

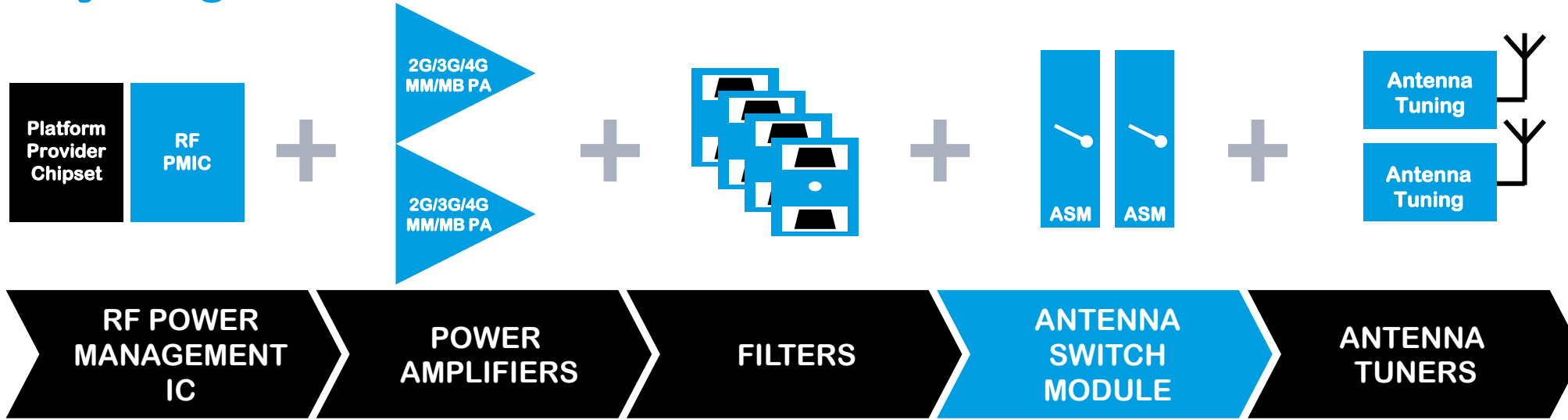
# What is QORVO ?

- The Merger of RF Micro Devices and TriQuint Semiconductor in 2014
- HQ is in Greensboro NC along with III-V/Filter Fab
- Additional Fabs in Hillsboro OR, and Richardson TX
- Approximately 8000 Employees Worldwide
- Mobile: A world class Leader in Cellular Front End components and modules
- Infrastructure and Defense (IDP): A world class Leader in Gallium Nitride, Cellular Base Stations, Wi-Fi, IoT



# Mobile Products and IDP (Infrastructure and Defense)

Everything Between the Transceiver and the Antenna!



Mobile

- The world Leader in Gallium Nitride (GaN) Technology
- Wireless Infrastructure
- Wi-Fi (802.11a/b/c/g/n/x) Power Amplifiers, LNAs, switches, filters
- Internet of Things (IoT)
- CATV Hybrid Amplifiers
- Defense & Aerospace
- Automotive (V2V)



Infrastructure

# Challenges for 5G

## What to expect based on past experience?

- Coverage
  - Is it going to be worth building out the >6GHz infrastructure?
- Band fragmentation and MIMO requirement is going to change a LOT of things
  - More complicated handsets
  - More antennas
- Technology selection
  - What will be the “right” technologies
  - Is availability/supply chain going to be able to support it?
- Habits and expectations
  - New phone model every year?
  - Do old tricks work for the new dog? ET, DPD, etc.
  - Will customers (phone manufacturers, etc) adjust expectations?
  - Will adoption and extinction of old stuff go as expected?

# Back-up slides

# Challenge I - Coverage

## mmW Issue

- Coverage. If it's bad, customers are not happy!
  - <https://www.theverge.com/2019/4/4/18295600/verizon-5g-network-first-tests-data-speed>



Ugly "Tree"



Will People Hug a Really Ugly "Tree"?  
5G Tower in Chicago

 **Neville** ✓  
@NevilleRay

Hey @Verizon! Great job on launching your mmW 5G treasure hunt in Minneapolis & Chicago! To be clear, things you need are:

- An extra \$10 a month 💰
- Modded Moto Z3 📱
- A non-existent 5G map 🗺️
- No walls, trees, buildings, windows 🚫🏠
- LOTS of luck 🍀

♥️ 700 1:51 PM - Apr 3, 2019

🗨️ 205 people are talking about this

- Coverage has to be built out – will everyone benefit? Is the cost worth it?
- Other than cities, will people tolerate ugly poles everywhere?



# Challenge II-Band Fragmentation and MIMO

Currently multiple in, multiple out (MIMO) is optional. For 5G it is required.

## 5G-NR Bands

Country / Region	Sub-6 GHz Spectrum (Low and mid band)	Spectrum Above 6 GHz (High band)
USA	600MHz 3100 – 3550 MHz 3700 – 4200 MHz	27.5 – 28.35 GHz 37 – 40 GHz 64 – 71 GHz
UK / Europe	700 MHz (UK) 2.3 GHz (UK) 3.4 GHz (UK) 694 – 790 MHz 3400 – 3800 MHz	24.25 – 27.5 GHz
Japan	3600 – 4200 MHz 4400 – 4900 MHz	27.5 – 28.25 GHz
China	3300 – 3600 MHz 4400 – 4500 MHz 4800 – 4990 MHz	24.25 – 27.5 GHz 37.25 – 43.5 GHz

Current LTE 50 frequency bands which are below 3.6 GHz

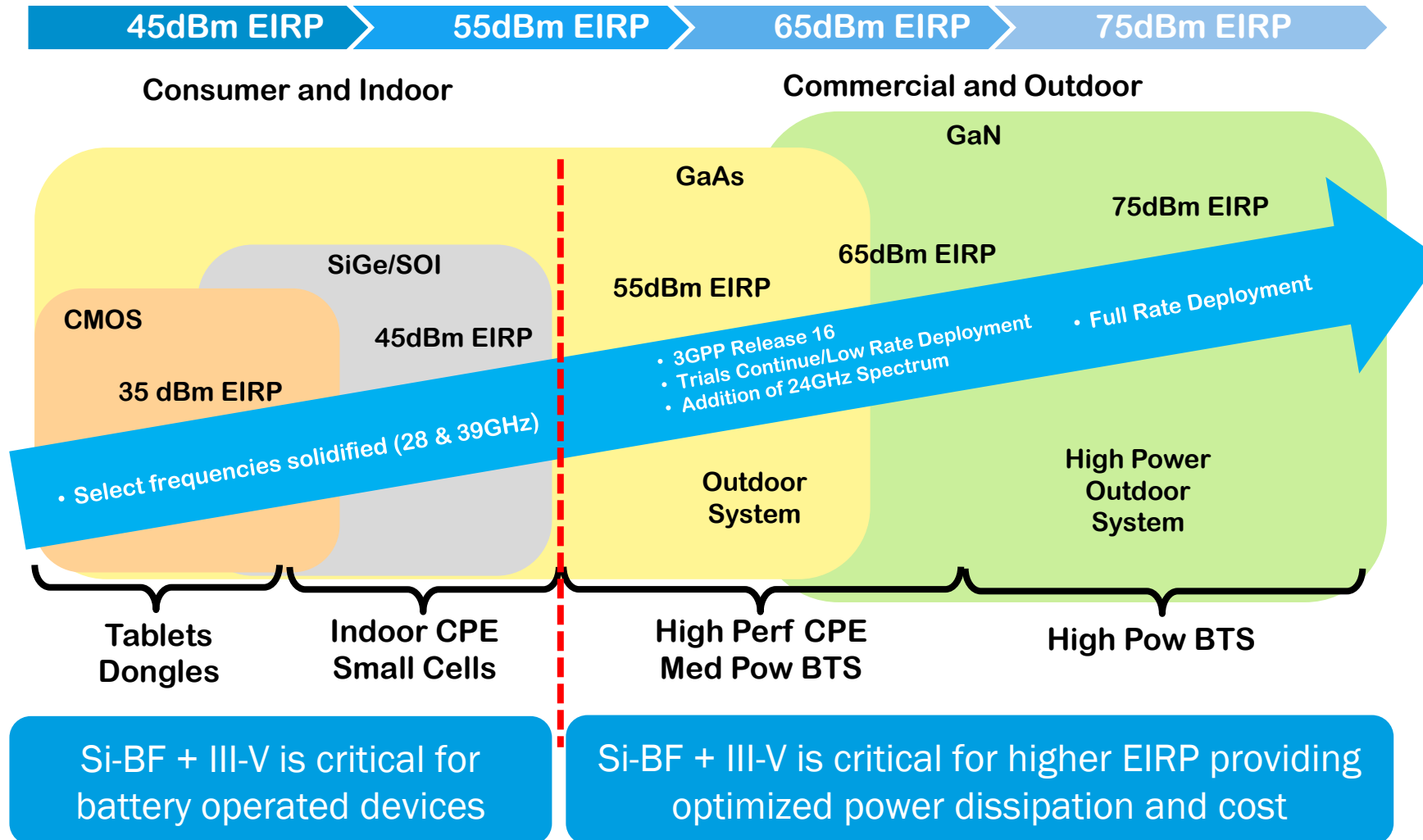
More bands=more problems

Phone manufacturers will need to include all these! This will increase already too expensive phone costs.



# Challenge III - Technology Selection and Availability? mmW Semiconductor Technology

As Effective Isotropic Radiated Power (EIRP) increases the choice of front-end technology may change



# Challenge IV – Habits and Expectations

- Design cycle time has steadily decreased over time. Will customers accept longer development times?
  - Initially, evolutionary design path (especially at mmW) will be broken
- The industry has spent a lot of time and effort in the last 5 years preparing for envelope tracking and digital pre-distortion to improve power added efficiency (PAE)
  - What is the customer (phone manufacturer or end user) expectation when these things no longer work?
  - Will the much worse figures of merit (like PAE+ACPR) be acceptable?
- Will adoption be as wide spread as hoped (or as fast as hoped)? How fast will old specifications be killed off? Example – look how long it took to get rid of AMPS (which meant worse CDMA performance) and/or GSM!