



AHEAD OF WHAT'S POSSIBLE™

RF Technology for 5G mmwave Systems

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WHAT WE DO

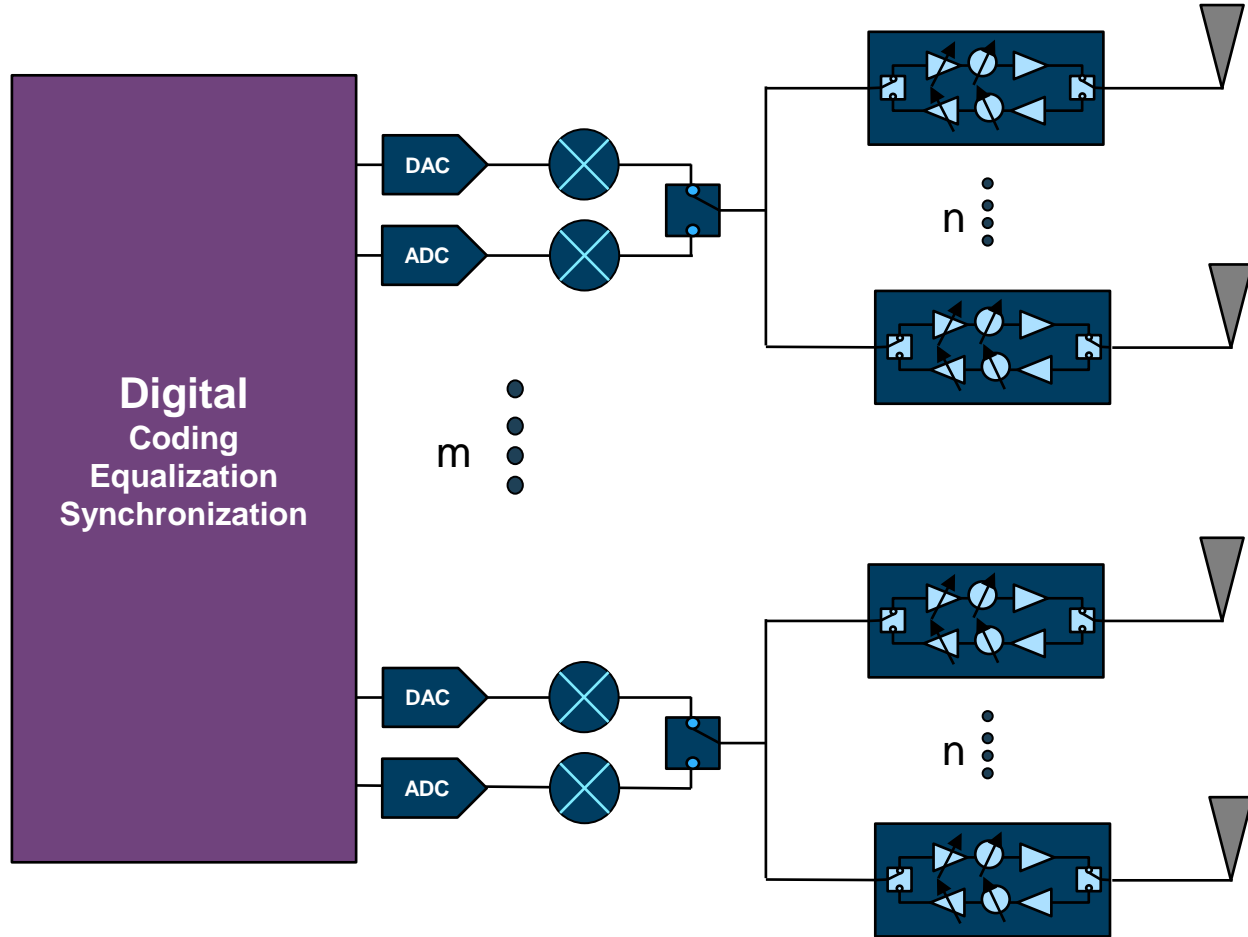
We enable our customers to interpret the world around us by intelligently bridging the physical and digital with unmatched technologies that sense, measure and connect.



Agenda

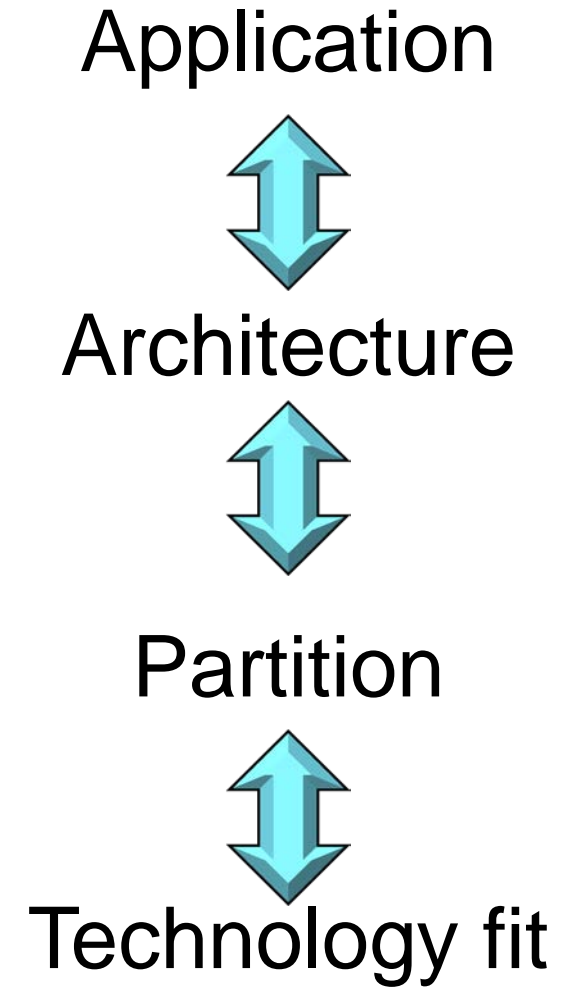
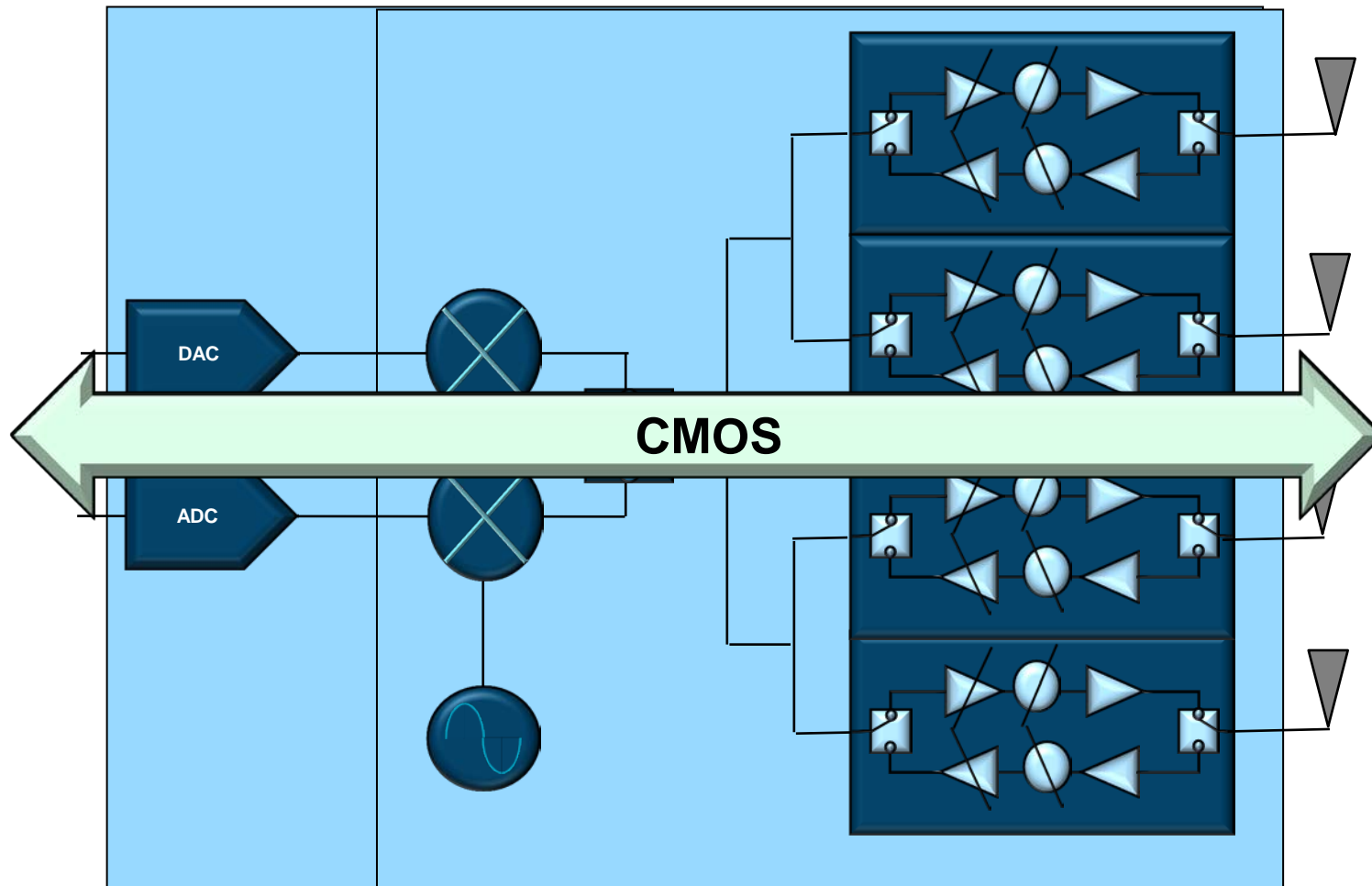
- ▶ Hybrid Beamforming
- ▶ mmwave Radio technologies
- ▶ Optimizing the Antenna Design
 - Example – antenna with 60dBm EIRP
- ▶ RF Technology Pipeline

mmwave Hybrid Beam Forming

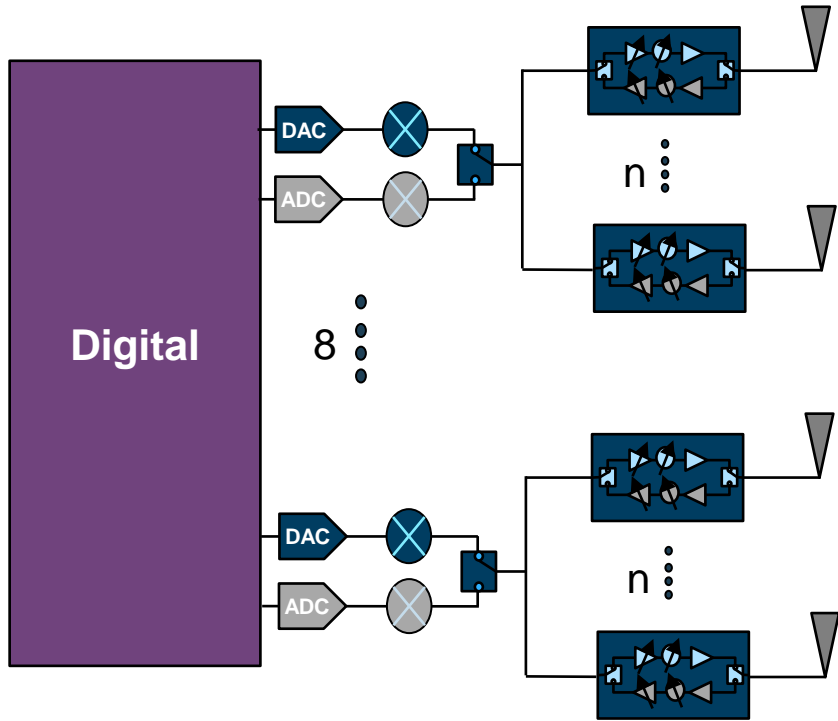


- ▶ RF beamforming channel for single stream (n antennae per data stream)
- ▶ m up/down converters and m sets of ADCs and DACs
- ▶ Total antennae = $m \times n$
- ▶ Enables spatial multiplexing and multi-user MIMO

mmwave Radio Technology

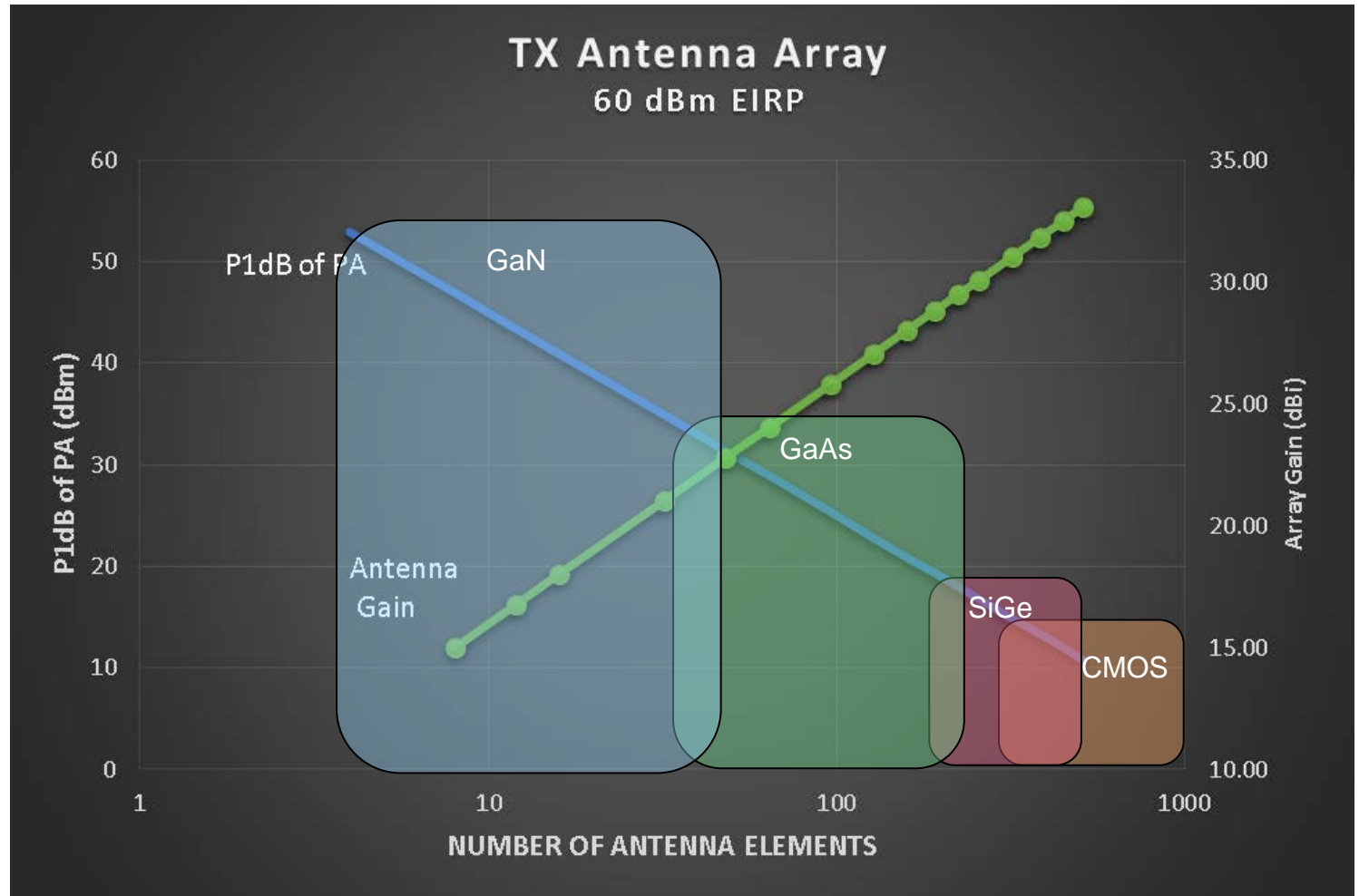


Optimizing the Antenna Array Design

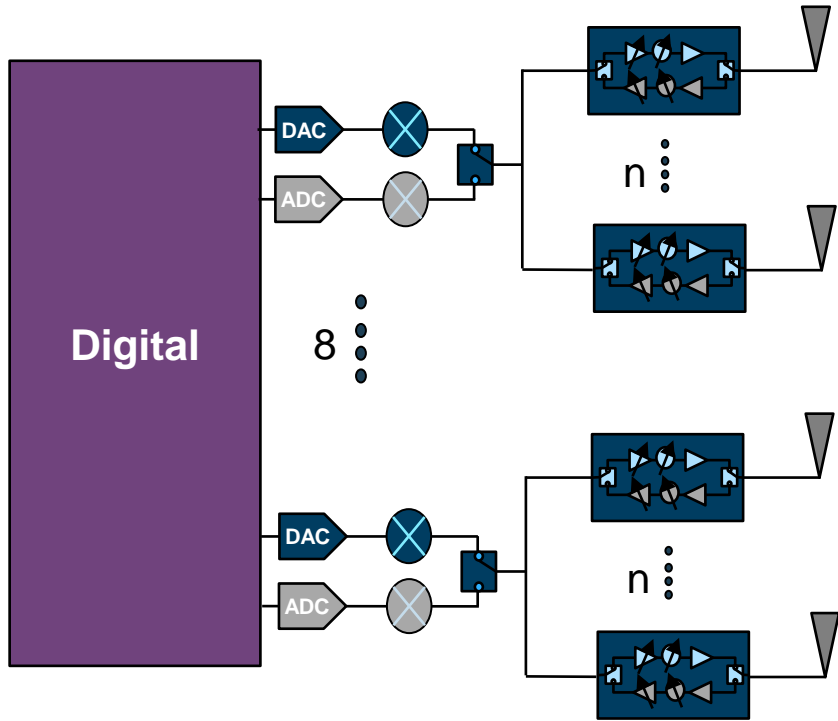


Assumptions:

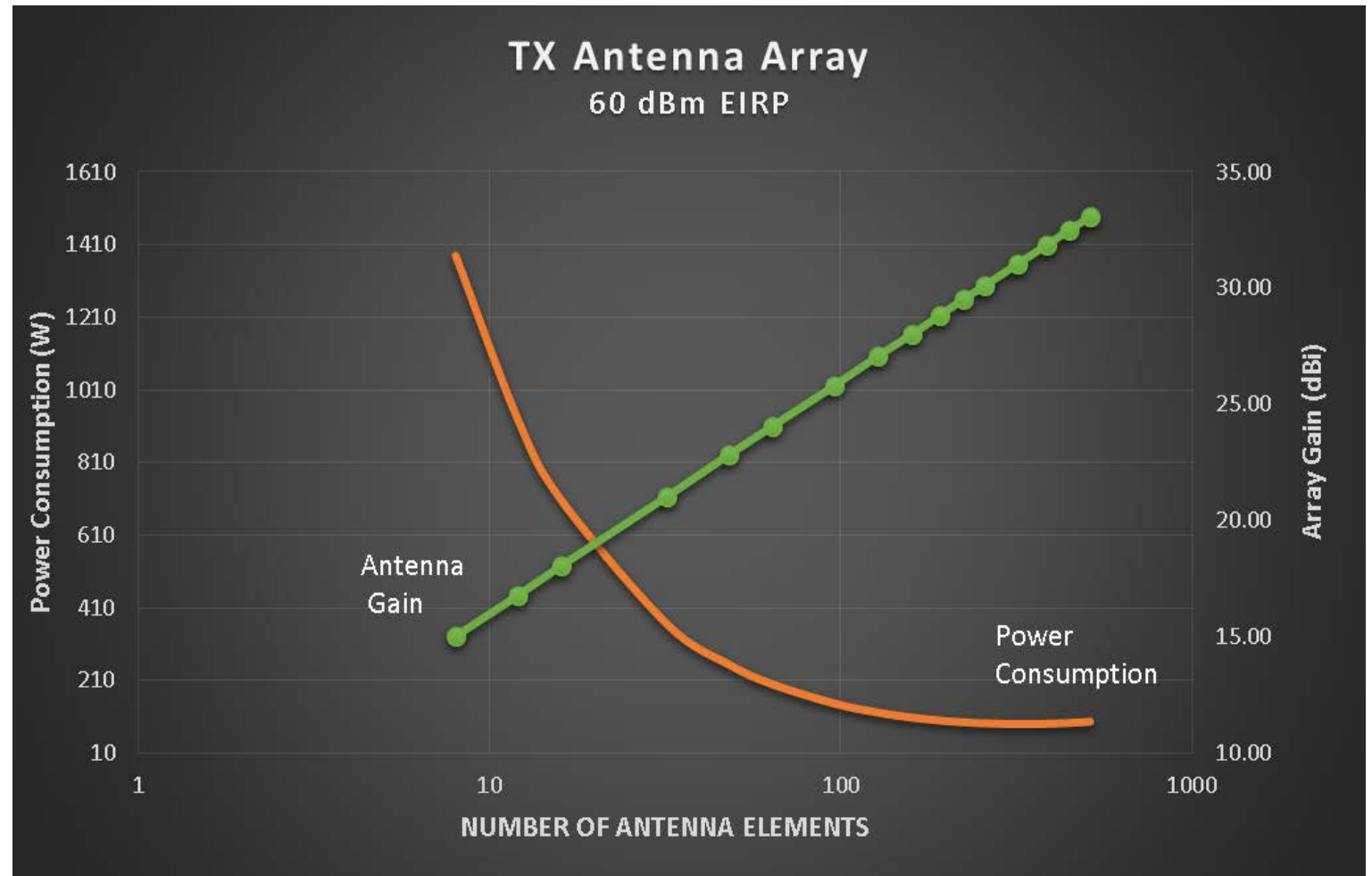
- 60dBm EIRP
- 3-4 GHz IF, 800MHz BW
- PAPR =9 dB



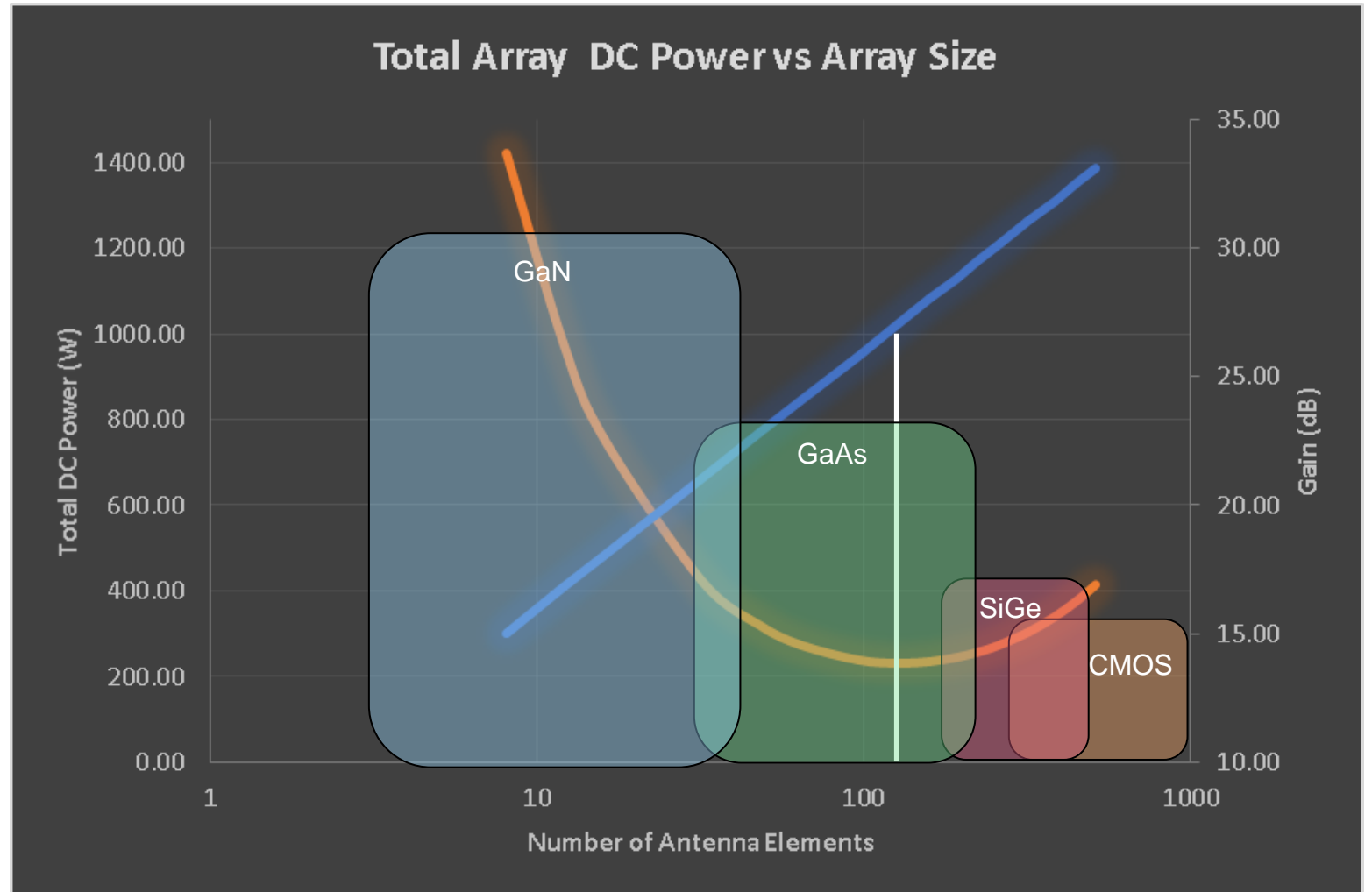
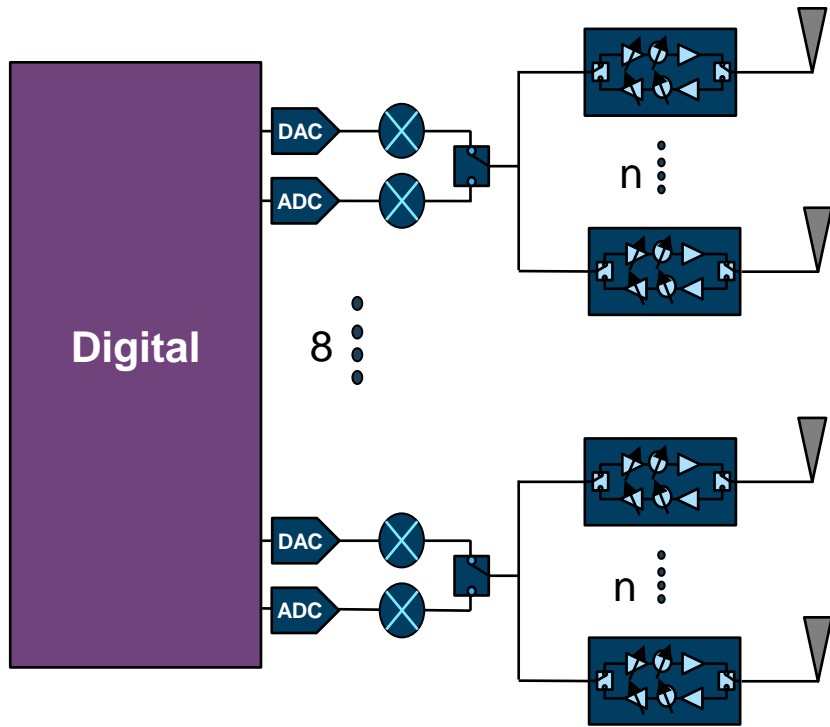
Optimizing the Antenna Array Design



- ▶ DC power consumption scales inversely with antenna size
- ▶ Beyond 500 elements diminishing returns

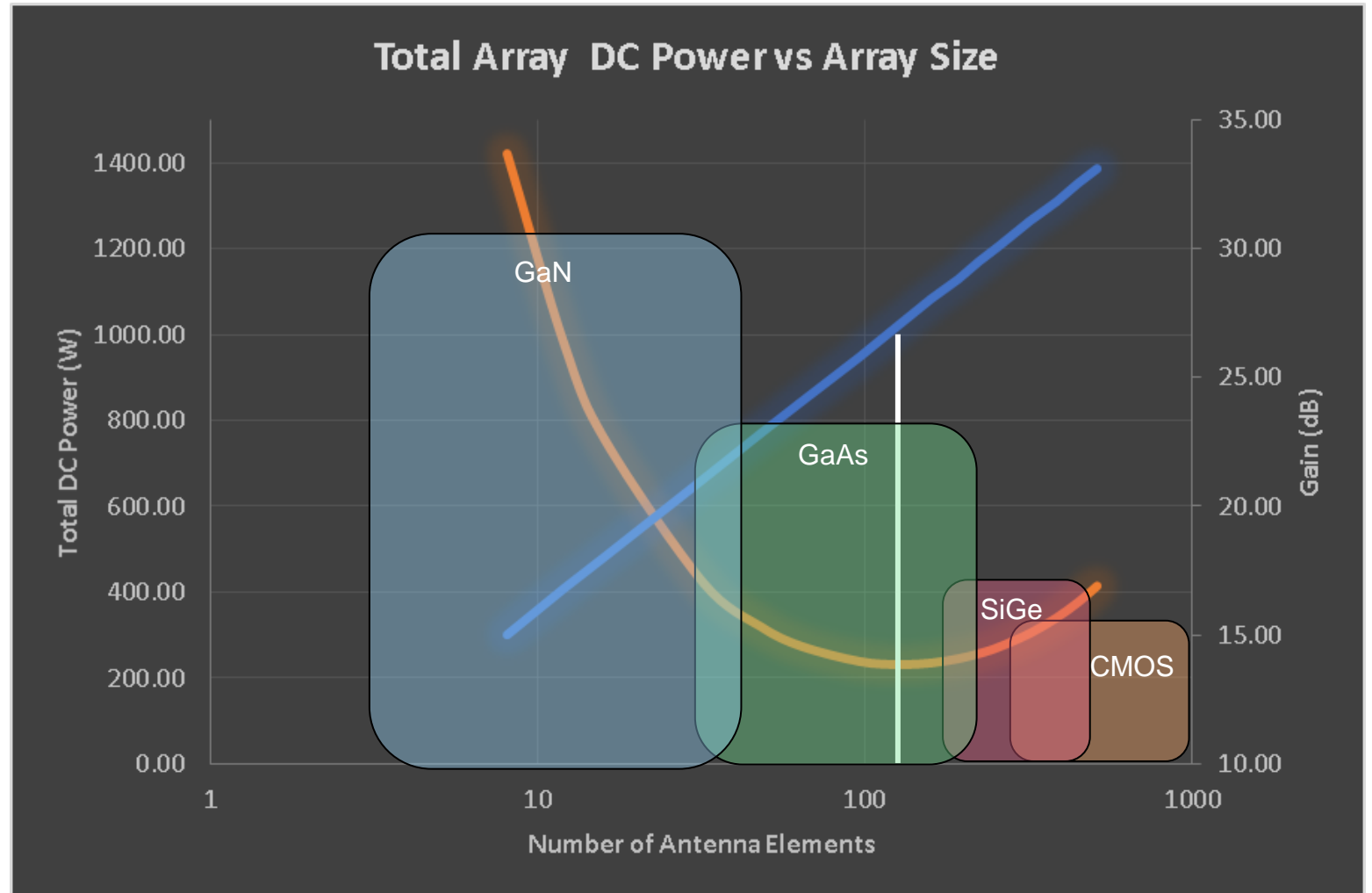


Optimizing the Antenna Array

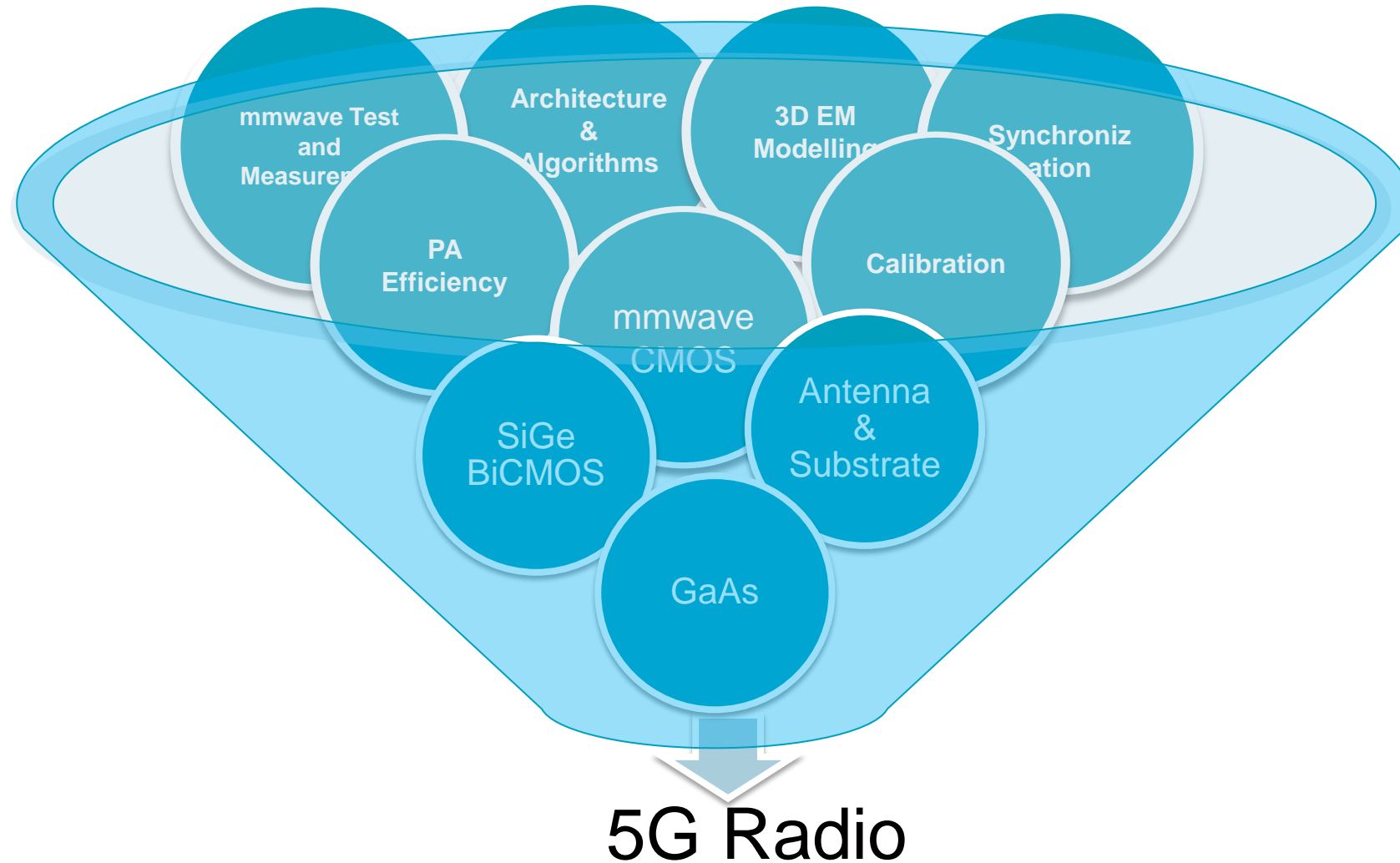


Optimizing the Antenna Array

- ▶ DC power is optimized with array sizes of ~128 element
- ▶ Larger arrays allow for the use of silicon PAs and allow RFICs to fit $\lambda/2$ spacing
- ▶ Smaller arrays would be optimal for lower EIRP requirements



5G RF Technology Pipeline





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