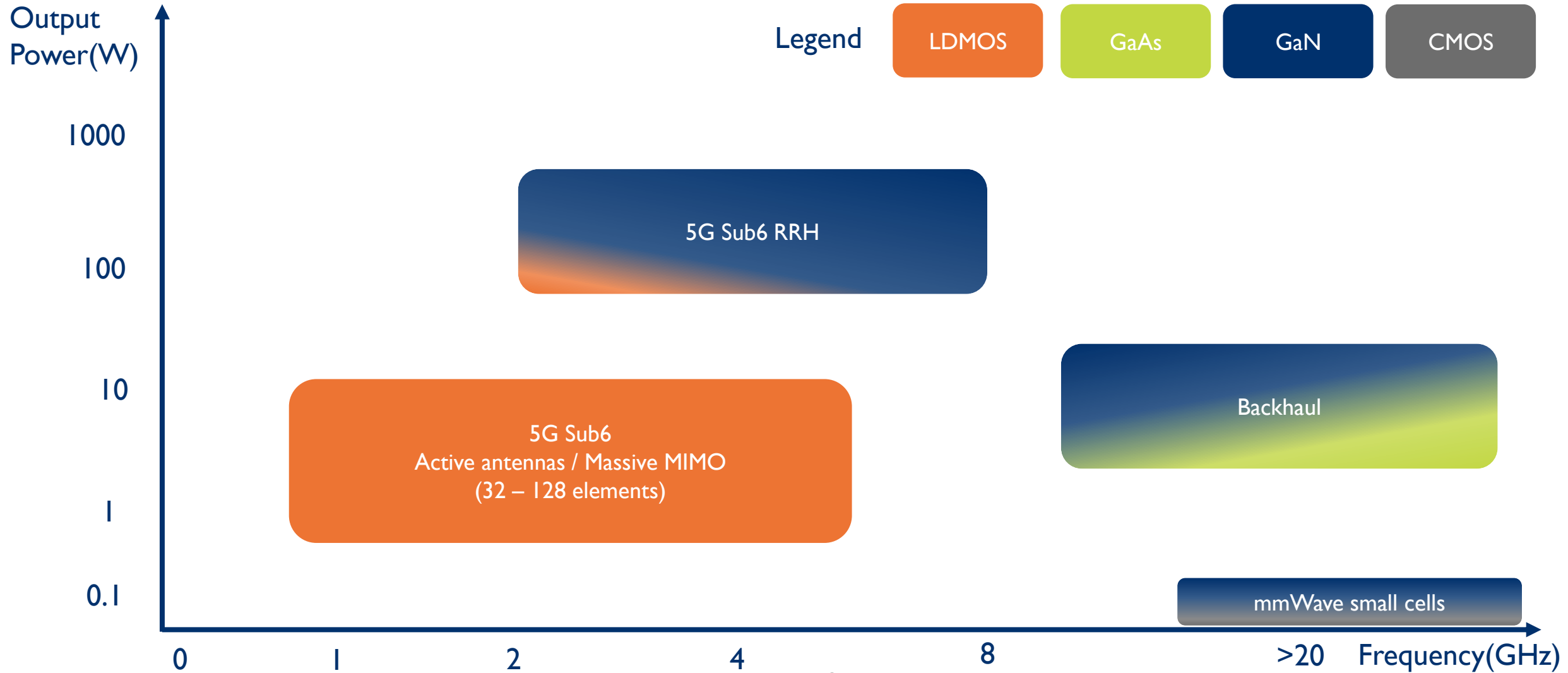


Power vs. Frequency characteristics 2019



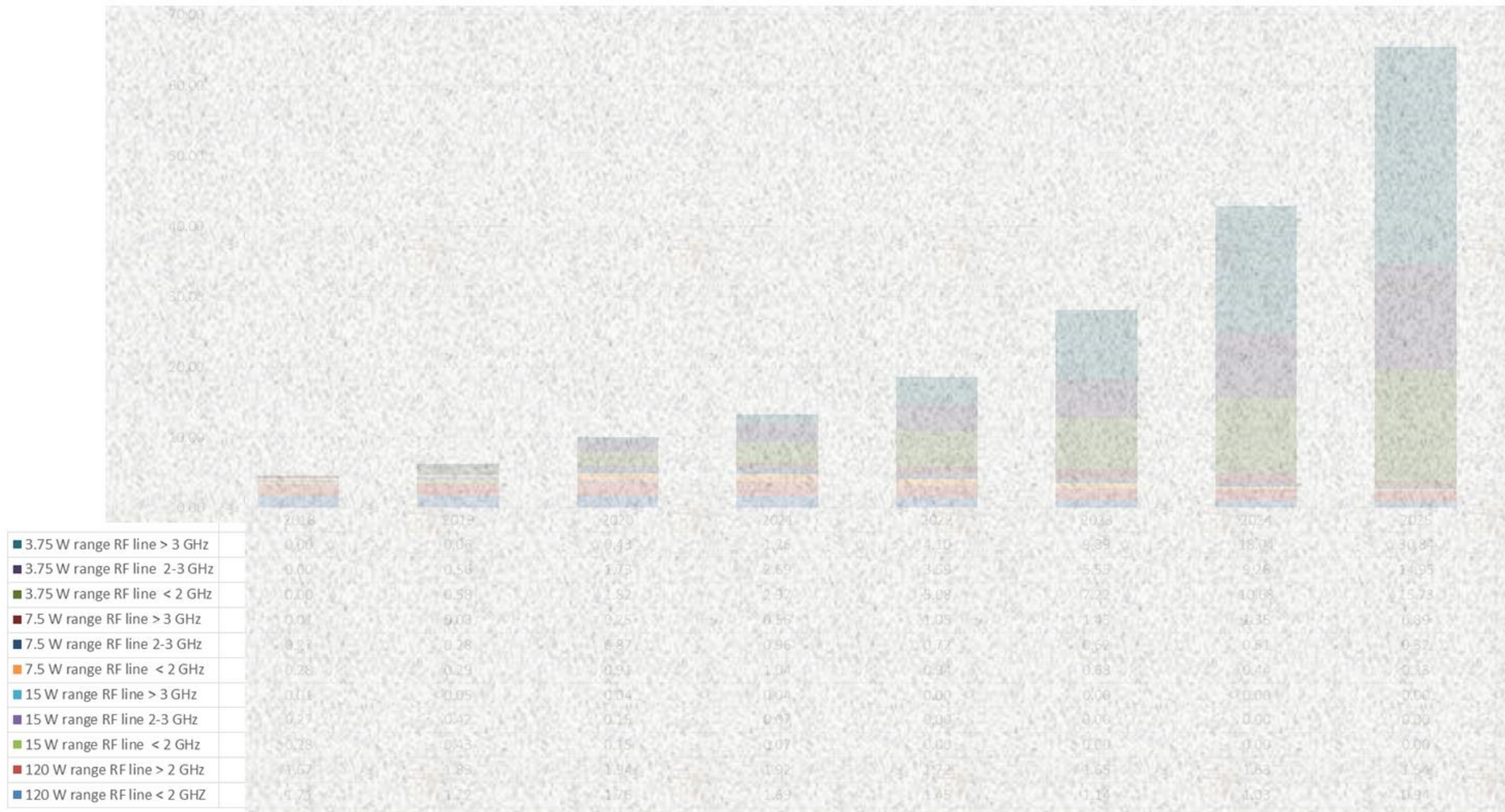
Source:Yole

Power vs. Frequency characteristics 2025

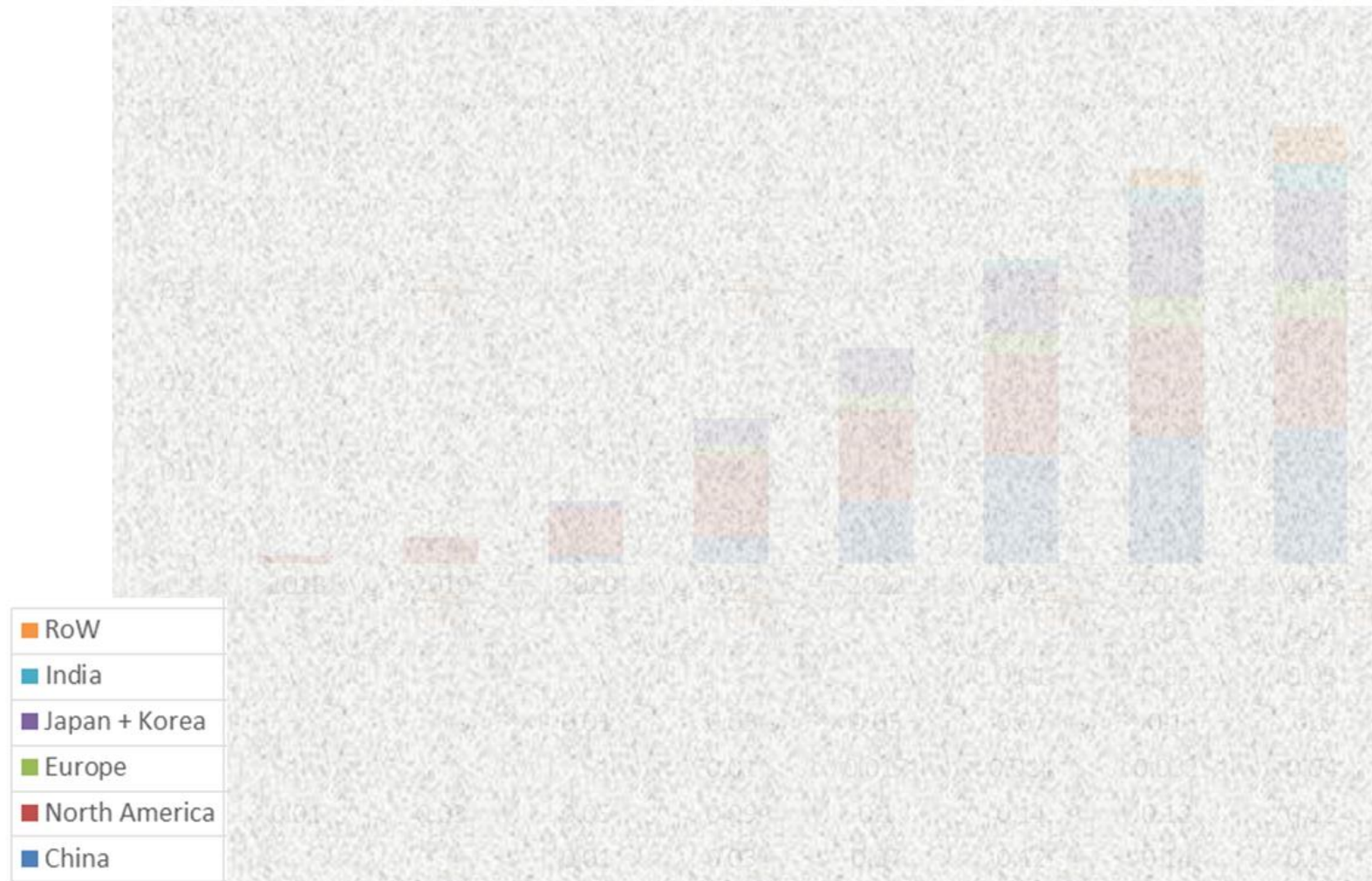


Source:Yole

4G/5G macro-site antenna systems TX RF lines market volumes 2018-2025 by power level and frequency in M Units.



5G small cells mmWave antenna systems market volumes
2018-2025 in M Units by region.



YOLE GROUP OF COMPANY RELATED REPORTS

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Radar and Wireless for Automotive: Market and Technology Trends 2019



RF GaN Market: Applications, Players, Technology and Substrates 2019



Antenna for 5G and 5G-related Applications 2019 - Patent Landscape Analysis



5G Impact on RF Front-End Modules & Connectivity for Cellphones 2018

5G'S IMPACT ON TELECOM INFRASTRUCTURE 2019

Market & Technology Report - June 2019

Network evolution and 5G implementation are driving massive structural changes.

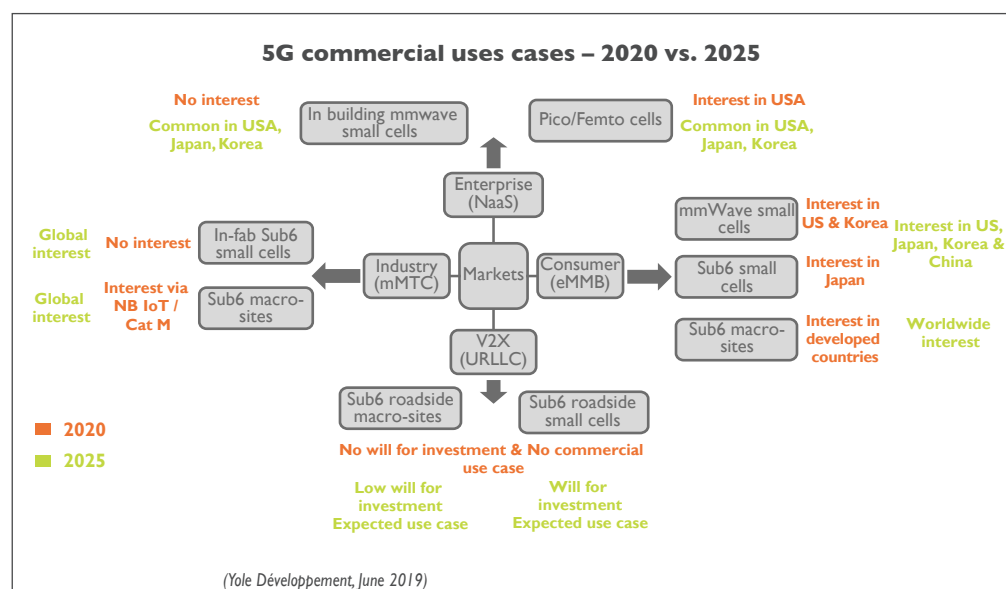
REPORT KEY FEATURES

- Infrastructure market split by antenna system technology, by region
- Volumes of infrastructure RF line products, characterized by power level and frequency
- Key infrastructure players positioning
- Regional market trends for 5G implementation
- Technological comprehensive description of 4G/5G networks
- Explanation of 5G market trends and market interests

5G – AN ATTEMPT TO ENLARGE A STEADY, CONSOLIDATED MARKET

The telecom infrastructure market has not moved much in the past decade in terms of the value of operators' investments. Customer pricing also keeps decreasing, and building new infrastructure keeps showing smaller and smaller returns on investments for telecom operators. In this context, an attempt to create new markets and enlarge operators' reach to customers beyond mobile phones created 5G. By modifying the network to allow for ultra-fast, ultra-reliable and ultra-flexible communications, 5G's aim is to expand to new opportunities, such as enterprise-

owned networks, industrial automation or road safety. Nevertheless this is a bet on the future, and actual infrastructure market growth is not expected in the foreseeable future at site level. Yole Développement (Yole) expects the global market to remain steady and oscillate between 1.7 and 2 million macro site antenna systems shipped a year between 2018 and 2025. On the other hand, a new type of smaller infrastructure should still see notable growth. That infrastructure is referred to as 'small cells', and should reach shipment levels in the eight hundred thousands of units by 2025.



A CONSOLIDATED MARKET, RECENTLY DESTABILIZED

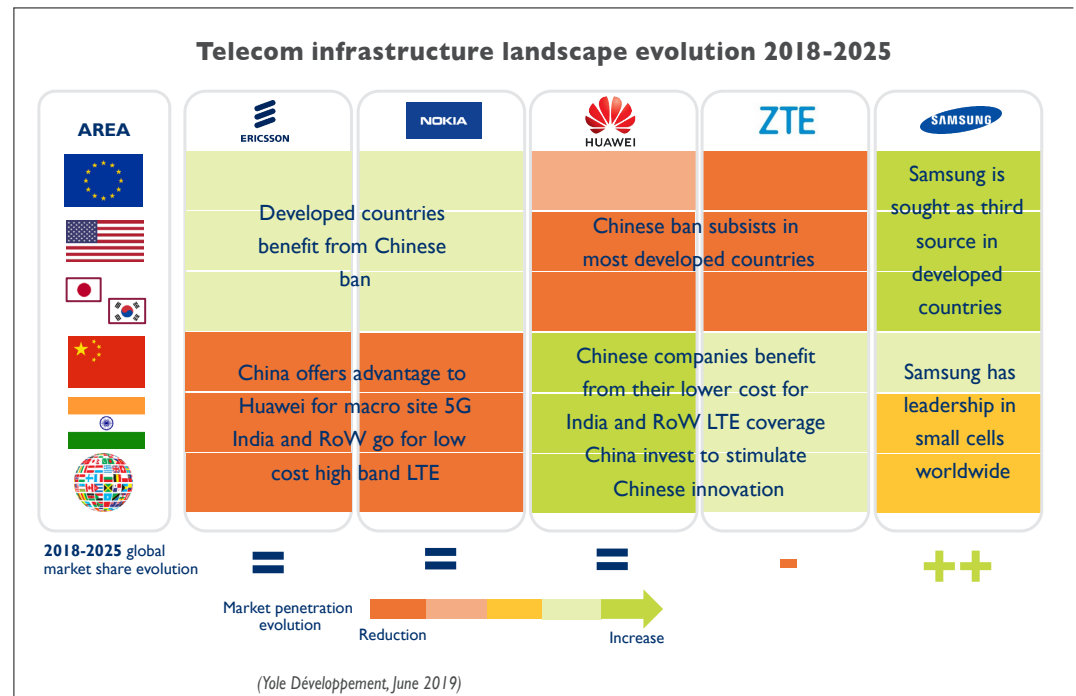
In the infrastructure market, consolidation has already occurred and it is dominated by only a few players, namely Huawei, Ericsson, Nokia, ZTE and Samsung. But even though no new entrant is expected, some major changes are happening. They are due to recent geopolitical events, such as Huawei's ban in the US, and the low interest in 5G in developing countries. The players will remain the same, but their market share will evolve. Yole's analysts expect Samsung to sharply increase its global presence thanks to both its expertise in small cell developments and the ban on Chinese technology in developed countries. Indeed, one of the outcomes is that operators will need Samsung to increase its presence, as dealing with only

two infrastructure suppliers, namely Nokia and Ericsson, represents a sourcing risk.

The global landscape at network level will not move much before 2025. But it will definitely change in terms of technology and antenna systems, thus completely restructuring the radio frequency (RF) component industry. On one hand frequencies are going from less than 3 GHz to up to 6 GHz for macro deployments, while small cells exploit millimetre-wavelengths (mm-waves). Meanwhile RF line power levels in front-ends will decrease from a few hundred watts to down to a few watts in macro site antenna systems, thanks to massive MIMO and active antenna

systems implementation. With these new higher frequencies, the GaN players like Sumitomo Electric Device Innovations, Cree, Qorvo and RFHIC should see growing interest in their products. Also, very low power levels are required for future small cell

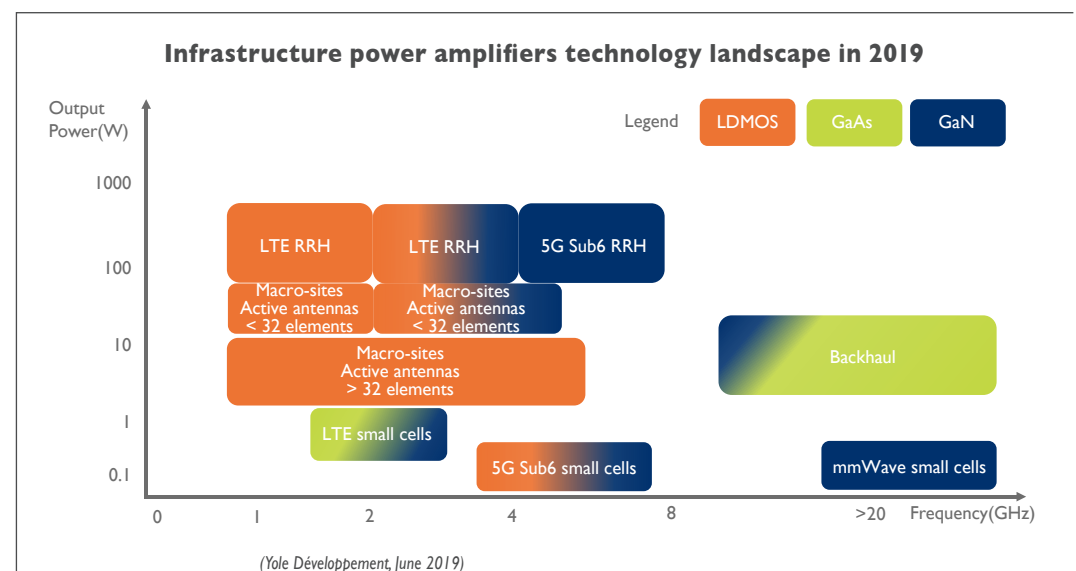
developments, in the hundreds of mW per RF line in small cells. Giants from the mobile RF front end industry like Broadcom and Skyworks are expected to come and compete with infrastructure players in the longer term.



RF FRONT END CHARACTERISTICS ARE DRIVEN BY ANTENNA SYSTEM TECHNOLOGY EVOLUTION

The most common antenna system today is the combination of a remote radio head (RRH) with a passive antenna array for signal transmission. This combination uses high power components, with a few RF lines per system handling up to a few hundred watts of RF power each. These devices are expected to remain the main approach for coverage deployments in developing countries and China, or in rural areas. On the other hand, in zones where network improvement is sought instead of higher coverage, the trend is for new generations of antenna systems that include beamforming and multiple streams. These new antenna technologies are active

antennas, meaning that each and every single antenna element will have a dedicated low power RF front-end feeding it. This is a drastic change of approach as it means that instead of a few RF feeds of about a hundred watts, the system will see up to 64 feeds of a few watts each. This changes the component types, their substrates, their form factors, their key characteristics, and so on. Small cells and mm waves will also bring innovations, with the need for components working on frequency bands in the tens of GHz, and at power levels down to a hundred mWs. This is creating a completely new market, and new opportunities for new entrants.



REPORT OBJECTIVES

- Provide an overview of the 4G/5G telecom infrastructure market
- Analyze geographical trends regarding 5G adoption and antenna technology/frequency band choices
- Outline market evolution from macro antenna systems to individual RF lines, split in frequency and power level
- Offer a comprehensive approach of the technologies encompassing 5G, from modulation to signal beamforming
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Antoine Bonnabel works as a Technology & Market Analyst for the Power & Wireless team of Yole Développement (Yole). He carries out technical, marketing and strategic analyses focused on RF devices, related technologies and markets. Prior to Yole, Antoine was R&D Program Manager for DelfiMEMS (FR), a company specializing in RF switches and supervised Intellectual Property and Business Intelligence activities of this company. In addition, he also has co-authored several market reports and is co-inventor of three patents in RF MEMS design. Antoine holds a M.Sc. in Microelectronics from Grenoble Institute of Technologies (France) and a M.Sc. in Management from Grenoble Graduate School of Business (France).



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The "More than Moore" market research, technology and strategy consulting company Yole Développement, along with its partners System Plus Consulting, PISEO and KnowMade, support industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to grow their business.

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From Technologies to Market

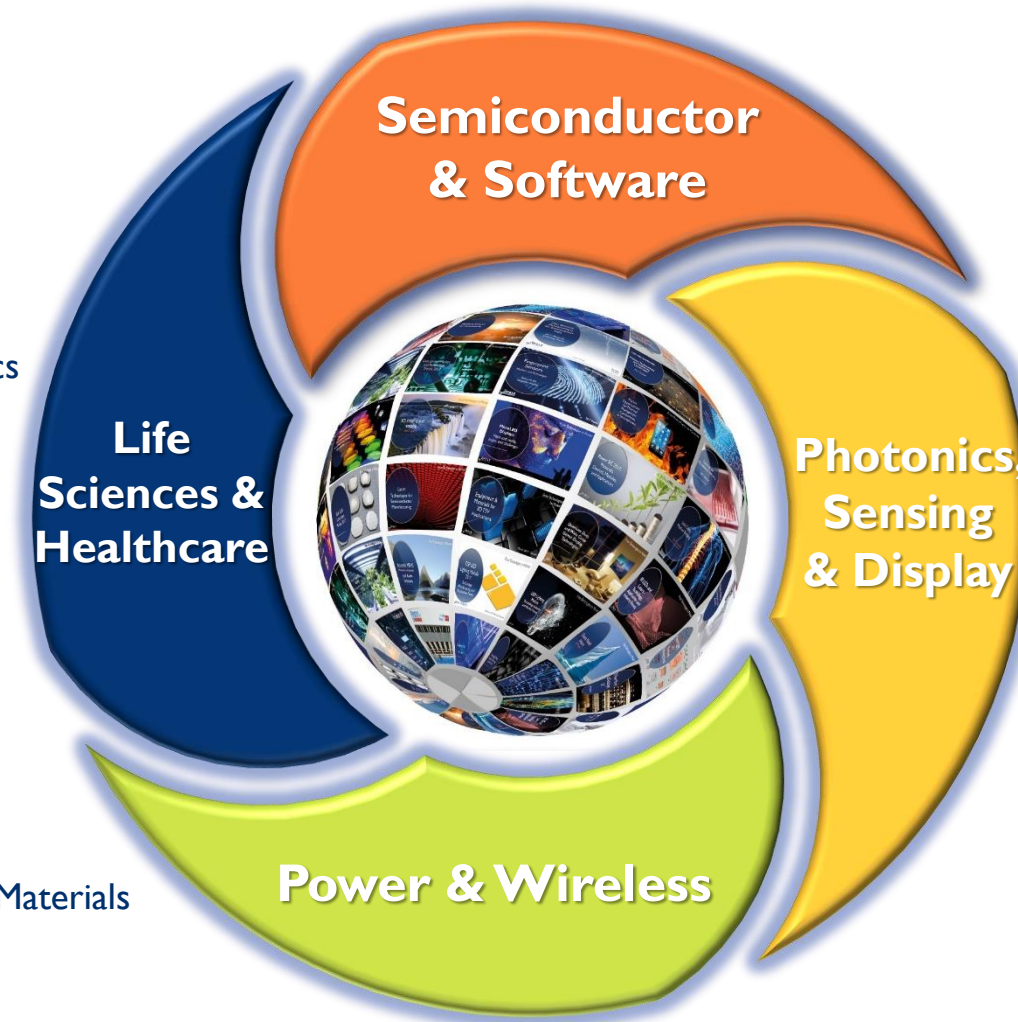


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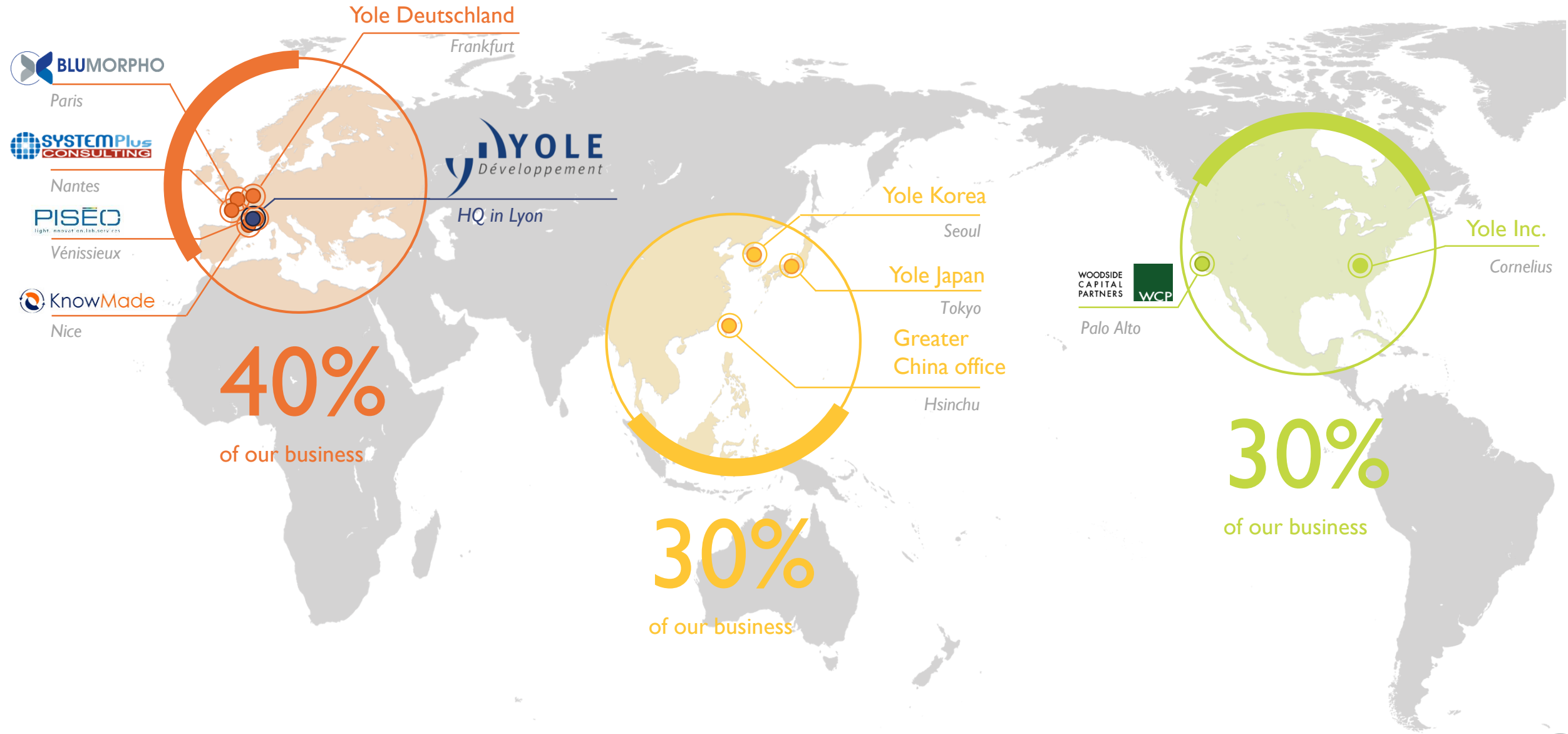
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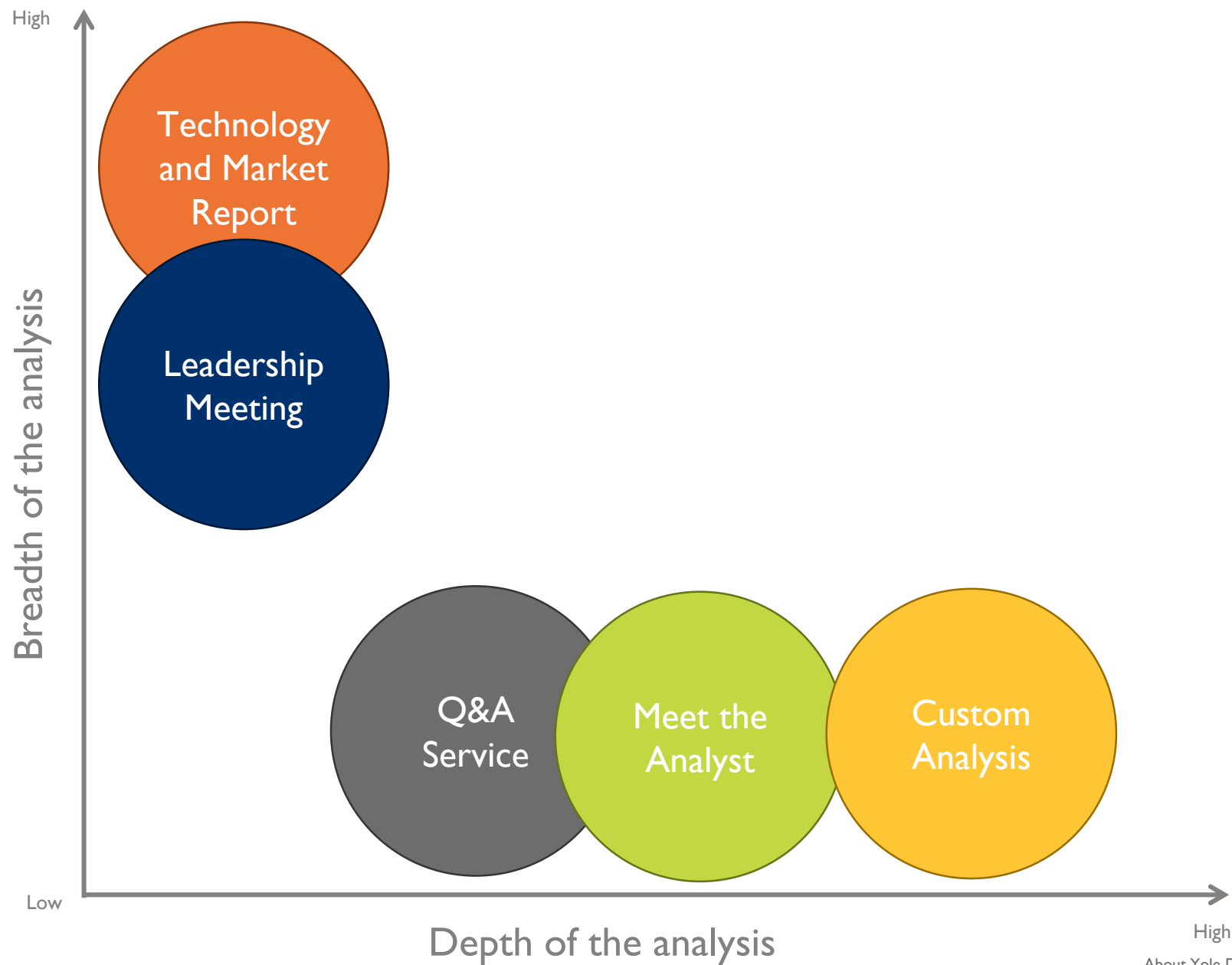


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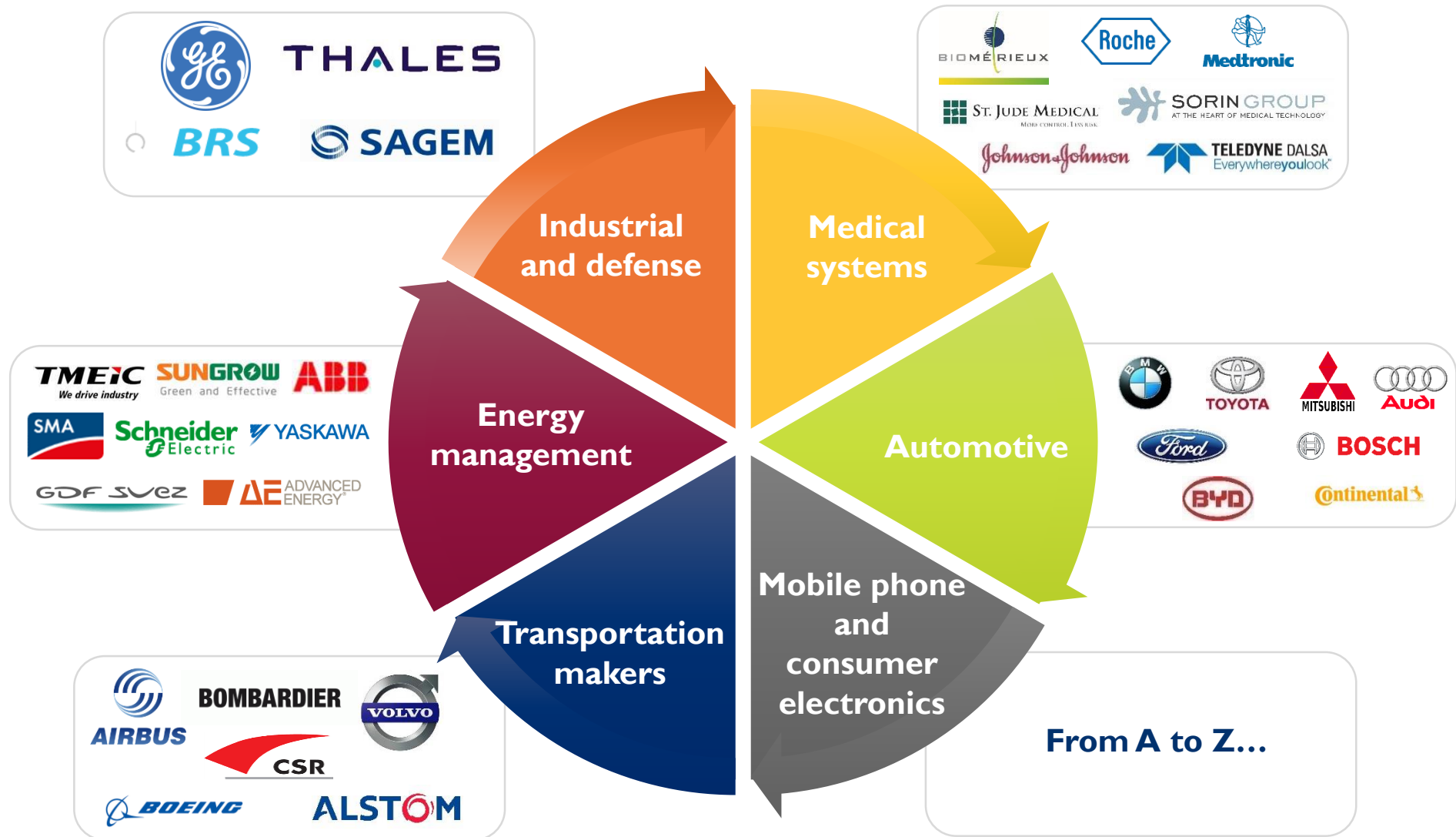
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Reverse Costing® – Structure, Process and Cost Analysis – by System Plus Consulting

The Reverse Costing® report developed by System Plus Consulting provides full teardowns, including detailed photos, precise measurements, material analyses, manufacturing process flows, supply chain evaluations, manufacturing cost analyses and selling price estimations. The reports listed below are comparisons of several analyzed components from System Plus Consulting. More reports are however available, and over 60 reports will be released in 2019. The complete list is available at www.systemplus.fr.

Patent Reports – by KnowMade

More than describing the status of the IP situation, these analyses provide a missing link between patented technologies and market, technological and business trends. They offer an understanding of the competitive landscape and technology developments from a patent perspective. They include key insights into key IP players, key patents and future technology trends. For 2019 KnowMade will release over 15 reports.

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-  Telecom & Infrastructure
-  Defense & Aerospace

Linked reports are dealing with the same topic to provide a more detailed analysis.

OUR 2019 REPORTS COLLECTION (1/5)

18 fields of excellence combined with six markets to provide a complete picture of your industry landscape

MEMS & SENSORS

○ MARKET AND TECHNOLOGY REPORT

- Status of the MEMS Industry 2019 - Update     
- Status of the Audio Industry 2019 - New 
- Uncooled Infrared Imagers and Detectors 2019 – Update  
- Consumer Biometrics: Technologies and Market Trends 2018 
- MEMS Pressure Sensor Market and Technologies 2018   
- Gas & Particle Sensors 2018   

○ STRUCTURE, PROCESS & COST REPORT

- MEMS & Sensors Comparison 2019   
- MEMS Pressure Sensor Comparison 2018   
- Particle Sensors Comparison 2019
- Miniaturized Gas Sensors Comparison 2018 

○ PATENT REPORT

- MEMS Foundry Business Portfolio 2019 - New 
- Miniaturized Gas Sensors 2019 - New 

PHOTONIC AND OPTOELECTRONICS

○ MARKET AND TECHNOLOGY REPORT

- Silicon Photonics and Photonic Integrated Circuits 2019     
- LiDARs for Automotive and Industrial Applications 2019 - Update  

○ PATENT REPORT

- Silicon Photonics for Data Centers: Optical Transceiver 2019 - New 
- LiDAR for Automotive 2018 

RF DEVICES AND TECHNOLOGIES

○ MARKET AND TECHNOLOGY REPORT

- RF GaN Market: Applications, Players, Technology, and Substrates 2019 - Update     
- 5G's Impact on RF Front-End Module and Connectivity for Cell Phones 2019 – Update 
- 5G Impact on Telecom Infrastructure 2019 - New 
- Radar and Wireless for Automotive: Market and Technology Trends 2019 - Update 
- Advanced RF Antenna Market & Technology 2019 - New     
- RF Standards and Technologies for Connected Objects 2018    

○ STRUCTURE, PROCESS & COST REPORT

- RF Front-End Module Comparison 2019 - Update 
- Automotive Radar RF Chipset Comparison 2018 

○ PATENT REPORT

- Antenna for 5G Wireless Communications 2019 - New 
- RF Front End Modules for Cellphones 2018 
- RF Filter for 5G Wireless Communications: Materials and Technologies 2019   
- RF GaN 2019 – Patent Landscape Analysis   

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IMAGING

○ MARKET AND TECHNOLOGY REPORT

- Status of the CIS Industry 2019: Technology and Foundry Business - Update      
- Imaging for Automotive 2019 - Update 
- Neuromorphic Technologies for Sensing 2019 - Update  
- Status of the CCM and WLO Industry 2019 – Update      
- 3D Imaging & Sensing 2018  
- Machine Vision for Industry and Automation 2018 
- Sensors for Robotic Vehicles 2018 

○ STRUCTURE, PROCESS & COST REPORT

- Compact Camera Modules Comparison 2019 
- CMOS Image Sensors Comparison 2019 

○ PATENT REPORT

- Facial & Gesture Recognition Technologies in Mobile Devices 2019 - New 
- Apple iPhone X Proximity Sensor & Flood Illuminator 2018 

MEDICAL IMAGING AND BIOPHOTONICS

○ MARKET AND TECHNOLOGY REPORT

- X-Ray Detectors for Medical, Industrial and Security Applications 2019- New   
- Microscopy Life Science Cameras: Market and Technology Analysis 2019 
- Ultrasound technologies for Medical, Industrial and Consumer Applications 2018   

○ PATENT REPORT

- Optical Coherence Tomography Medical Imaging 2018 

MICROFLUIDICS

○ MARKET AND TECHNOLOGY REPORT

- Status of the Microfluidics Industry 2019 - Update  
- Next Generation Sequencing & DNA Synthesis - Technology, Consumables Manufacturing and Market Trends 2019 - New 
- Organ-on-a-Chip Market & Technology Landscape 2019 - Update  
- Point-of-Need Testing Application of Microfluidic Technologies 2018  
- Liquid Biopsy: from Isolation to Downstream Applications 2018 
- Chinese Microfluidics Industry 2018 

○ PATENT REPORT

- Microfluidic Manufacturing Technologies 2019 – New 
- Nanopore Sequencing 2019 - New  

INKJET AND ACCURATE DISPENSING

○ MARKET AND TECHNOLOGY REPORT

- Inkjet Printheads - Dispensing Technologies & Market Landscape 2019 - Update   
- Emerging Printing Technologies for Microsystem Manufacturing 2019 - New      
- Piezoelectric Devices from Bulk to Thin Film 2019 - New     
- Inkjet Functional and Additive Manufacturing for Electronics 2018   

○ STRUCTURE, PROCESS & COST REPORT

- Piezoelectric Materials from Bulk to Thin Film Comparison 2019   

OUR 2019 REPORTS COLLECTION (3/5)

18 fields of excellence combined with six markets to provide a complete picture of your industry landscape

BIOTECHNOLOGIES

○ MARKET AND TECHNOLOGY REPORT







- CRISPR-Cas9 Technology: From Lab to Industries 2018  

○ PATENT REPORT

- Personalized Medicine 2019 – New 

BIOMEMS & MEDICAL MICROSYSTEMS

○ MARKET AND TECHNOLOGY REPORT

- Medical Wearables: Market & Technology Analysis 2019 - New  
- Neurotechnologies and Brain Computer Interface 2018  
- BioMEMS & Non-Invasive Sensors: Microsystems for Life Sciences & Healthcare 2018  

○ PATENT REPORT

- 3D Cell Printing 2019 - New 
- Circulating Tumor Cells Isolation 2019 - New 

SOFTWARE AND COMPUTING

○ MARKET AND TECHNOLOGY REPORT






- Artificial Intelligence Computing For Automotive 2019 - New 
- Hardware and Software for Artificial Intelligence (AI) in Consumer Applications 2019 - Update 
- Image Signal Processor and Vision Processor Market and Technology Trends 2019     
- xPU (Processing Units) for Cryptocurrency, Blockchain, HPC and Gaming 2019 – New  

○ PATENT REPORT

- Artificial Intelligence for Medical Diagnostics - New 

MEMORY

○ MARKET AND TECHNOLOGY REPORT

- Status of the Memory Industry 2019 - New      
- MRAM Technology and Business 2019 - New      
- Emerging Non Volatile Memory 2018      

○ STRUCTURE, PROCESS & COST REPORT

- Memory Comparison 2019 

○ PATENT REPORT

- Magnetoresistive Random-Access Memory (MRAM) 2019 - New      
- 3D Non-Volatile Memory 2018      

ADVANCED PACKAGING

○ MARKET AND TECHNOLOGY REPORT

- Fan Out Packaging Technologies and Market Trends 2019 - Update      
- 3D TSV Integration and Monolithic Business Update 2019 - Update      
- Advanced RF SiP for Cellphones 2019 - Update 
- Status of Advanced Packaging Industry 2019 - Update      
- Status of Advanced Substrates 2019 - Update      
- Panel Level Packaging Trends 2019 - Update      
- Automotive Packaging 2019 - New      
- Trends in Automotive Packaging 2018 
- Thin-Film Integrated Passive Devices 2018      

○ STRUCTURE, PROCESS & COST REPORT

- Advanced RF SiP for Cellphones Comparison 2019 

OUR 2019 REPORTS COLLECTION (4/5)

18 fields of excellence combined with six markets to provide a complete picture of your industry landscape

SEMICONDUCTOR MANUFACTURING

○ MARKET AND TECHNOLOGY REPORT

- Nano Imprint Lithography 2019 - New     
- Equipment and Materials for Fan Out Packaging 2019 - Update     
- Equipment for More than Moore: Thin Film Deposition & Etching 2019 - New     
- Wafer Starts for More Than Moore Applications 2018     
- Polymeric Materials at Wafer-Level for Advanced Packaging 2018     
- Bonding and Lithography Equipment Market for More than Moore Devices 2018     

○ STRUCTURE, PROCESS & COST REPORT

- Wafer Bonding Comparison 2018  

○ PATENT REPORT

- Hybrid Bonding for 3D Stack 2019 – New     

SOLID STATE LIGHTING

○ MARKET AND TECHNOLOGY REPORT

- Status of the Solid State Light Source Industry 2019 - New     
- Edge Emitting Lasers (EELS) 2019 - New     
- Light Shaping Technologies 2019 - New     
- Automotive Advanced Front Lighting Systems 2019 - New 
- VCSELs - Technology, Industry and Market Trends 2019 - Update     
- IR LEDs and Laser Diodes – Technology, Applications, and Industry Trends 2018 
- Automotive Lighting 2018: Technology, Industry and Market Trends 
- UV LEDs - Technology, Manufacturing and Application Trends 2018 
- LiFi: Technology, Industry and Market Trends 2018 

○ STRUCTURE, PROCESS & COST REPORT
















- VCSEL Comparison 2019 

○ PATENT REPORT

- VCSELs 2018  

DISPLAY

○ MARKET AND TECHNOLOGY REPORT

- Next Generation 3D Display 2019 - New     
- Next Generation Human Machine Interaction (HMI) in Displays 2019 - New  
- Micro-and Mini-LED Displays 2019 - Update     
- Technologies And Markets for Next Generation Televisions 
- Displays & Optical Vision Systems for VR, AR & MR 2018  

○ PATENT REPORT

- MicroLED Displays : Intellectual Property Landscape 2018 

OUR 2019 REPORTS COLLECTION (5/5)







18 fields of excellence combined with six markets to provide a complete picture of your industry landscape

POWER ELECTRONICS







○ MARKET AND TECHNOLOGY REPORT

- Power SiC: Materials, Devices and Applications 2019 - Update      
- Power Electronics for EV/HEV and e-mobility: Market, Innovations and Trends 2019 - Update 
- Status of the Power Electronics Industry 2019 - Update      
- Discrete Power Packaging : Material Market and Technology Trends 2019 - New      
- Status of the Power ICs Industry 2019 - Update      
- Status of the Passive Components for the Power Electronics Industry 2019 - Update      
- Status of the Inverter Industry 2019 - Update      
- Status of the Power Module Packaging Industry 2019 - Update  
- Wireless Charging Market Expectations and Technology Trends 2018      
- Power GaN 2018: Epitaxy, Devices, Applications and Technology Trends      

○ STRUCTURE, PROCESS & COST REPORT









- Automotive Power Module Packaging Comparison 2018 
- GaN-on-Silicon Transistor Comparison 2019   
- SiC Transistor Comparison 2019  

○ PATENT REPORT

- Power SiC : Materials, Devices and Modules 2019 - New   
- Power GaN : Materials, Devices and Modules 2019 – Update   

BATTERY & ENERGY MANAGEMENT

○ MARKET AND TECHNOLOGY REPORT

- Status of the Rechargeable Li-ion Battery Industry 2019 - New      
- Li-ion Battery Packs for Automotive and Stationary Storage Applications 2019 - Update  

○ PATENT REPORT







- Battery Energy Density Increase: Materials and Emerging Technologies 2019 - New  
- Solid-State Batteries 2019 - New      
- Status of the Battery Patents 2018      

COMPOUND SEMI.

○ MARKET AND TECHNOLOGY REPORT

- Emerging Semiconductor Substrates: Market & Technology Trends 2019- New      
- Status of the Compound Semiconductor Industry 2019 - New      
- InP Materials, Devices and Applications 2019 - New      
- GaAs Wafer and Epiwafer Market: RF, Photonics, LED and PV Applications 2018      

○ PATENT REPORT

- GaN-on-Silicon Substrate: Materials, Devices and Applications 2019 - Update      

OUR 2019 MONITORS COLLECTION (1/2)

Get the most updated overview of your market to monitor your strategy

Yole Développement, System Plus Consulting and KnowMade, all part of the Yole Group of Companies, are launching a collection of 10 monitors in 2019. The monitors aim to provide updated market, technology and patent data as well dedicated quarterly analyses of the evolution in your industry over the previous 12 months. Furthermore, you can benefit from direct access to the analyst for an on-demand Q&A and discussion session regarding trend analyses, forecasts and breaking news.

Topics covered will be compact camera modules (CCMs), advanced packaging, compound semiconductors, microfluidics, batteries, RF and memory.

MARKET MONITOR by Yole Développement

A FULL PACKAGE:

The monitors will provide the evolution of the market in units, wafer area and revenues. They will also offer insights into what is driving the business and a close look at what is happening will also be covered in it.

The following deliverables will be included in the monitors:

- An Excel database with all historical and forecast data
 - A PDF slide deck with graphs and comments/analyses covering the expected evolutions
- **ADVANCED PACKAGING – NEW**
This monitor will provide the evolution of the advanced packaging platforms. It will cover Fan-Out Wafer Level Packaging (WLP), Fan-Out Panel Level Packaging (PLP), Wafer-Level Chip Scale Packaging (WLCSP), Flip Chip packaging platforms, and 2.5D and 3D Through Silicon Via (TSV) integration. *Frequency: Quarterly, starting from Q3 2019*

REVERSE TECHNOLOGY MONITOR by System Plus Consulting

- **SMARTPHONES – NEW**
To stay updated on the latest components, packaging and silicon chip choices of the smartphone makers, System Plus Consulting has created its first Smartphone Reverse Technology monitor. This year, get access to the packaging and silicon content database of at least 20 different flagship smartphones – more than five per quarter. Starting at the beginning of 2019, the monitor will include an Excel database report for each phone and a quarterly comparison.

- **COMPOUND SEMI. – NEW**

This monitor will describe how the compound semiconductor industry is evolving. It will offer a close look at GaAs, InP, SiC, GaN and other compounds of interest providing wafer volumes, revenues, application breakdowns and momentum. *Frequency: Quarterly, starting from Q3 2019*

- **CAMERA MODULE – NEW**

This monitor will provide the evolution of the imaging industry, with a close look at image sensor, camera module, lens and VCM. Volumes, revenues and momentum of companies like Sony, Samsung, Omnivision and OnSemi will thus be analysed. *Frequency: Quarterly, starting from Q3 2019*

- **MEMORY – UPDATE**

For the memory industry you can have access to a quarterly monitor, as well as an additional service, a monthly pricing. Both services can be bought separately:

- DRAM Service: Including a quarterly monitor and monthly pricing.
- NAND Service: Including a quarterly monitor and monthly pricing.



Get the most updated overview of your market to monitor your strategy

PATENT MONITOR by KnowMade

A FULL PACKAGE:

Starting at the beginning of the year, the KnowMade monitors include the following deliverables:

- An Excel file including the monthly IP database of:
 - New patent applications
 - Newly granted patents
 - Expired or abandoned patents
 - Transfer of IP rights through re-assignment and licensing
 - Patent litigation and opposition
- Quarterly report including a PDF slide deck with the key facts & figures of the quarter: IP trends over the three last months, with a close look to key IP players and key patented technologies.
- **GaN for Power & RF Electronics**
Wafers and epiwafers, GaN-on-SiC, silicon, sapphire or diamond, semiconductor devices such as transistors, and diodes, devices and applications including converters, rectifiers, switches, amplifiers, filters, and Monolithic Microwave Integrated Circuits (MMICs), packaging, modules and systems.
- **GaN for Optoelectronics & Photonics**
Wafers and epiwafers, GaN-on-sapphire, SiC or silicon; semiconductor devices such as LEDs and lasers; and applications including lighting, display, visible communication, photonics, packaging, modules and systems.
- **Li-ion Batteries**
Anodes made of lithium metal, silicon, and lithium titanate (LTO); cathodes made of Lithium Iron Phosphate (LFP), Nickel-Manganese-Cobalt (NMC), Lithium Nickel Cobalt Aluminium Oxide (NCA), Lithium Nickel Metal Dioxide (LiNiMO₂), Lithium Metal Phosphate (LiMPO₄), and Lithium Metal Tetroxide (LiMO₄); electrolytes including liquid, polymer/gel, and solid inorganics; ceramic and other separators; battery cells including thin film/microbattery, flexible, cylindrical and prismatic; and battery packs and systems.
- **Post Li-ion Batteries**
Battery technologies including redox-flow batteries, sodium-ion, lithiumsulfur, lithium-air, and magnesium-ion, and their supply chains, including electrodes, electrolytes, battery cells and battery packs/systems.
- **Solid-State Batteries**
Supply chain including electrodes, battery cells, battery packs/systems and electrolytes, including polymer, inorganic and inorganic/polymer, inorganic materials, including argyrodites, Lithium Super Ionic CONductor, (LISICONs), Thio-LISICONs, sulfide glasses, oxide glasses, perovskites, anti-perovskites and garnets.
- **RF Acoustic Wave Filters**
Including Surface Acoustic Wave (SAW), Temperature Compensated (TC)- SAW, Bulk Acoustic Wave- Free-standing Bulk Acoustic Resonator (BAWFBAR), BAW-Solidly-Mounted Resonator (BAW-SMR), and Packaging.
- **RF Power Amplifiers**
Including Low Noise Amplifiers, Doherty Amplifiers, Packaging, and Millimeter-Wave technology.
- **RF Front-End Modules**
- **Microfluidics**
From components to chips and systems, including all applications.



To meet the growing demand for market, technological and business information, i-Micronews Media integrates several tools able to reach each individual contact within its network.

We will ensure your company benefits from this



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ONSITE

Events

Brand visibility, networking opportunities

Today's technology makes it easy for us to communicate regularly, quickly, and inexpensively – but when understanding each other is critical, there is no substitute for meeting in-person. Events are the best way to exchange ideas with your customers, partners, prospects while increasing your brand/product visibility.

#110 attendees on average
#7+ key events planned for 2019 on different topics

INPERSON

Webcasts

Targeted audience involvement equals clear, concise perception of your company's message.

Webcasts are a smart, innovative way of communicating to a wider targeted audience. Webcasts create very useful, dynamic reference material for attendees and also for absentees, thanks to the recording technology.

#380 registrants per webcast on average to gain new leads for your business

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