

Market opportunities for microwave technology

Claire TROADEC

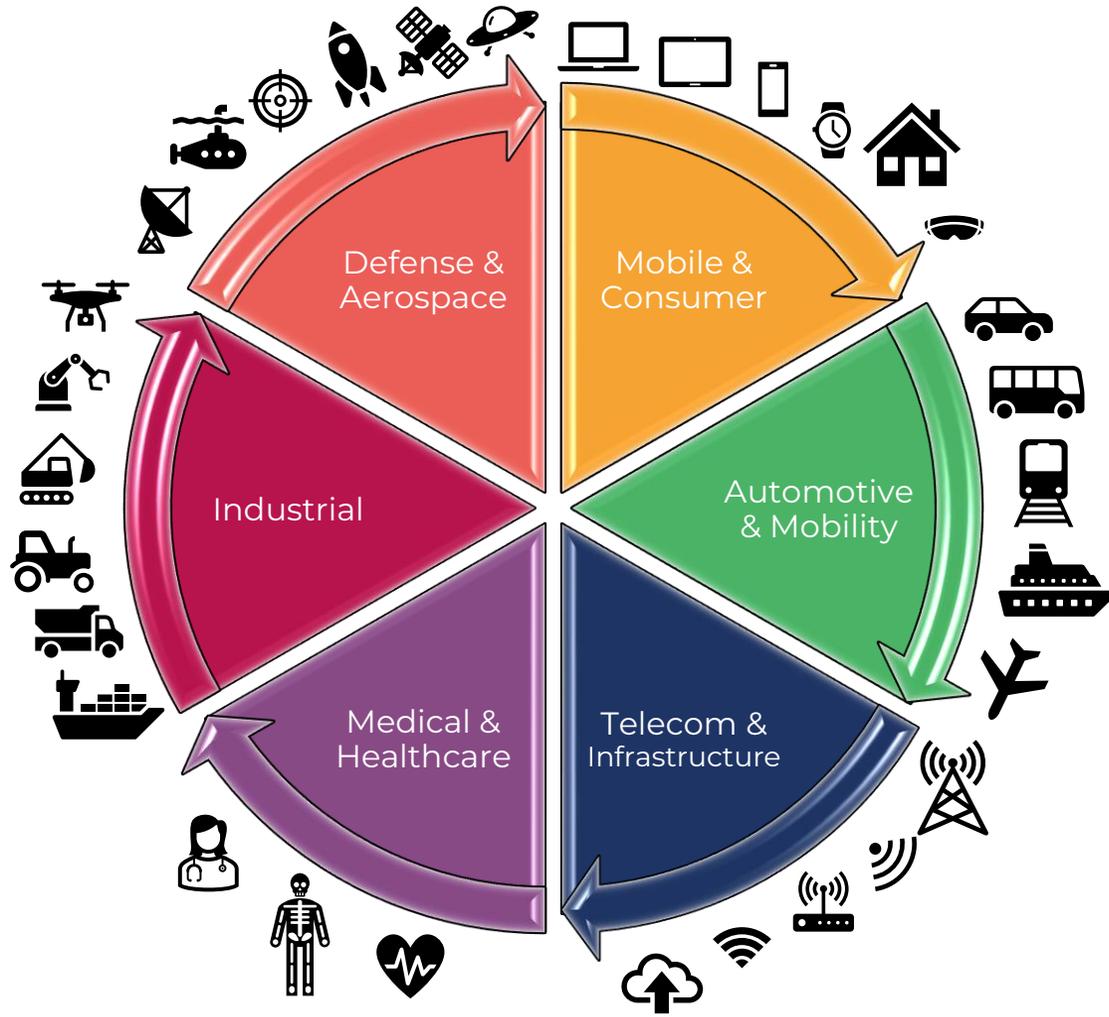
Director

More than Moore Business Line

MICROWAVE AND MILLIMETER WAVE ARE ENABLING TECHNOLOGIES



For multiple market vertical and use cases

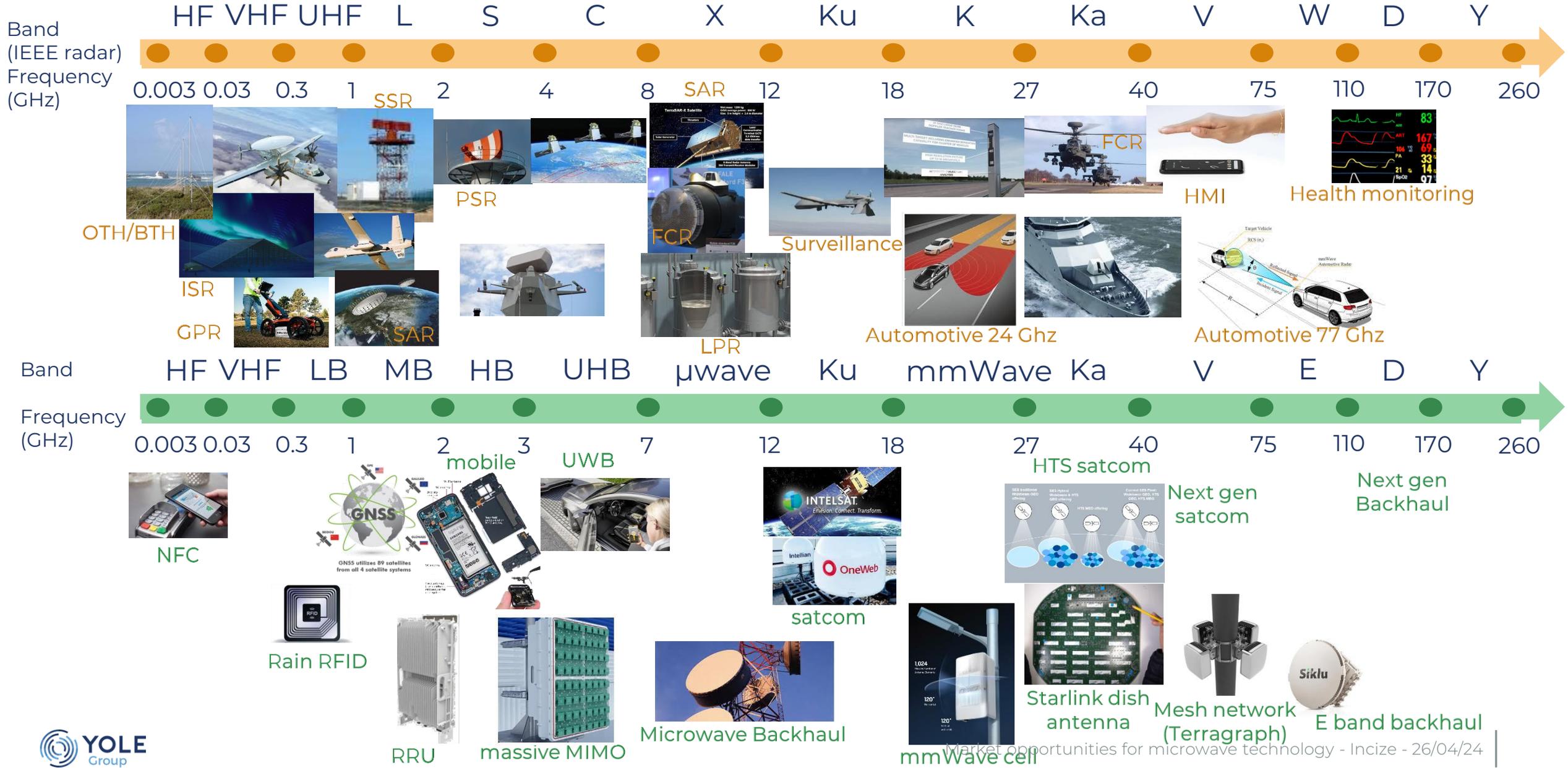


- Detecting
- Measuring
- Localizing
- Imaging
- Interacting
- ...



- Connecting
- Streaming
- Paying
- Opening
- Jamming
- ...

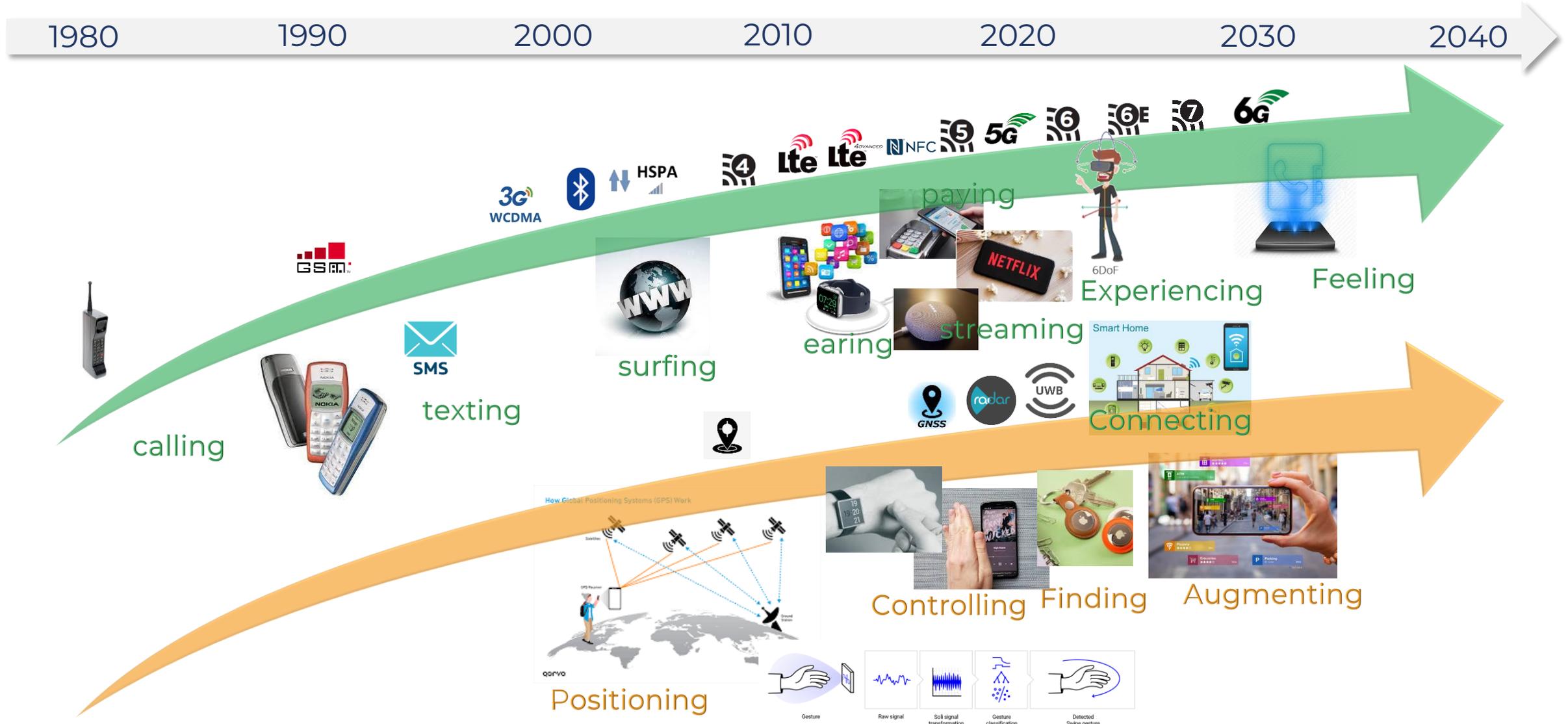
WIDE RANGE OF APPLICATION ACROSS WIDE RANGE OF SPECTRUM





MOBILE AND CONSUMER

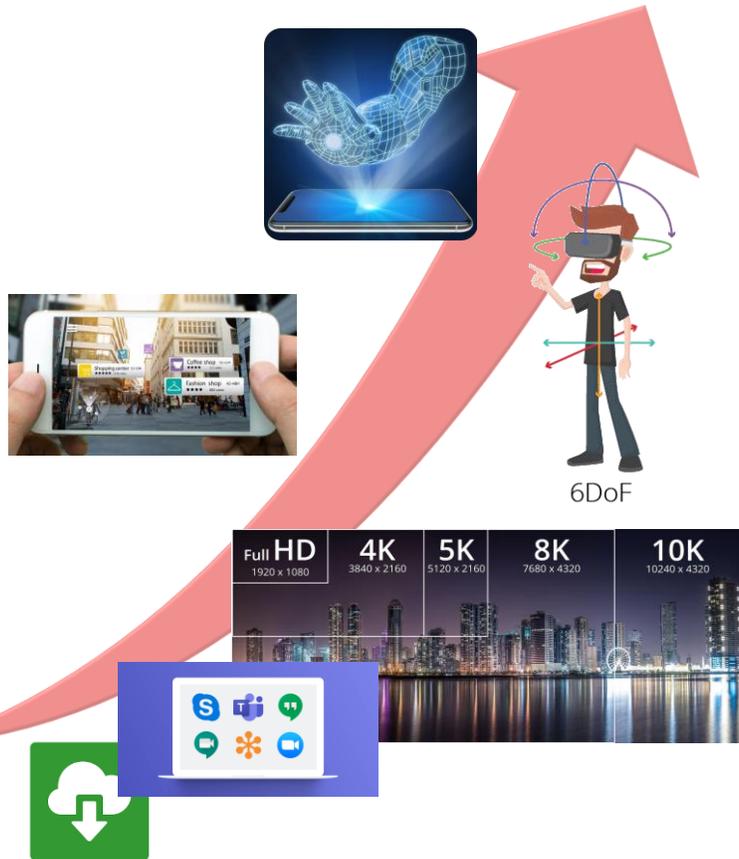
EVOLUTION TOWARDS AN HYPER CONNECTED WORLD





Exponential growth in data traffic

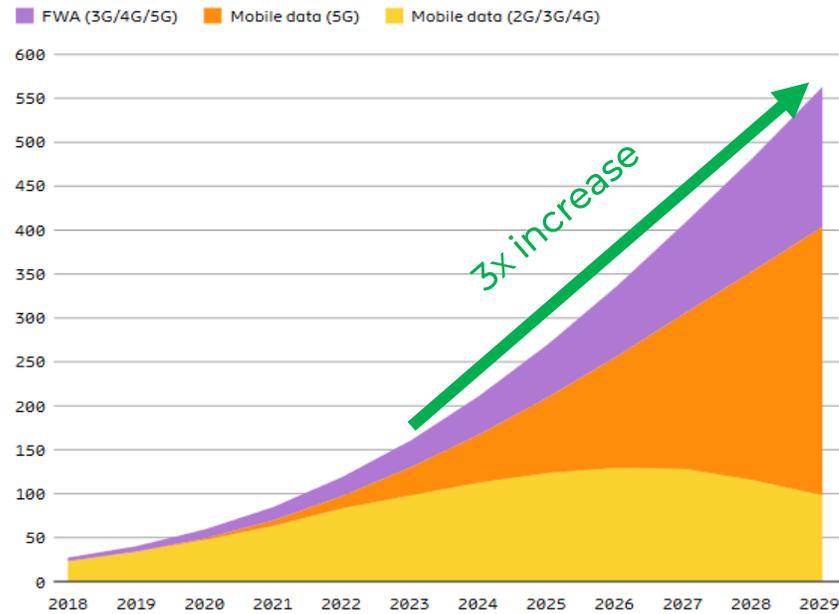
Increased bandwidth demand



More connected objects



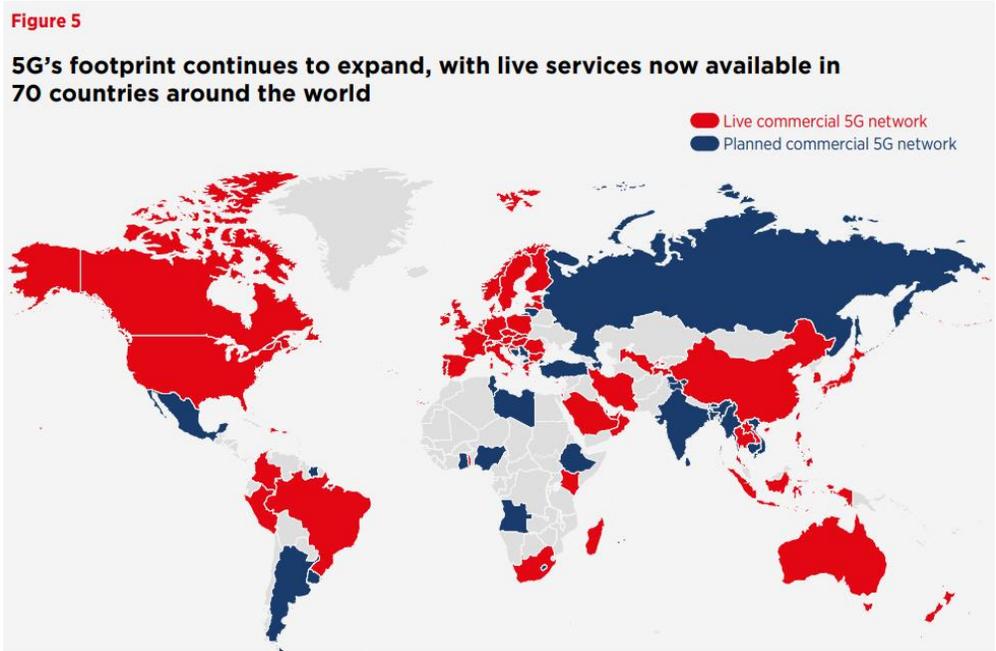
Figure 9: Global mobile network data traffic (EB per month)



Source: Ericsson global mobile data traffic outlook

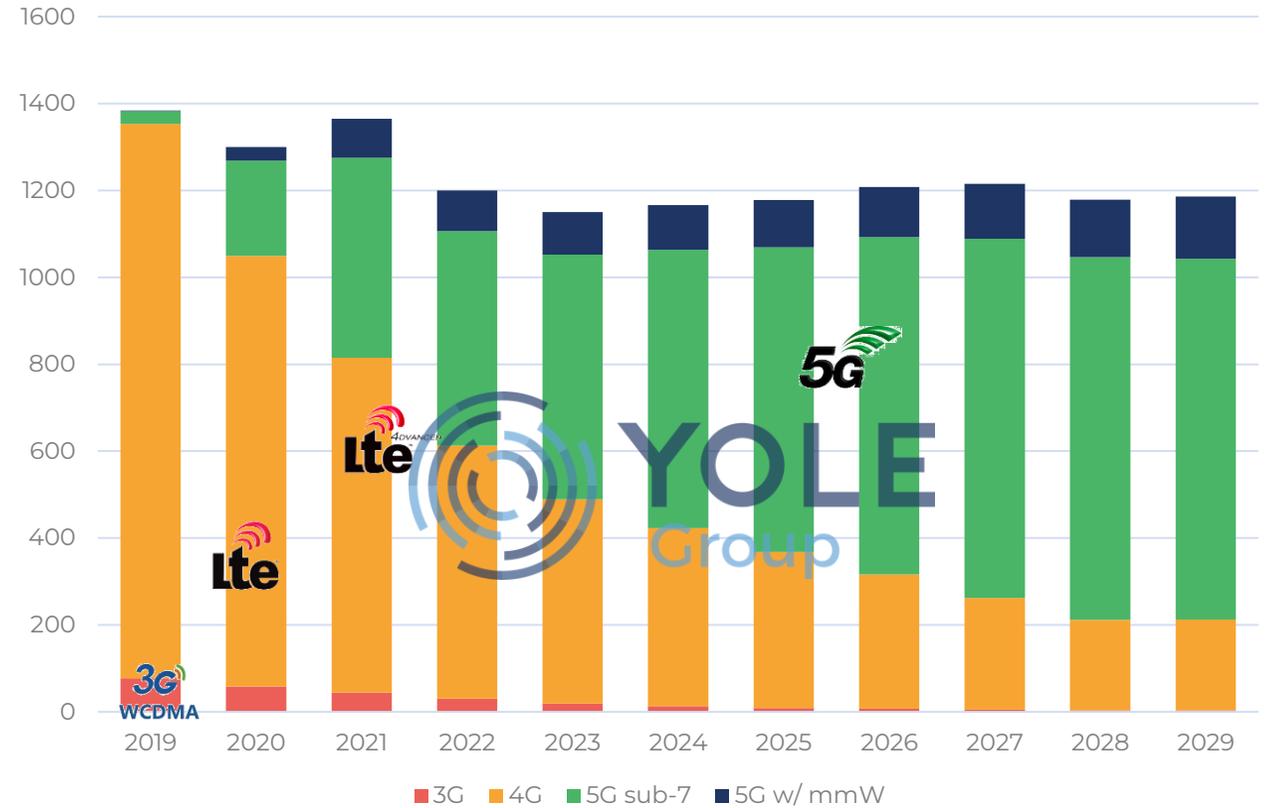
FOCUS ON SMARTPHONES AND 5G

Substantial benefits, fast transition



Source: GSMA Intelligence - January 2022

2018-2028 mobile phone volume forecast per air standard (Munits)



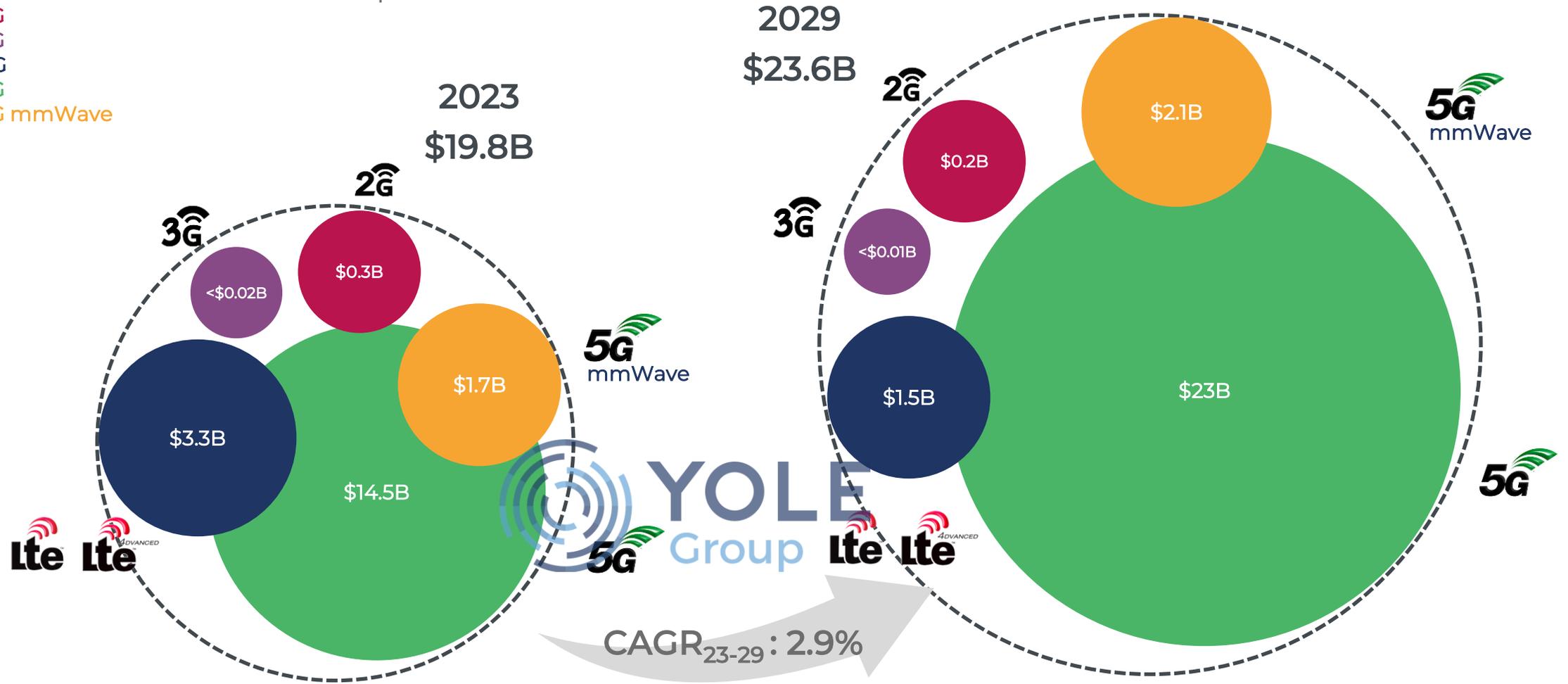
RF FRONT-END MARKET FORECAST

By air standard



-- TAM: Modules and RF front-end components

- 2G
- 3G
- 4G
- 5G
- 5G mmWave

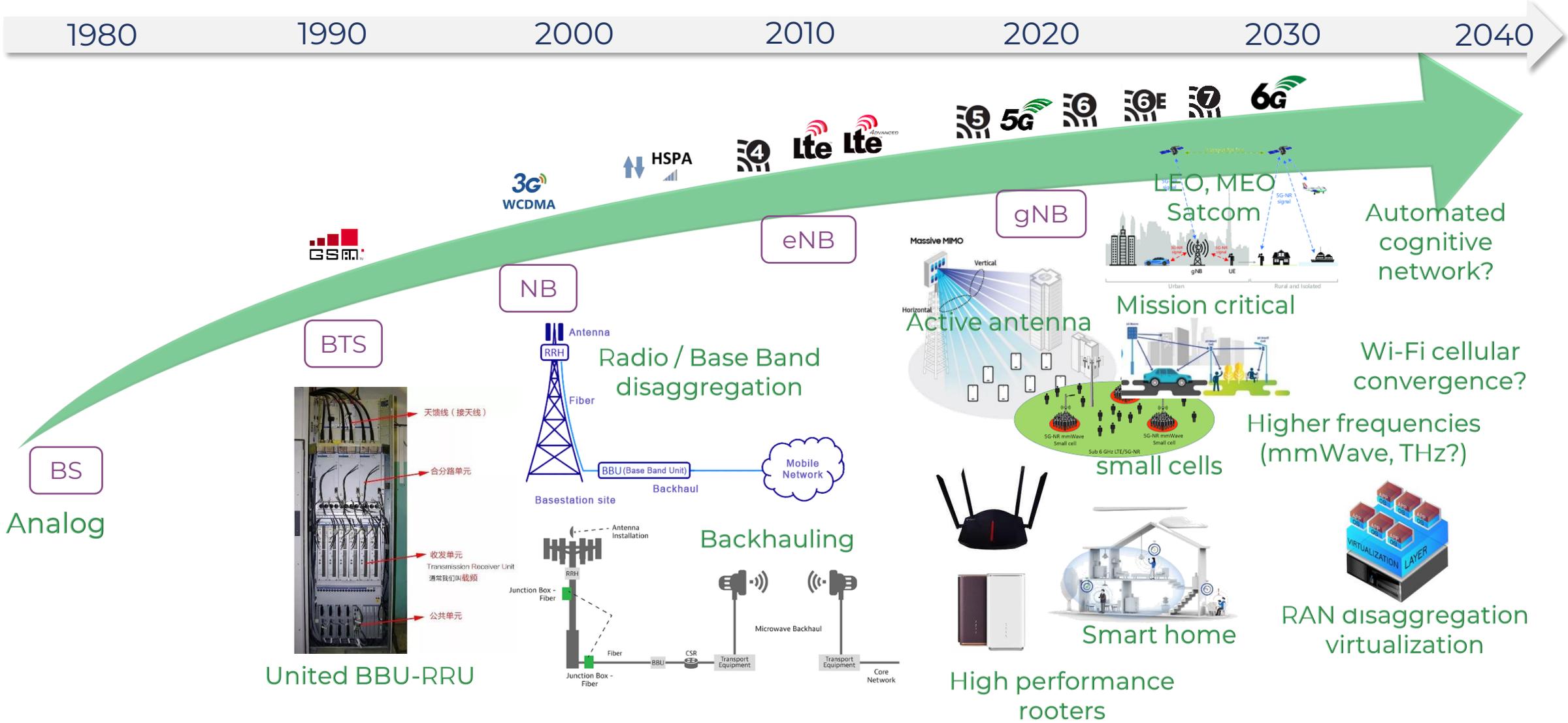


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TELECOMMUNICATION AND INFRASTRUCTURE



DEEP TELECOM TRANSFORMATION GOING FORWARD

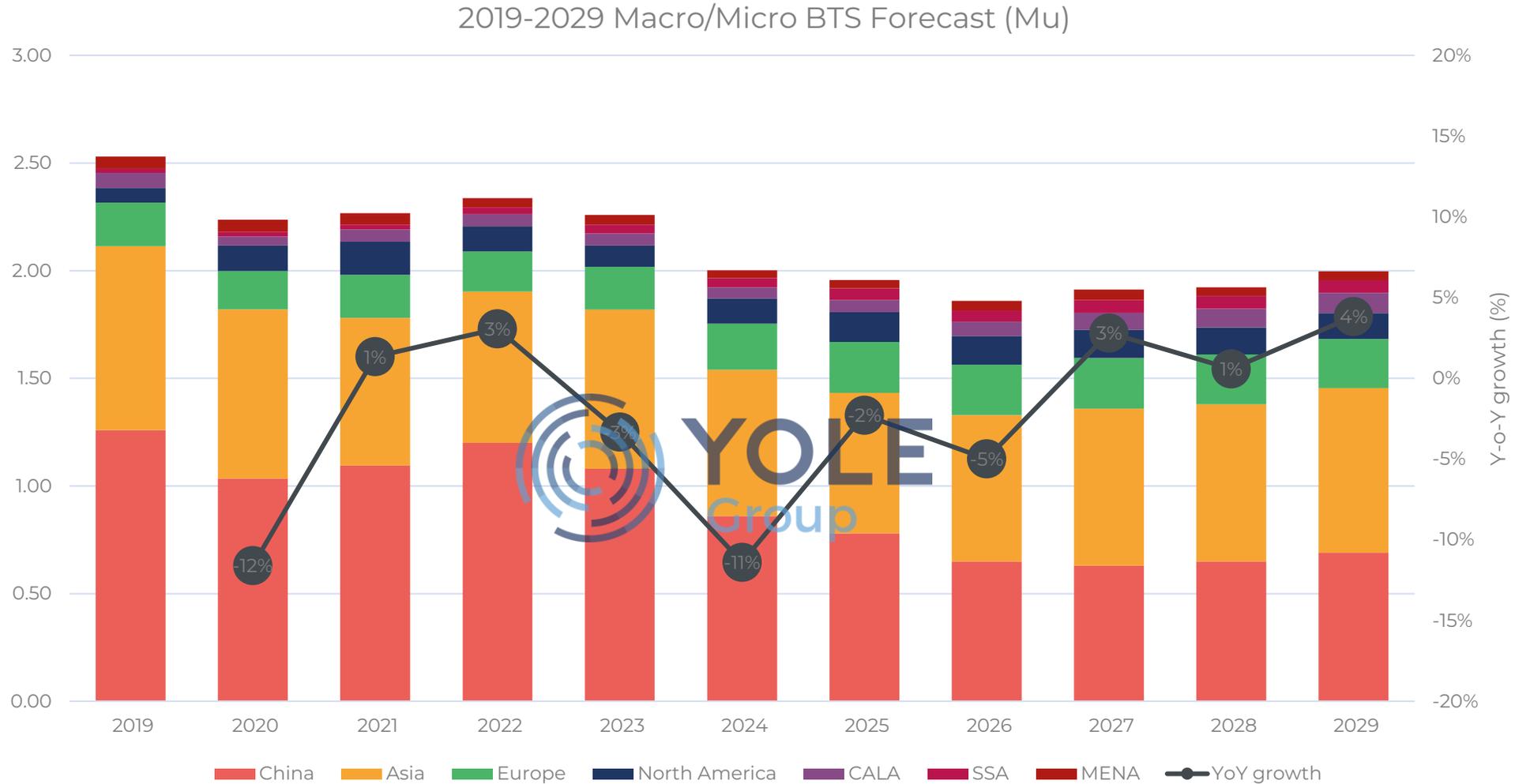


MACRO AND MICRO BASE STATION FORECAST (LTE & 5G)



Geographic View

Half of all LTE and 5G BTS deployments are in China. We saw massive investment in India for 2023 with very high deployment rate. The market is expected to decrease in the coming years.

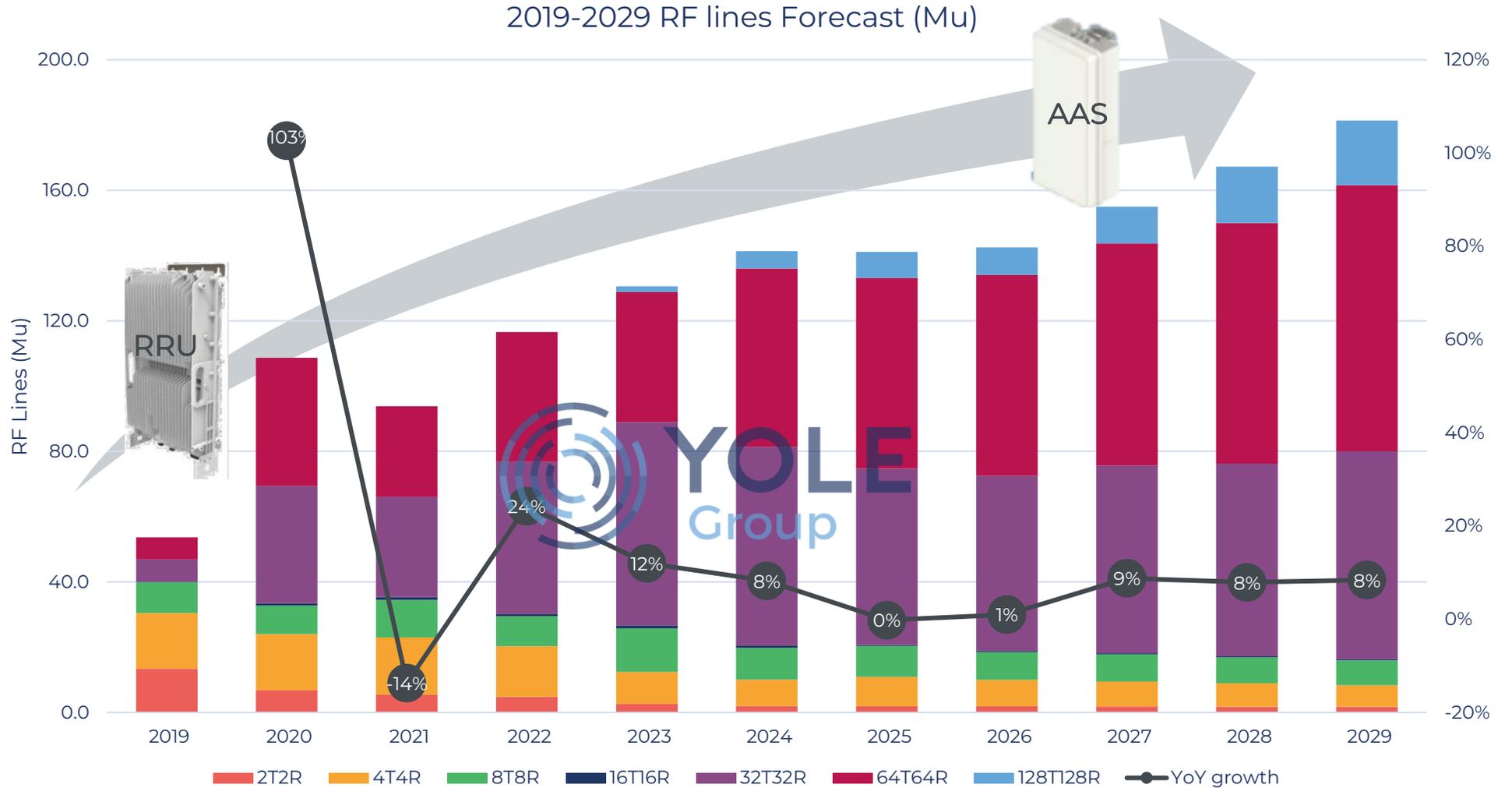




TRANSITION FROM REMOTE RADIO UNIT TO ACTIVE ANTENNA SYSTEMS

Strong Increase in RF Components

5G leverage 4T4R and 8T8R RU as well as mMIMO radio ranging from 32T32R to 128T128R. 32T32R AAS is the sweet spot thanks to a cost/performance tradeoff. 64T64R is the preferred option for dense urban areas.

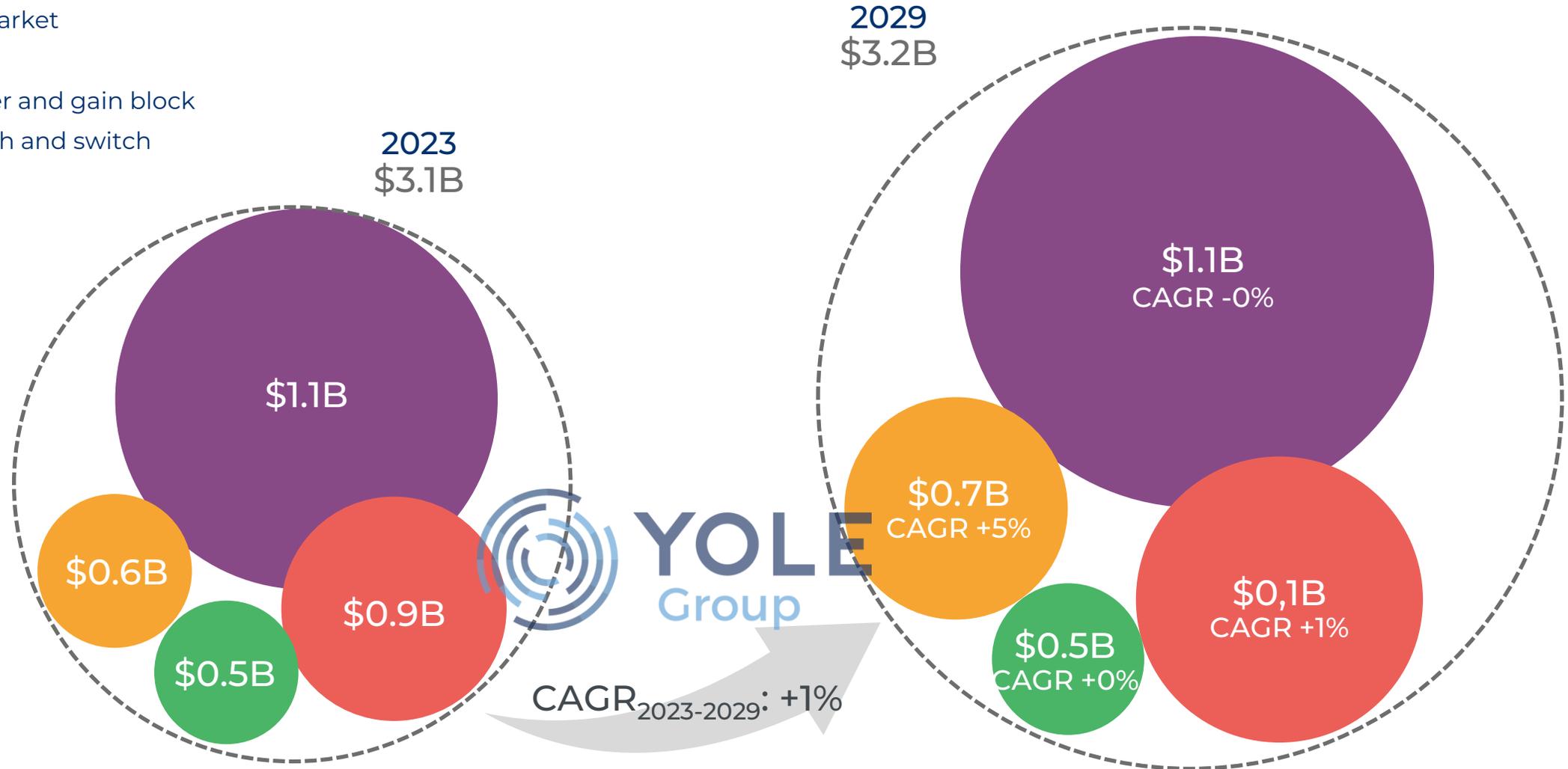


MACRO AND MICRO BTS RF FRONT-END MARKET REVENUES



By type of component

- RF front-end market
- Final stage PA
- Pre-driver, driver and gain block
- LNA, LNA/Switch and switch
- Filter



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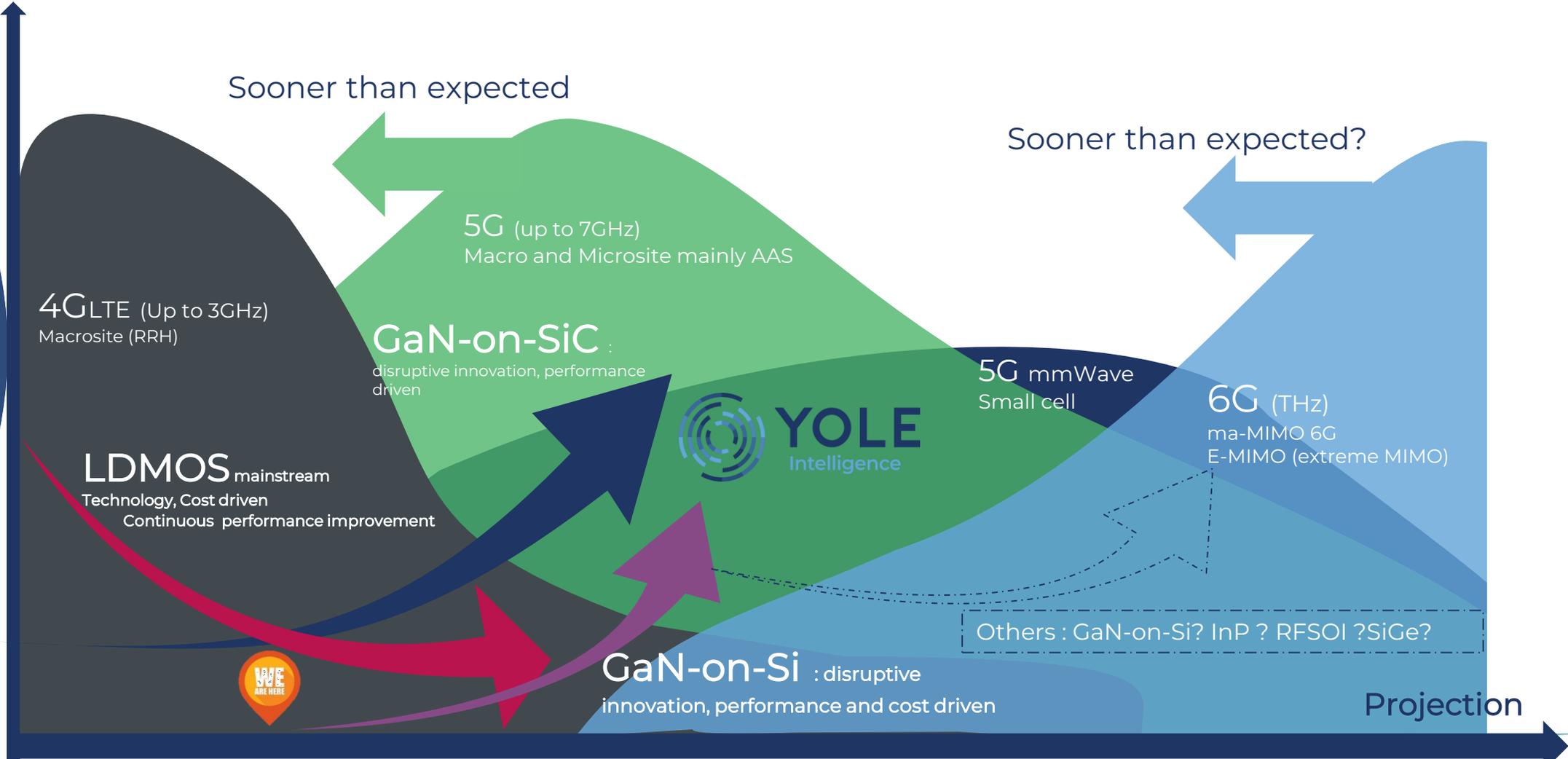


PA TELECOM INFRASTRUCTURE MARKET TREND

From 4G to 6G : Power amplifier innovation

Market Opportunities

Since 1980, the telecom standard moved to a new generation every decade. Starting in 2020, 5G has been deployed in sub-6GHz where GaN PA is becoming standard. For mmWave, the competition is still open, which can be an opportunity for GaN-on-Si. Looking into the 6G era, PA for THz will need to be developed.



2023

2025

2030

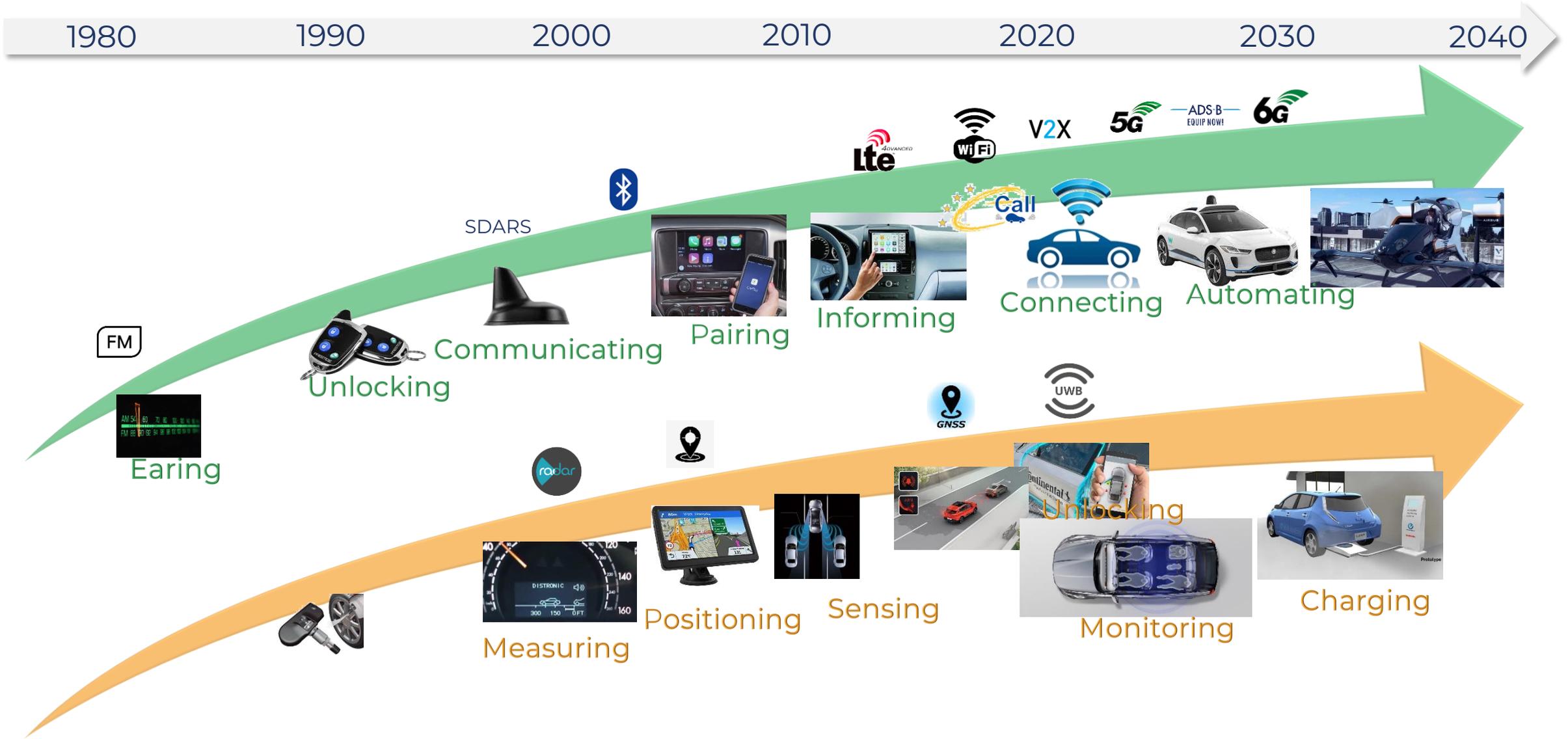
2035



A futuristic, dark-colored car is centered in the frame, viewed from a front-quarter perspective. The car's headlights and front grille are illuminated with a bright blue glow. The car is positioned on a dark, textured surface that appears to be a road or a platform. In the background, a city skyline is visible, with several tall buildings, including one with a prominent spire. The overall scene is set in a dark, atmospheric environment with a blue color palette. The text "AUTOMOTIVE AND MOBILITY" is overlaid on the car in a white, sans-serif font.

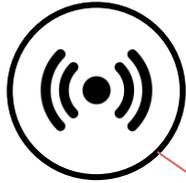
AUTOMOTIVE AND MOBILITY

TOWARD VEHICLE AUTOMATION AND BETTER USER EXPERIENCE



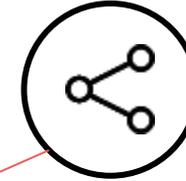
AUTOMOTIVE INDUSTRY – MEGATRENDS

C.A.S.E.: the acronym leading the current auto revolution



Autonomous

Sensor suite and computing developments for safer roads.



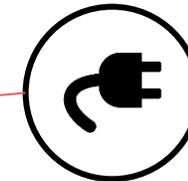
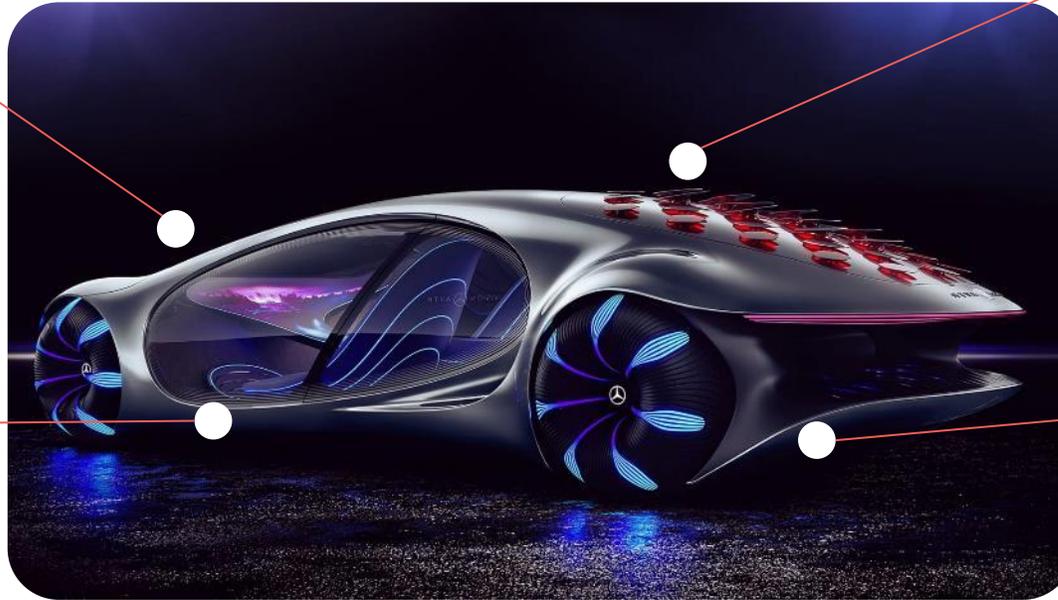
Shared

Owning, sharing, or renting, the mobility of the future offers greater flexibility.



Connectivity

Comfort, safety, and entertainment in a new dimension. UX and HMI.



Electric

Alternative drive systems to reduce CO₂ emissions.

source: Daimler

MACRO MARKET – DRIVER RADAR



The short- and long-term forces driving radar adoption in automotive


Mass-market
Autonomous driving

Safety features

- Automatic emergency braking
- Lane-change assist
- Blind-spot detection
- **Regulation driven:** NCAP, mandatory ADAS features by European Commission or NHTSA



Comfort features

- Park assist
- Adaptive cruise control
- In-cabin monitoring
- Hands off on highways
- **Business-driven:** converting radar-based features into cash

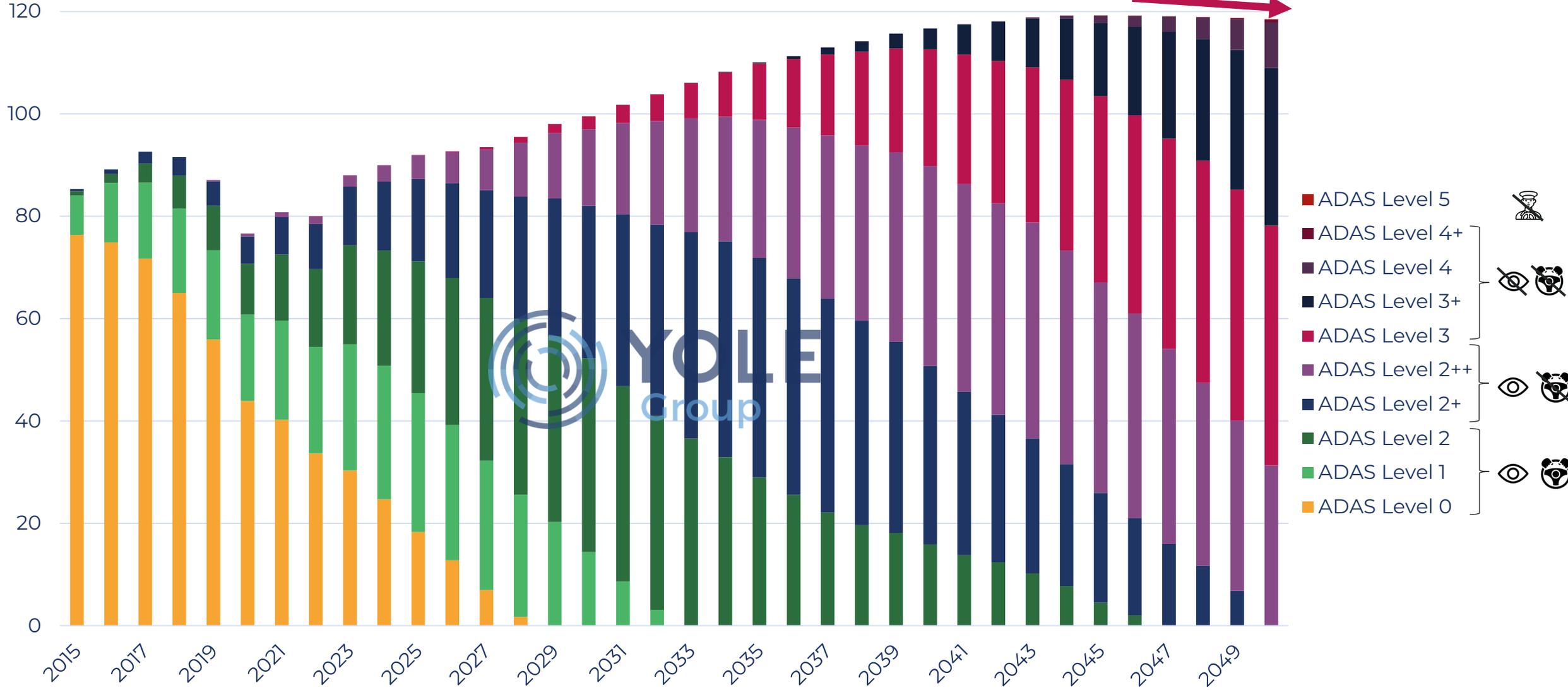


- Lowest levels of autonomy are cost-driven.
- Highest level of autonomy are more premium with less cost constraint, thus more technology-driven.

THE LONG ROAD TOWARDS AUTONOMOUS DRIVING



LCV and PC production breakdown forecast by level of autonomy - Munits - 2015/2050



RADAR SENSING – PARADIGM CHANGE



Towards imaging radar

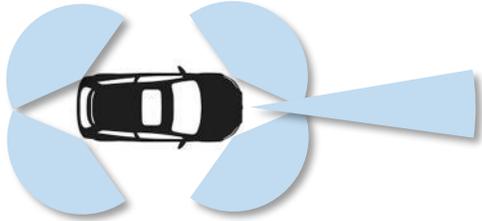
(L0)-L1-L2

FEET-OFF



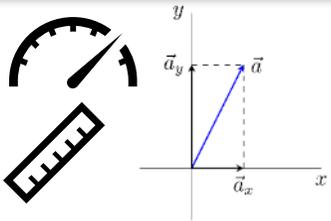
ADAS

Warning, ACC, AEB



Gen 1 to Gen 4
Legacy radar

Moving targets



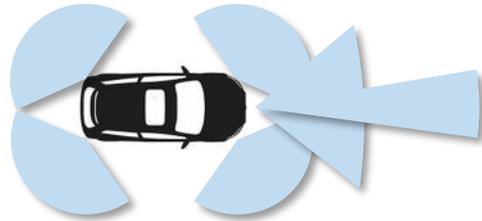
L2+-L2++

HANDS-OFF



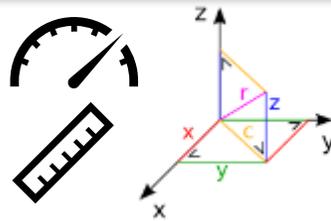
Partial automation

ALC, stop & go



Gen 5
4D and 4D imaging

Moving / static targets



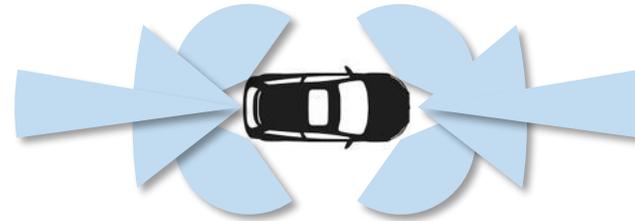
L3-L4

EYES-OFF



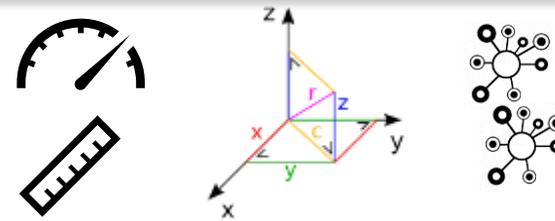
Conditional automation

Conditional road pilot, remote parking



Gen 6 and beyond
Next-gen 4D imaging radar

Radar-based perception



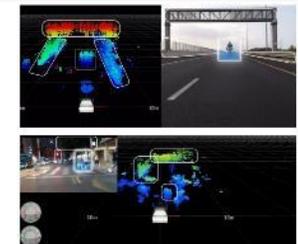
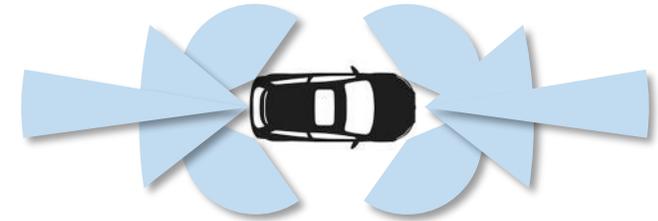
L5

MIND-OFF



AD

Full road pilot



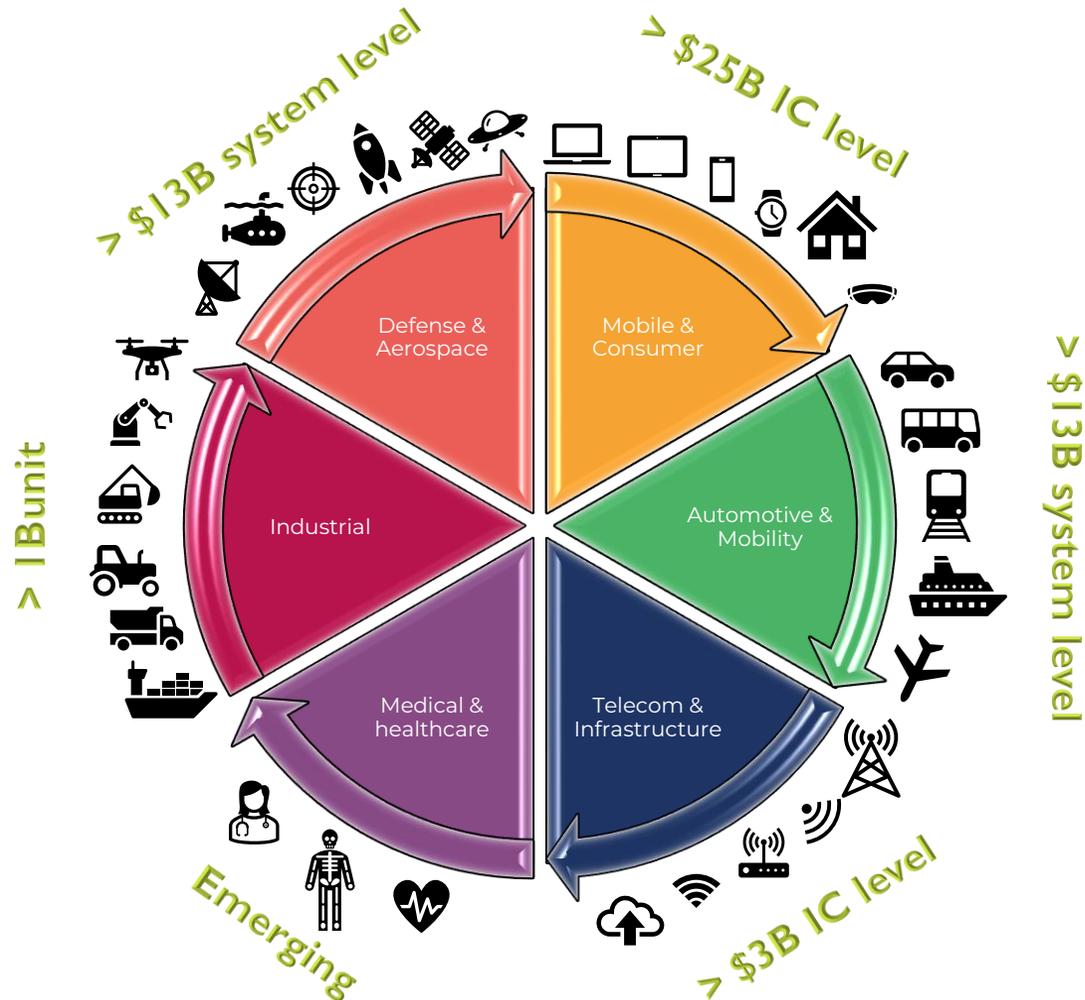
courtesy of Arbe



Finish Line
Just Ahead

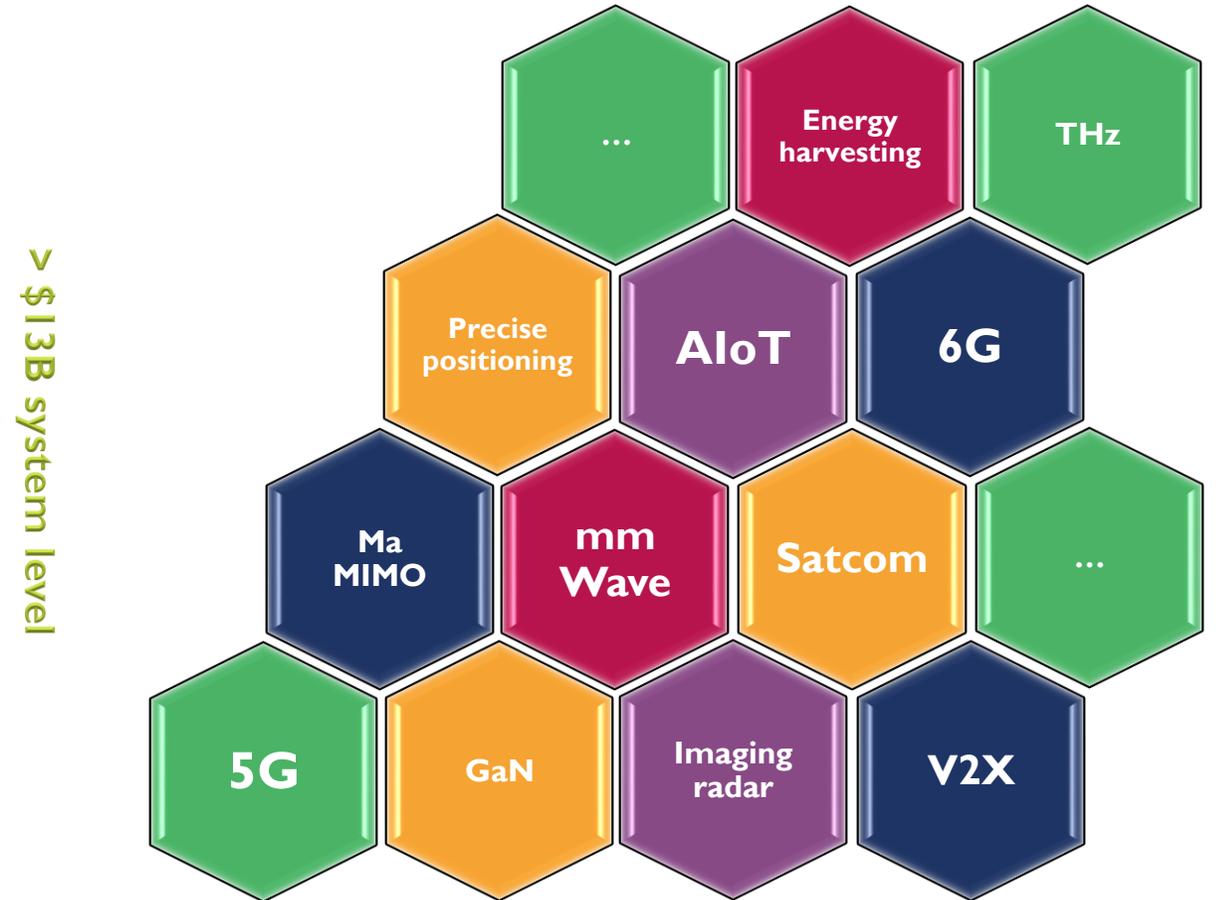


Market Opportunity in brief



Non exhaustive market review

Key technologies to Watch



Market opportunities for microwave technology - Incize - 26/04/24

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