The webinar will begin shortly…

IF YOU HAVE NOT SIGNED IN WITH YOUR FULL NAME & COMPANY, PLEASE DO SO
YOU CAN "RENAME" YOURSELF IN THE "PARTICIPANTS" TAB

IF YOU DO NOT INCLUDE YOUR NAME AND COMPANY
YOU MAY BE EJECTED FROM THE WEBINAR!

Welcome to Webinar Wednesday!

HOUSEKEEPING:

- Make sure you **SIGN IN** with your **FULL NAME & COMPANY**, as we may need it to unmute you and bring you into the discussion (If you do not include your name and company, you may be ejected from the call!)
- You can **"rename"** yourself in the "**participants**" tab

- Questions can be asked by either:
  - Clicking the **"Participants"** tab and then "**Raise hand**"
  - Click the **"Chat"** tab and use text box to ask a question
  - you can direct this privately to me or to everyone

- The **PRESENTATION PDF** and **RECORDING** of this webinar will be available for download to members from the IWPC research library at www.iwpc.org

IWPC Webinars & Workshops H2 2021

Aug 18: Building The 5G Network Of The Future

Aug 25: Antenna in Package for 5G mmWave Infrastructure

Sept 1: High Imaging Automotive Radar

Sept 14: Web-based Solutions to Address Automation for mmWave Propagation and 5G Network Planning

Sept 22 TBC: 5G Network Architecture, Technology/Service Evolution and 5G User Equipment Evolution

Sept 29: 5G End-to-End Orchestration and Automation of O-RAN Based Network Slices across RAN, 5G Core and Transport Domains

Oct 6: Sub-THz Technologies for Advanced In-Cabin Sensor Systems, Sensor Fusion and High-Speed Data Links

Oct 13: RF Laminates And Advanced Antenna Technologies For mm-Wave Radar Applications

Oct 27: Exploring 5G Vertical Market Drivers & Connected Mobility

Nov 3: Applications for High Power User Equipment (HPUE) on FirstNet

Nov 8-10 TBC: Exploring The 6G Vision and Key Enablers (F2F)

Nov 10-12 TBC: Connected Mobility in Vehicles (F2F)

Dec TBC: Open RAN Deployment Opportunities and Challenges (F2F)

Dec 15: Concept Design, Functional Prototyping, Engineering Design Development, Certified 3rd Party Environmental and Mechanical Testing, Verification and Design Validation

Building the 5G Network of the Future

Eric Westberg – Director, Product Management

Yash Suvarna – Portfolio Manager

Duco Das – Portfolio Manager

18 AUGUST 2021

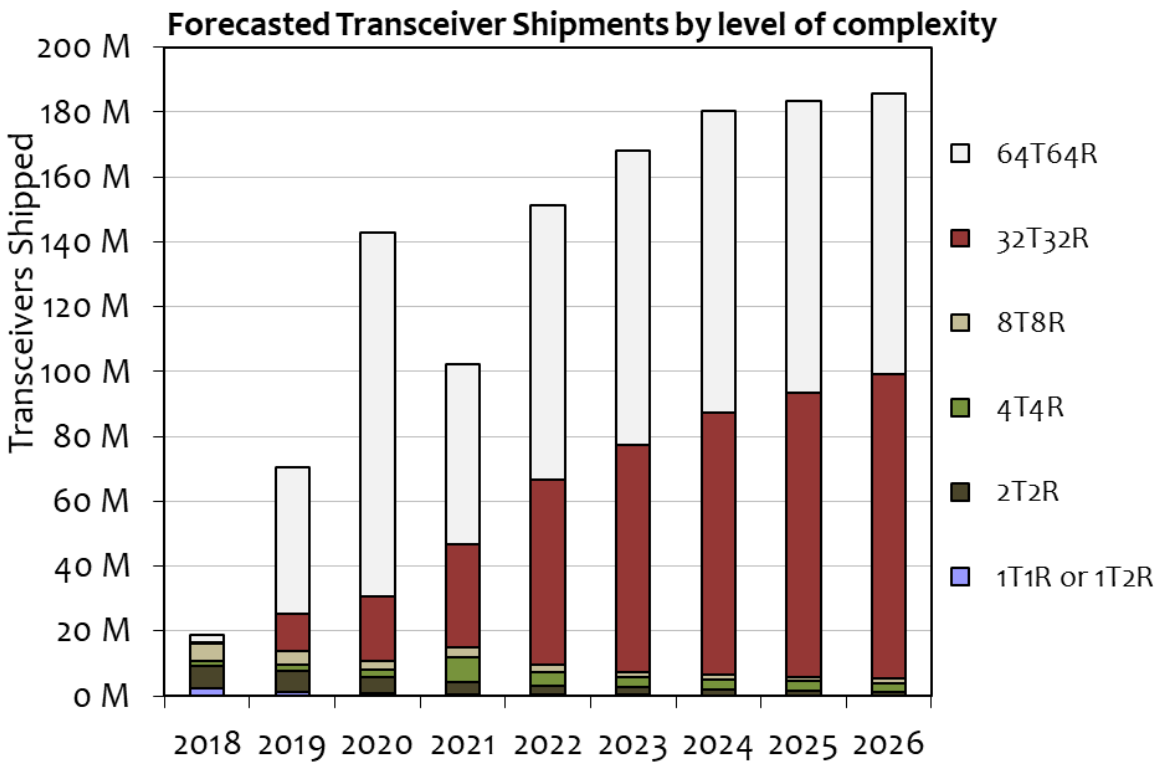
SECURE CONNECTIONS FOR A SMARTER WORLD

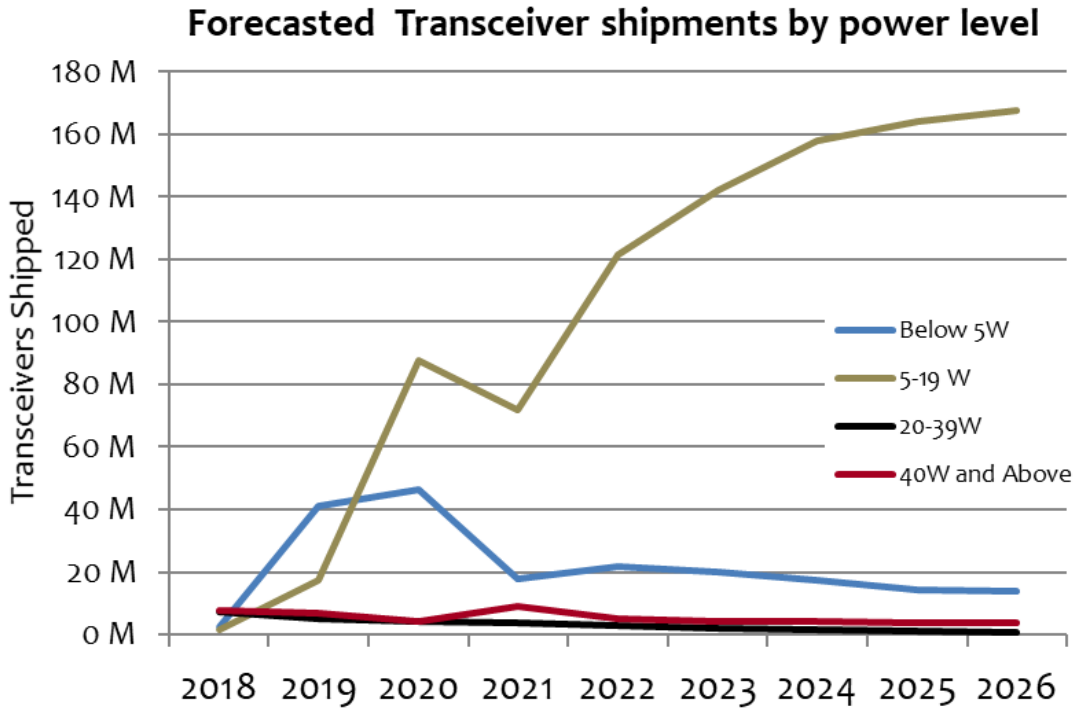
Agenda

1. Market Insights
2. Technology and Radio Unit Challenges
3. Sub 6-GHz
4. mmWave

LATEST 5G MARKET DEVELOPMENTS

Mobile Experts, May 2021

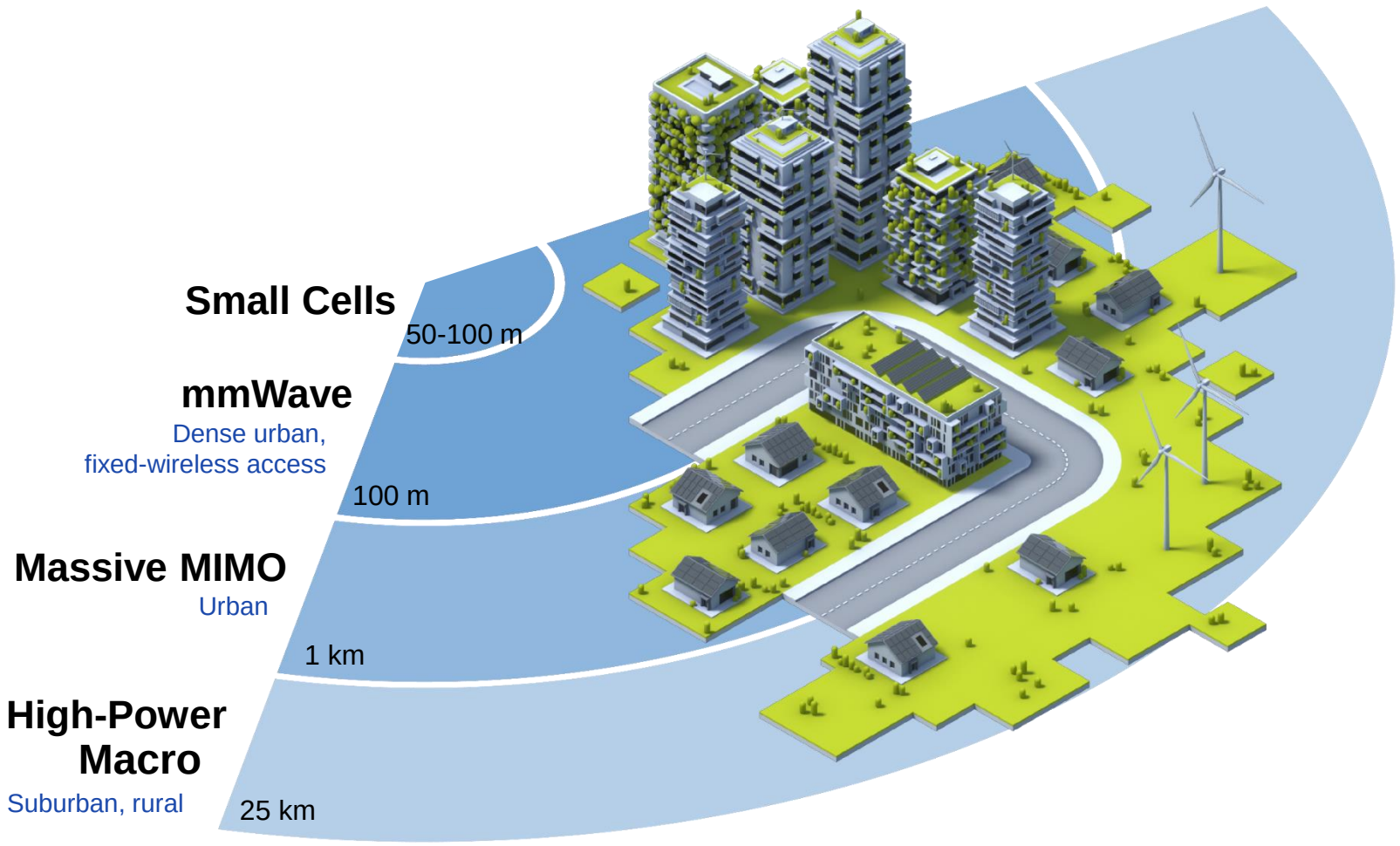




Transmit and Receiver lineups will grow significantly due to Massive-MIMO deployments for both sub-6 GHz and mmWave.

Due to increased number of transmit and receive per radio we will see more of 5-19W PA's shipped over next few years. mmWave (higher frequencies, lower powers) will be added on top as a non-standalone layer in the network

5G IS A DIVERSE AND COMPLEMENTARY NETWORK ECOSYSTEM



MULTIPLE NETWORK ARCHITECTURES

RAPIDLY EVOLVING DEPLOYMENTS

Key Challenges:

Frequencies

Power levels

Architectures

Source: NXP, 3GPP

ACCELERATING 5G ENERGY EFFICIENCY

5G INFRASTRUCTURE EFFICIENCY

Radio Efficiency

Technology combination for optimal performance

Deployment Efficiency

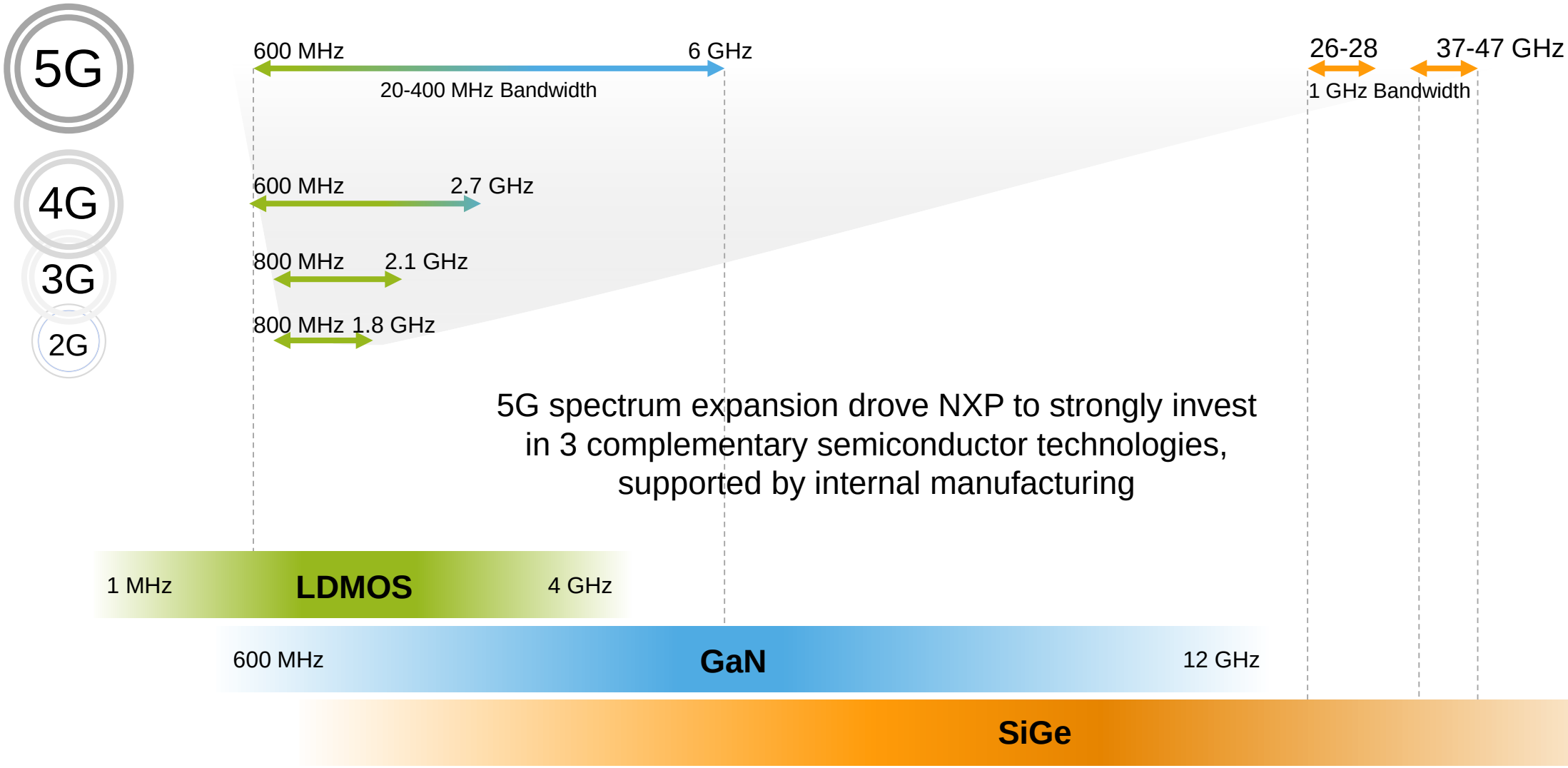
Multi-Chip module integration for size & weight reduction

Wideband capability for multi-band radios

Time-to-market Efficiency

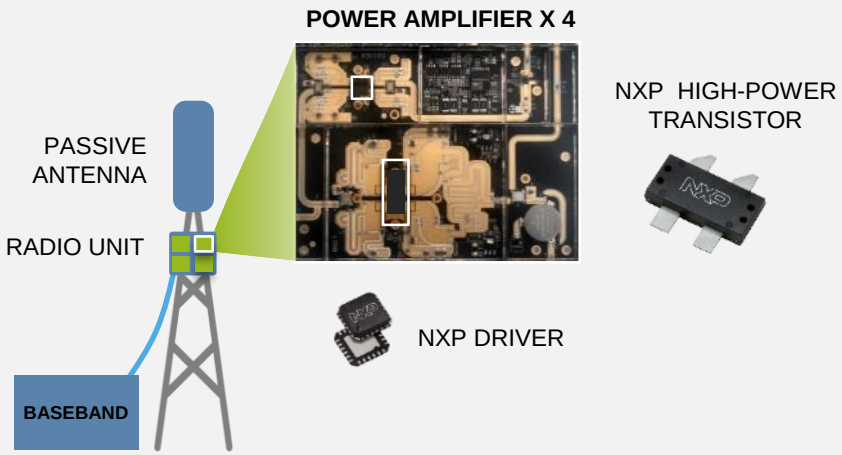
Scalability across frequency bands and power levels

KEY TECHNOLOGIES TO ENABLE 5G RF POWER

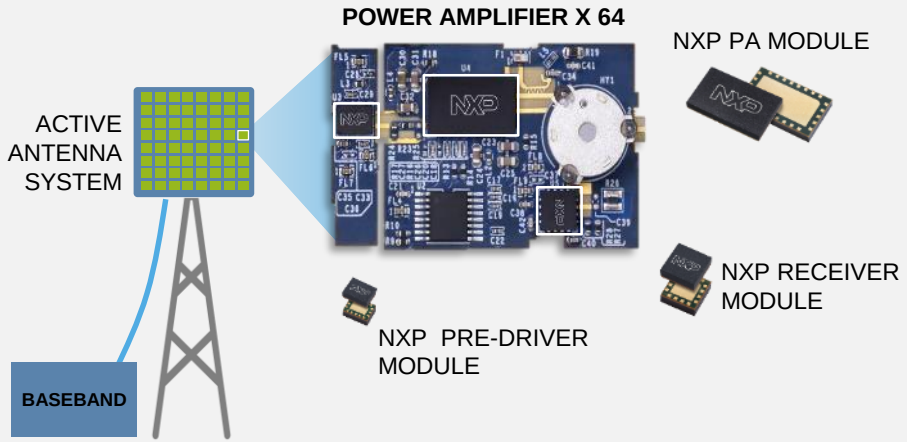


RADIO UNIT RF FRONT-END

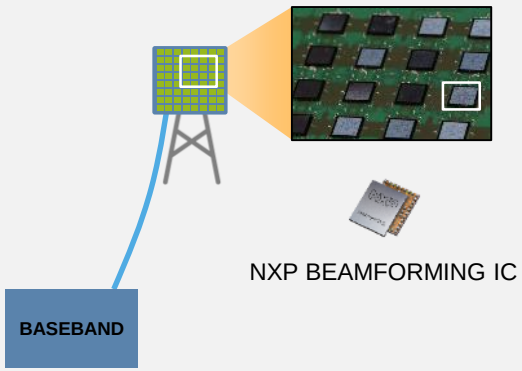
High-power Macro



Massive MIMO



mmWave



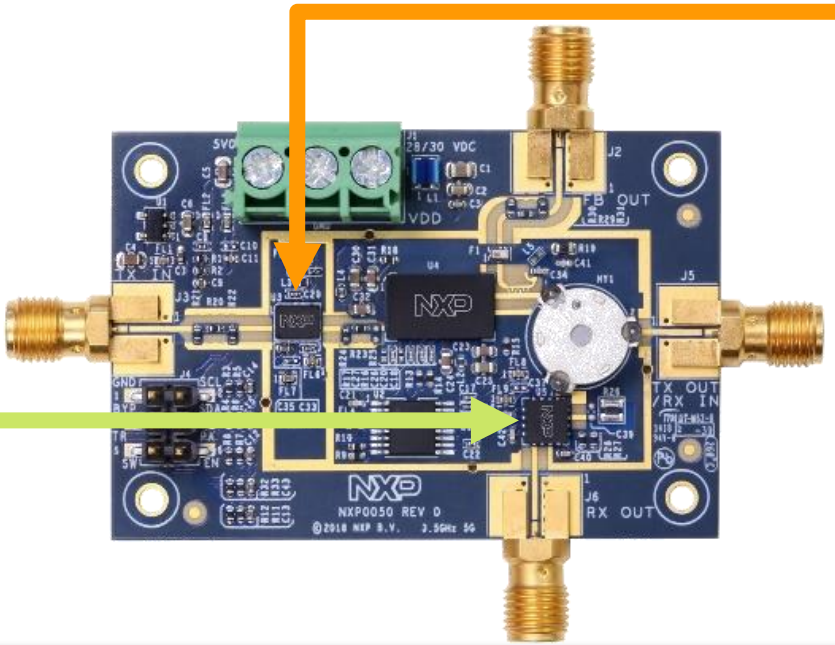
4T4R	8T8R	32T32R	64T64R	mmWave
4 X 40 W	8 X 40 W	32 X 10 W	64 X 5 W	256 X 200 mW

Coverage (lowest cost / km²) — *Capacity (lowest cost / Gb/s)*

NXP Addressing all deployment options

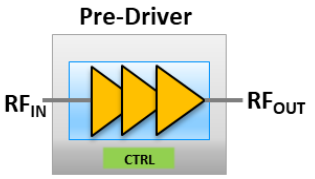
+ **Small Cells**: macro-like architecture at low-power level

PRE-DRIVER AND RECEIVER



Pre-Driver Amplifier Module

- GaAs or SiGe technology
- Typically, 2-3 stage design
- Operated at 12-14dB OBO
- Higher Gain to drive final PA
- High linearity
- Wide RF Bandwidth
- 50 Ω in/out with pin-to-pin compatibility

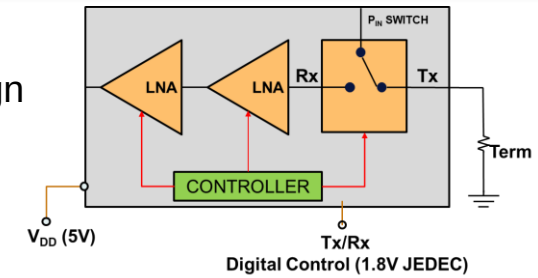


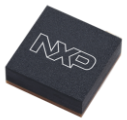
NXP Pre-Driver Product Example:

- 50 Ohm in/out
- SiGe Technology
- 3 x 3 QFN package
- Frequency 2300 to 4200 MHz
- Gain 30.5dB
- Psat 28 dBm
- ACLR -46dBc
- 95mA Icc

Rx Front-End Module

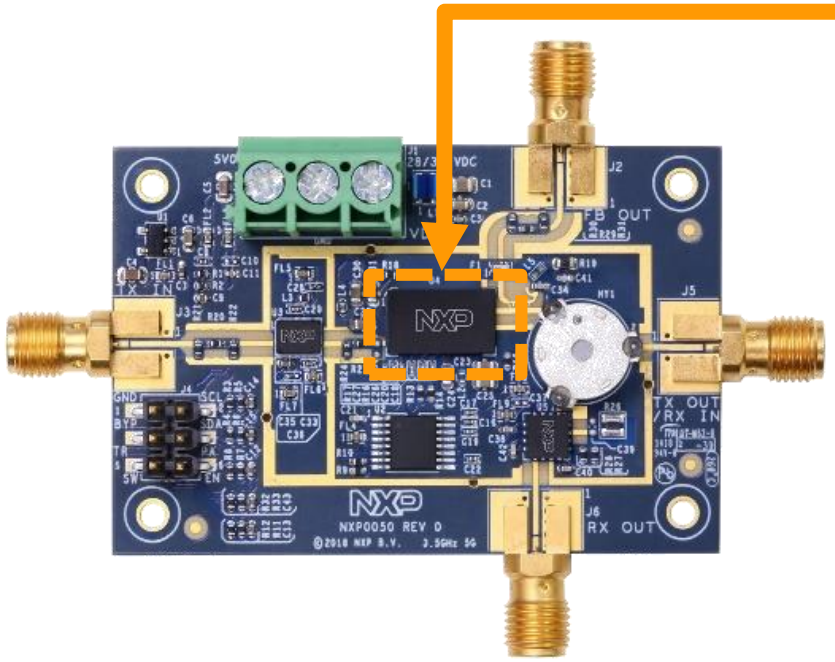
- GaAs or SiGe Technology
- Switch + 2 stage LNA design
- Lowest NF <1dB
- Higher gain design
- High isolation
- Low power consumption
- 50 Ω in/out with pin-to-pin compatibility





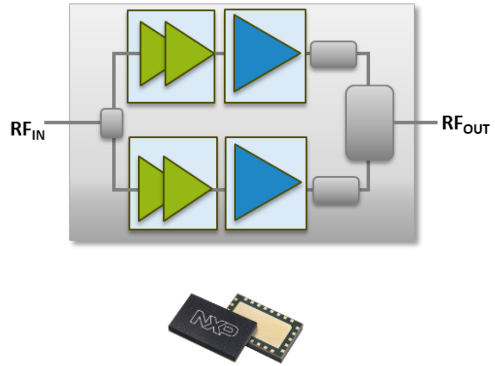
NXP RX FEM Product Example:

- 50 Ohm in/out
- SiGe Technology
- 5 x 5 QFN package
- Frequency 3300 to 4200 MHz
- Gain 36dB
- 37dBm TX power handling (9dB PAPR)
- Noise Figure 1.3dB
- 170mW Pdiss per channel



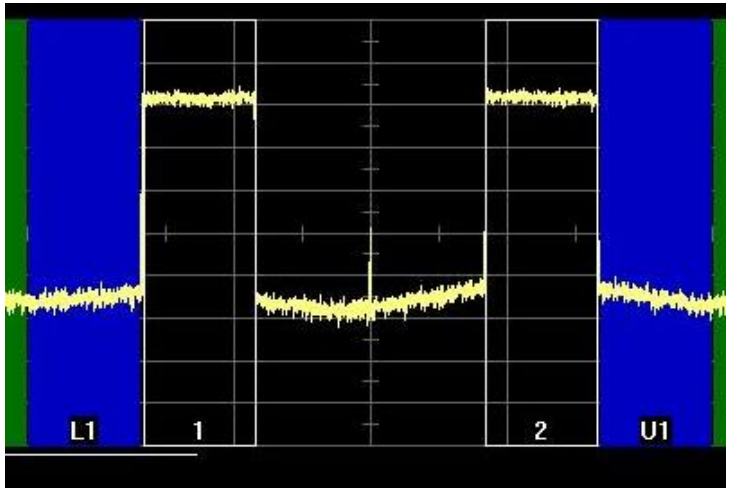
Power Amplifier Module

- LDMOS or GaN technology
- Doherty power amplifier
- Operated at 8-9dB OBO
- High linearized efficiency
- Wide RF Bandwidth and iBW
- Reduced size
- Thermal management
- 50 Ω in/out with pin-to-pin compatibility across frequency and power



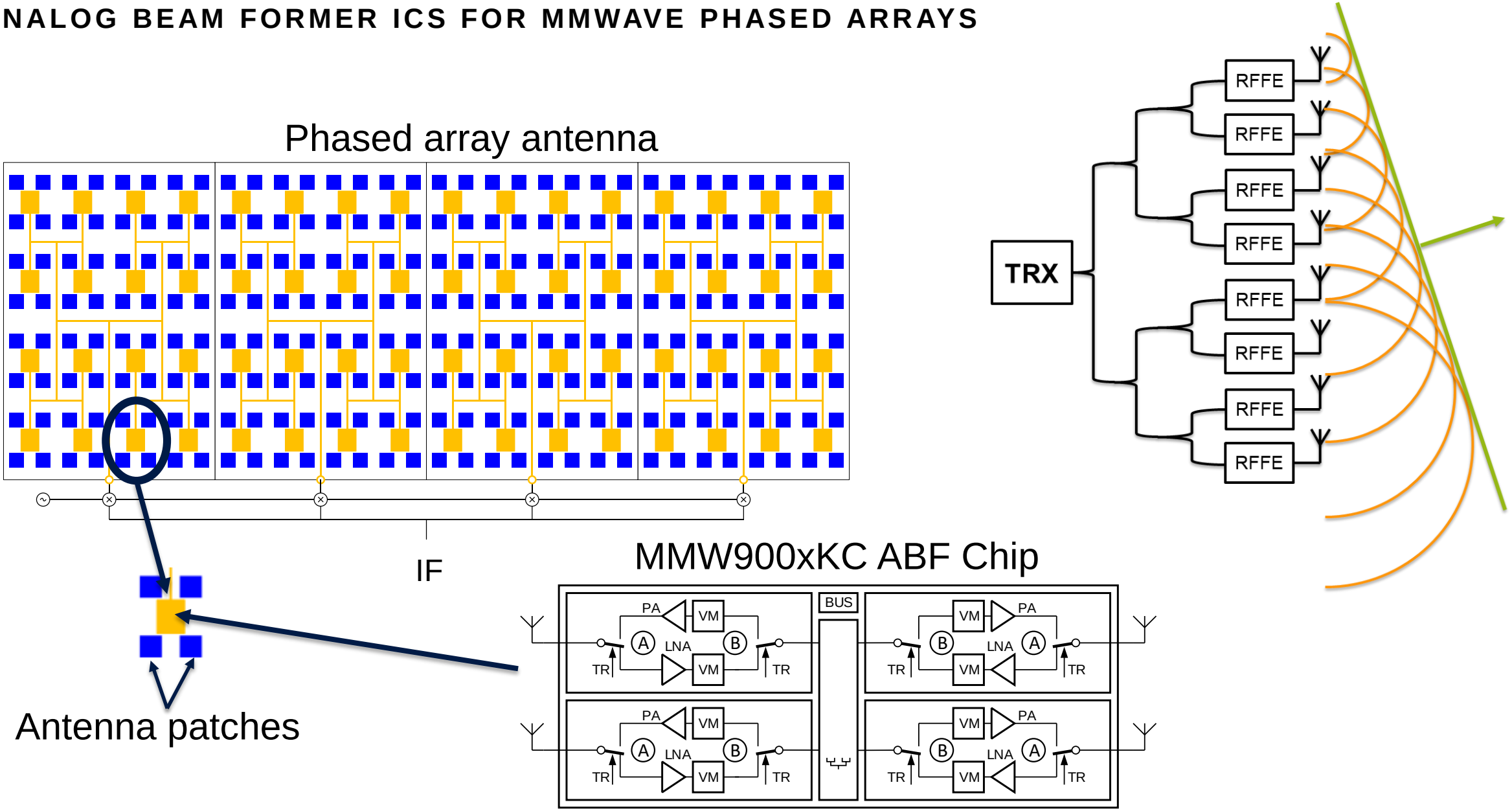
NXP Product Example:

- 50Ohm in/out Integrated Doherty
- 5V LDMOS driving 48V GaN final stage
- 10 x 6 LGA over-molded plastic package
- Frequency 3400 to 3800 MHz
- Pavg = 39.5 dBm
- P5dB = 48dBm
- Gain > 32dB
- PAE > 46%
- iBW = 400MHz

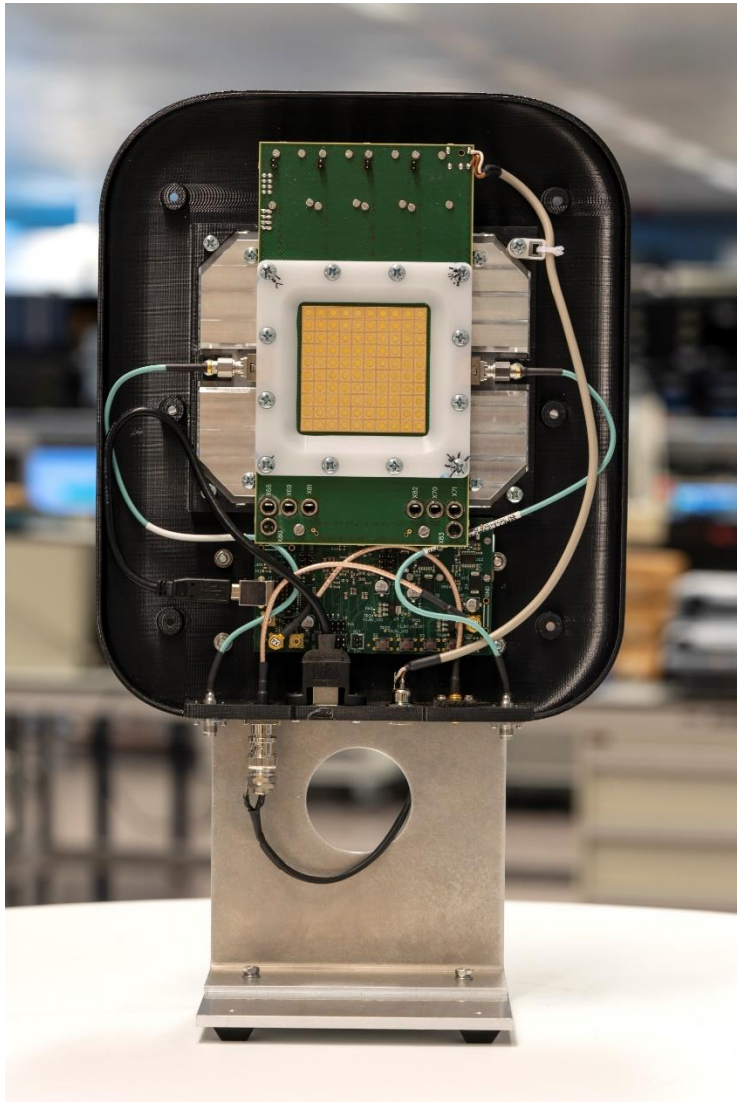


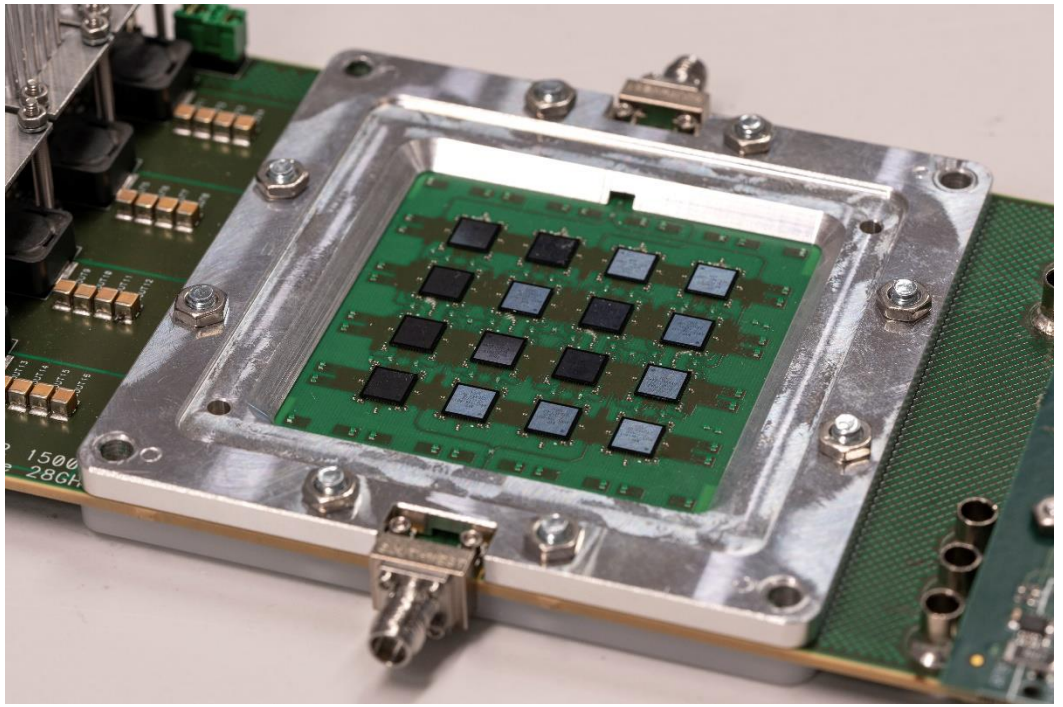
Center Freq = 3.6 GHz,
Carrier BW = 100MHz,
Channel Spacing = 200MHz,
Pavg = 39.5dBm

ANALOG BEAM FORMER ICS FOR MMWAVE PHASED ARRAYS



ANTENNA DEMO / REFERENCE DESIGN KIT

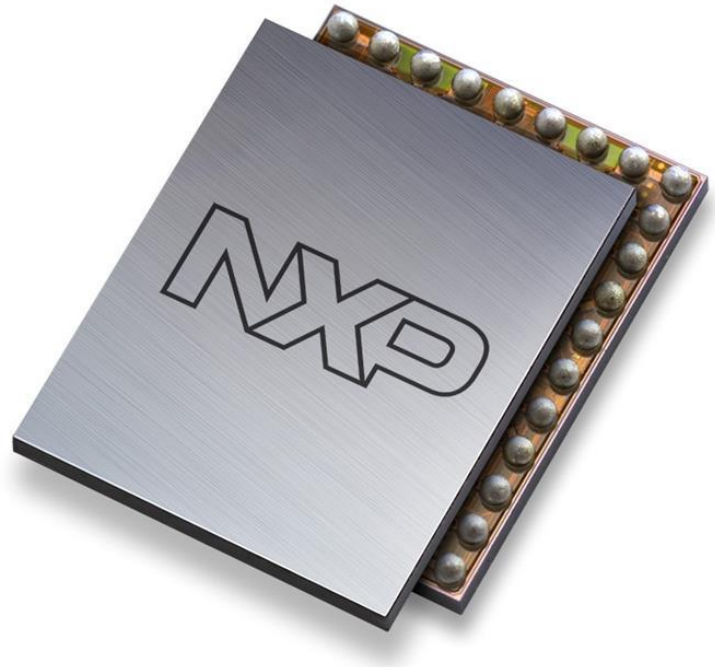


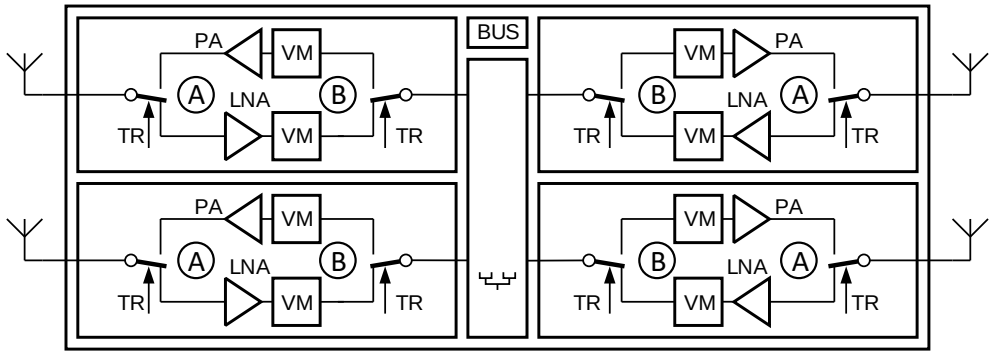


- System development kit to support system co-design and evaluate BFICs at antenna level
- Full demo kit with 8x8 antenna panel, control board with GUI and power supplies included

28 GHZ MMW9002KC ANALOG BEAMFORMER

Features and Benefits		
TX	Pdiss	400 mW per channel
	P1dB	19 dBm
	EVM	< 2% at 8 dBm
	Power Gain	27 dB
RX	Pdiss	0.35 W per channel
	Power Gain	22 dB
	Noise Figure	6 dB
Digital	High-speed SPI interface	
Diagnostics	Temperature sensor and power detectors on all antenna ports	
Package	4.39 x 3.59 x 0.5 mm WLCSP	



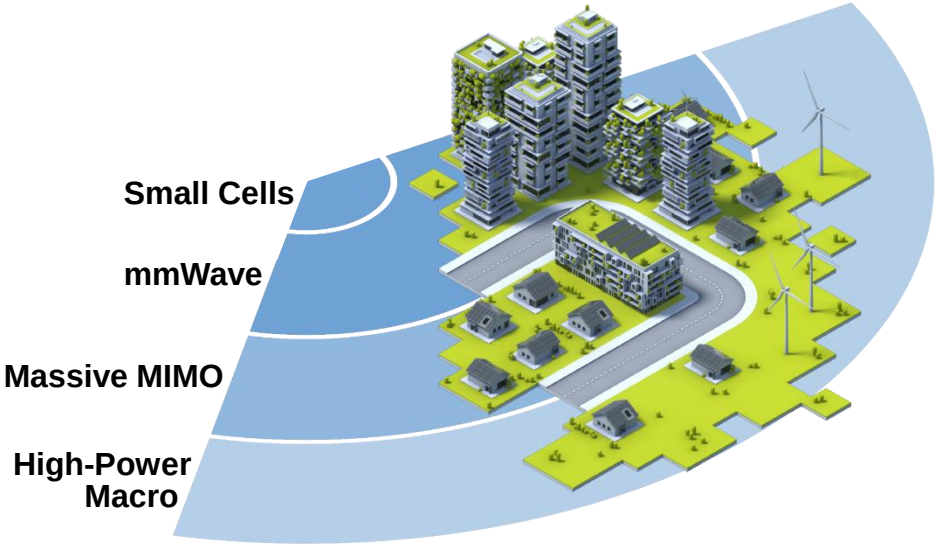


CONCLUSION: JOURNEY TO 5G

From:

2-3-4G

To:



5G

NXP enables the diversification of 5G Radio Access Networks

NXP SERVES ALL 5G CONFIGURATIONS

Frequencies

Power levels

Architectures

SECURE CONNECTIONS
FOR A SMARTER WORLD

IWPC Webinars & Workshops H2 2021

Aug 18: Building The 5G Network Of The Future

Aug 25: Antenna in Package for 5G mmWave Infrastructure

Sept 1: High Imaging Automotive Radar

Sept 14: Web-based Solutions to Address Automation for mmWave Propagation and 5G Network Planning

Sept 22 TBC: 5G Network Architecture, Technology/Service Evolution and 5G User Equipment Evolution

Sept 29: 5G End-to-End Orchestration and Automation of O-RAN Based Network Slices across RAN, 5G Core and Transport Domains

Oct 6: Sub-THz Technologies for Advanced In-Cabin Sensor Systems, Sensor Fusion and High-Speed Data Links

Oct 13: RF Laminates And Advanced Antenna Technologies For mm-Wave Radar Applications

Oct 27: Exploring 5G Vertical Market Drivers & Connected Mobility

Nov 3: Applications for High Power User Equipment (HPUE) on FirstNet

Nov 8-10 TBC: Exploring The 6G Vision and Key Enablers (F2F)

Nov 10-12 TBC: Connected Mobility in Vehicles (F2F)

Dec TBC: Open RAN Deployment Opportunities and Challenges (F2F)

Dec 15: Concept Design, Functional Prototyping, Engineering Design Development, Certified 3rd Party Environmental and Mechanical Testing, Verification and Design Validation