Active and Passive antennas to support coverage Capacity and Rollout needs

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IITB

IITH

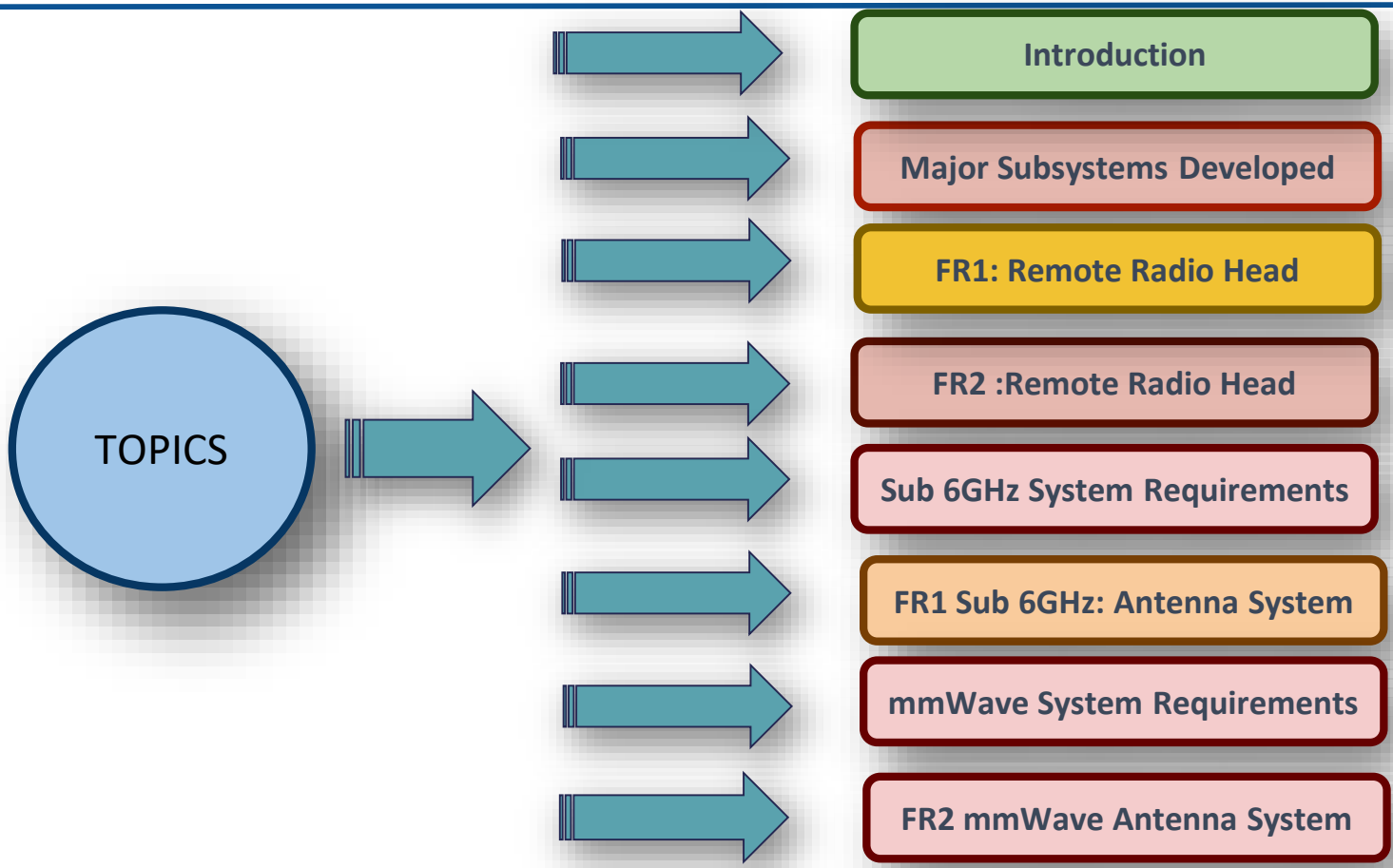
IITM

IITD

IISc

IITK

OUTLINE


TOPICS
Introduction
Major Subsystems Developed
FR1: Remote Radio Head
FR2 :Remote Radio Head
Sub 6GHz System Requirements
FR1 Sub 6GHz: Antenna System
mmWave System Requirements
FR2 mmWave Antenna System

5G and beyond : Enablers for next generation Cellular Systems

- More spectrum (mmWave)
- Efficient frequency reuse/coexistence (massive MIMO) sub 6GHz
- mmWave
- Massive amount of spectrum ⇒ Higher data rates •Large attenuation from path loss& shadowing
    - Stringent ADC requirements
    - High speed baseband processor requirements
- massive MIMO
    - High directivity
    - Large antenna array size
    - Channel estimation challenges

mmWave massive MIMO in cellular

- Directivity of massive MIMO compensates for high mmWave attenuation, reduces multipath and multiuser interference
- mmWave frequencies reduce the size required for massive MIMO antenna arrays.

Major Subsystems developed

- Integrated mmWave Radio Front end
  - Development of hybrid analog/digital architectures
  - 256 Antenna (with 4 streams)
- Massive MIMO subsystem
  - 64 Antenna systems (Sub 6 GHz) Radio, Front end, Baseband
- 5G Base band
  - 5G NR (3GPP 38 Series) compliant
  - SA mode :Supporting lower bands (< 6 GHz) and higher bands (> 6 GHz).
- 5G Core Network. SDN based Multi-RAT using WiFi etc

FR1: Remote Radio Head

Designed and built in-house

At IMC

RF Features

- 3.5 GHz
- 100 MHz
- 64 TRX
- Dual Polarized
- 1.5 Watt per Antenna
- TDD

Mechanical Features

- IP65
- 33 Kg

Fronthaul

- e-Cpri (10/25G)

Software

- 3GPP (5G NR)
- 7.2 split (3GPP)

Antenna

Sameer

RF | FPGA | Front Haul

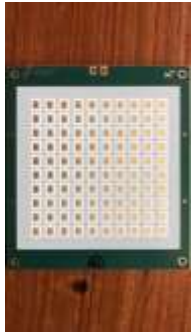
IITM, Sameer

Xilinx

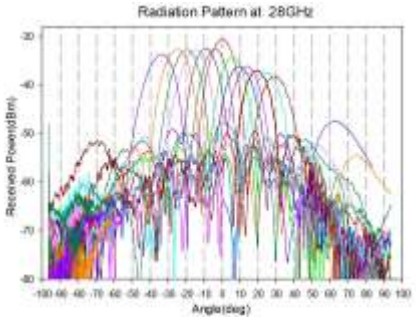
L1 Software (embedded)

IITM, CEWiT,
IITH, IITD, IISC

FR2 :Remote Radio Head



Designed and built in-house



RF Features

- 28 GHz
- 400 MHz
- 4x 64 element phased array
- TDD

Mechanical Features

- IP65
- 15 Kg

Fronthaul

- e-Cpri (10/25G)

Software

- 3GPP (5G NR)
- 7.2 split (3GPP)

Antenna

Sameer

RF | FPGA | Front Haul

IITM, Sameer

Xilinx, NXP

L1 Software (embedded)

IITM, CEWiT,
IITH, IITD, IISC

Sub 6GHz System Requirements

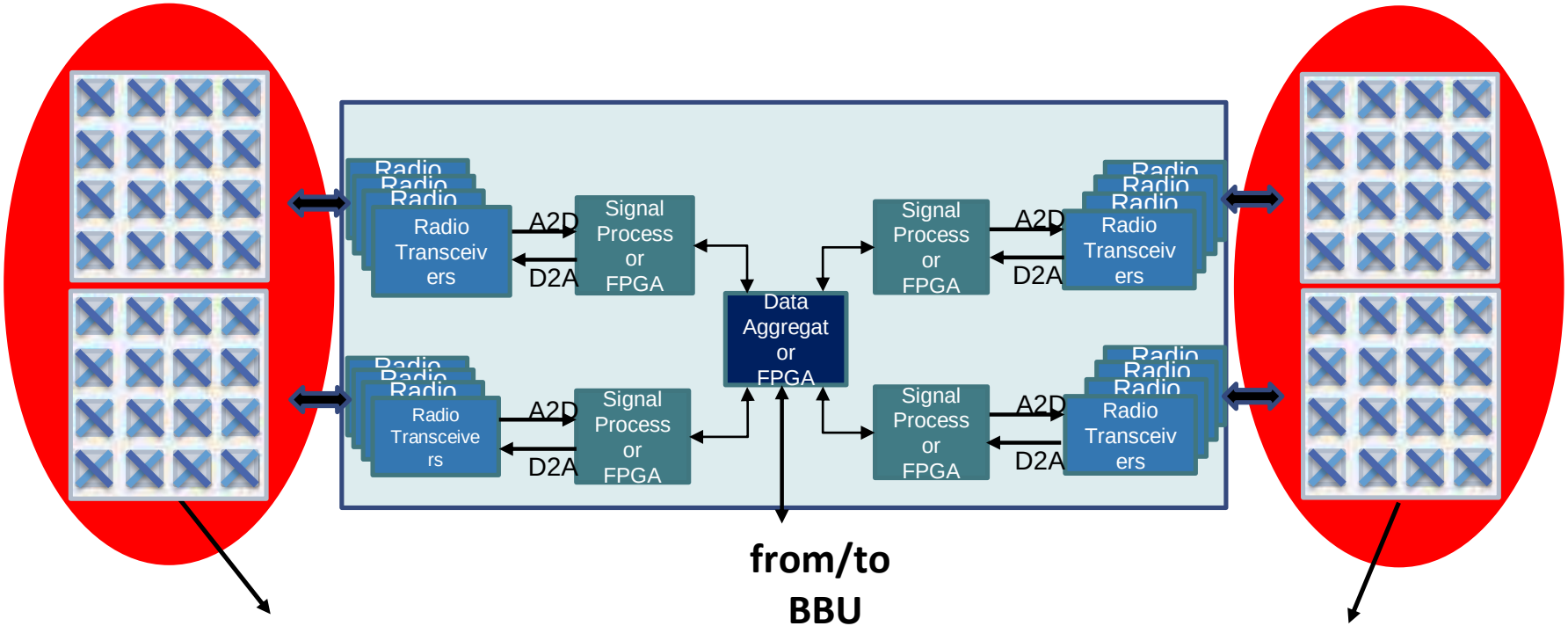
Operating Mode	TDD
TDD switching speed	10 us
Rx Noise figure of Radio Transceiver	13 dB
Tx output power from Radio Transceiver	-25 dBm
Tx gain required to get 20 dBm output	45 dB
Reciprocity and Linearity Maintenance	TDD Calibration Path and ORx Path to do DPD
To Attenuate Out of band Interferers and Reduce Out of band radiation	Saw Filters

Massive MIMO system

- **64 Antenna systems (Sub 6 GHz)**
- **Radio Front End Modules**

- Design and Development of RF Front end modules along with IITM
- UE RF development
- Research in novel Antenna configurations
- Design and development of CRAN MIMO antennas
- UE antenna Design
- RF front-end – PA, LNA, Antennas
- RF operation at 3.5GHz - 100 MHz bandwidth

FR1 Sub 6GHz: Antenna System



Massive MIMO : 64 antennas for sub-6 GHz

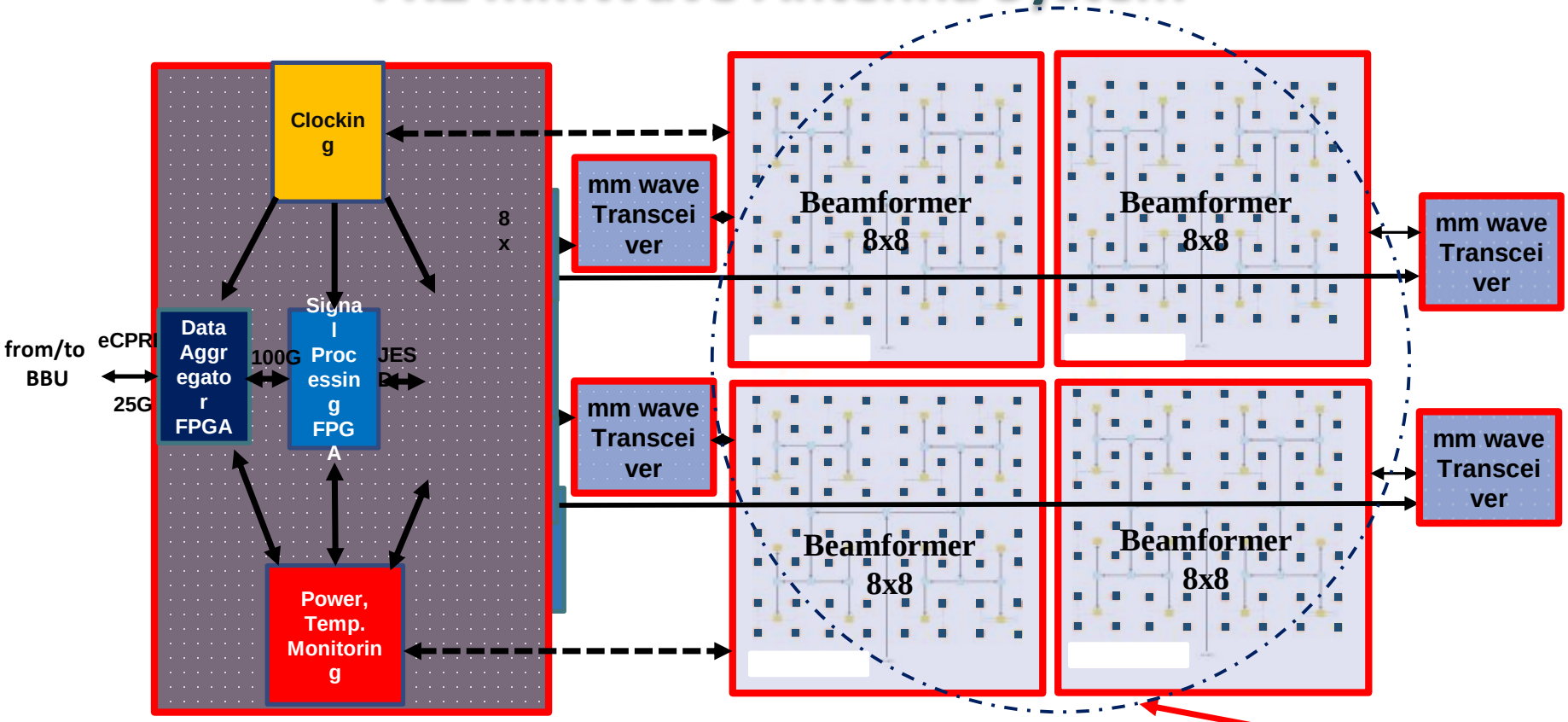
mmWave System Requirements

- RF front-end – PA, LNA, Antennas
- RF operation at 28 GHz – 400 MHz bandwidth
- ADC, DAC interfacing
- eCPRI interface with BBU
- Low PHY processing
- Clock Synchronization
- **Support for Hybrid beamforming @mmWave**
- **256 antennas for mmWave (4 streams)**

FR2

- Design and development of digitally controlled Phased array antennas for mmWave
- Development of Phased Array control Algorithms/Software
- Development of antenna diagnostic algorithms
- Integration of mmWave antenna with RF and Baseband
- Development of 1D Switched beam antennas (Rotman Lens based designs)
- Development of 2D Switched beam antennas (Lens based designs)
- mmWave Tx/Rx design
- UE: RF and Antenna development

FR2 mmWave Antenna System



256 antennas for mmWave (4 streams).