LTE – Base Station Design Considerations and Challenges

Presenter -

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Tata Elxsi – At a Glance

Technology-led Services Company

- TATA ELXSI – the Technology arm of the TATA group
- Headquartered in Bangalore
- Core Practice Areas– Embedded product design services, industrial design & engineering, Animation & Visual effects and System Integration Services
- **Product Design Services** focus on
  - Communications
  - Broadcast networks
  - Automotive
- International presence - US, Europe, APAC and Japan

World Class Systems & Processes

- Mature Quality Processes and Custom methodologies
- Assessed at SEI CMMI Level 5 and ISO 9001:2000
- Assessed at Auto SPICE Level 5
- Assessed at ISO 13485:2003 for Medical Product design
- BS 7799 certified Information Management Processes

Global Delivery Capabilities

- 3500+ team of designers, engineers & creative talent
- World-class Labs, Design Studios & Centers of Excellence

Product Design - Business Units

Communications Business Unit

VOIP, Unified Communications, Data Networking & Security Solutions, Next Gen Wireless Solutions

Broadcast Business Unit

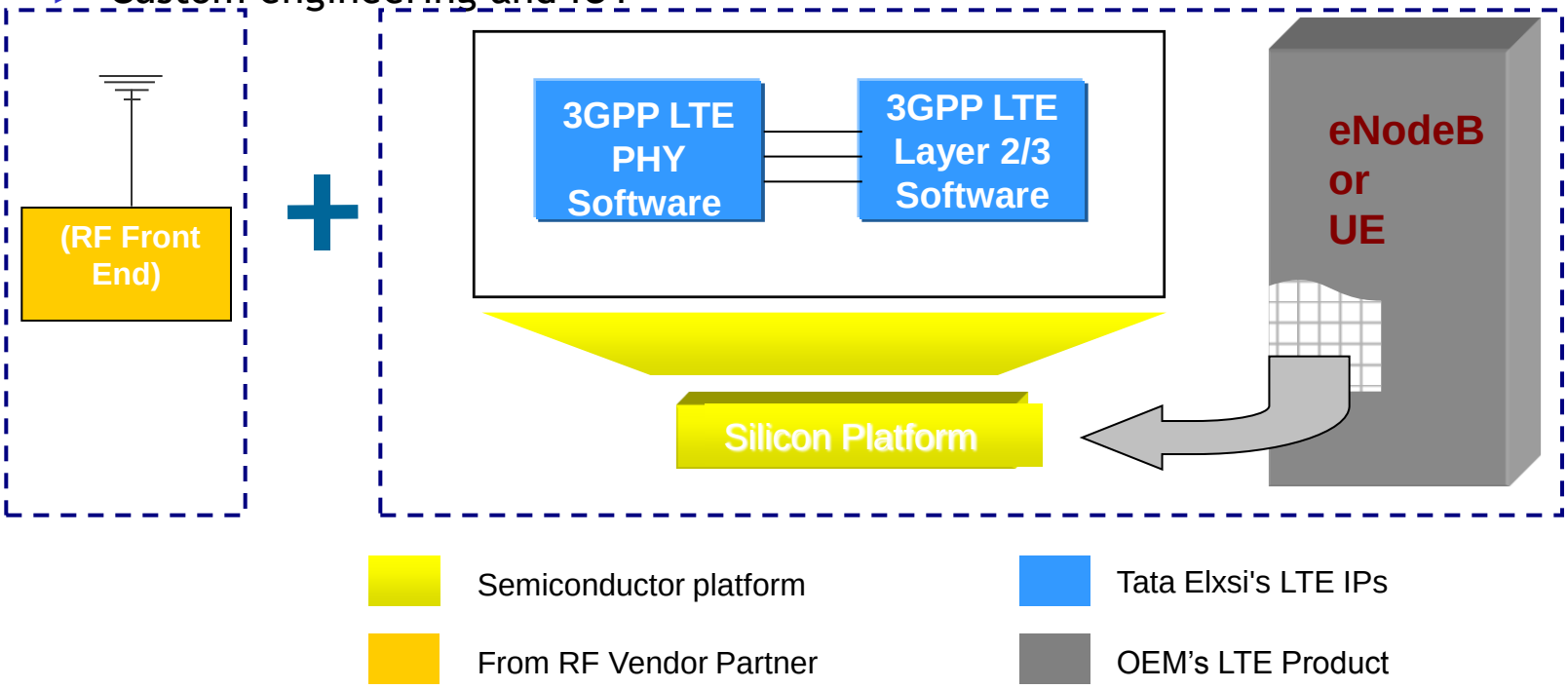
Set top boxes, VOD & media servers, Media and authoring software, Multimedia codecs

Transportation Business Unit

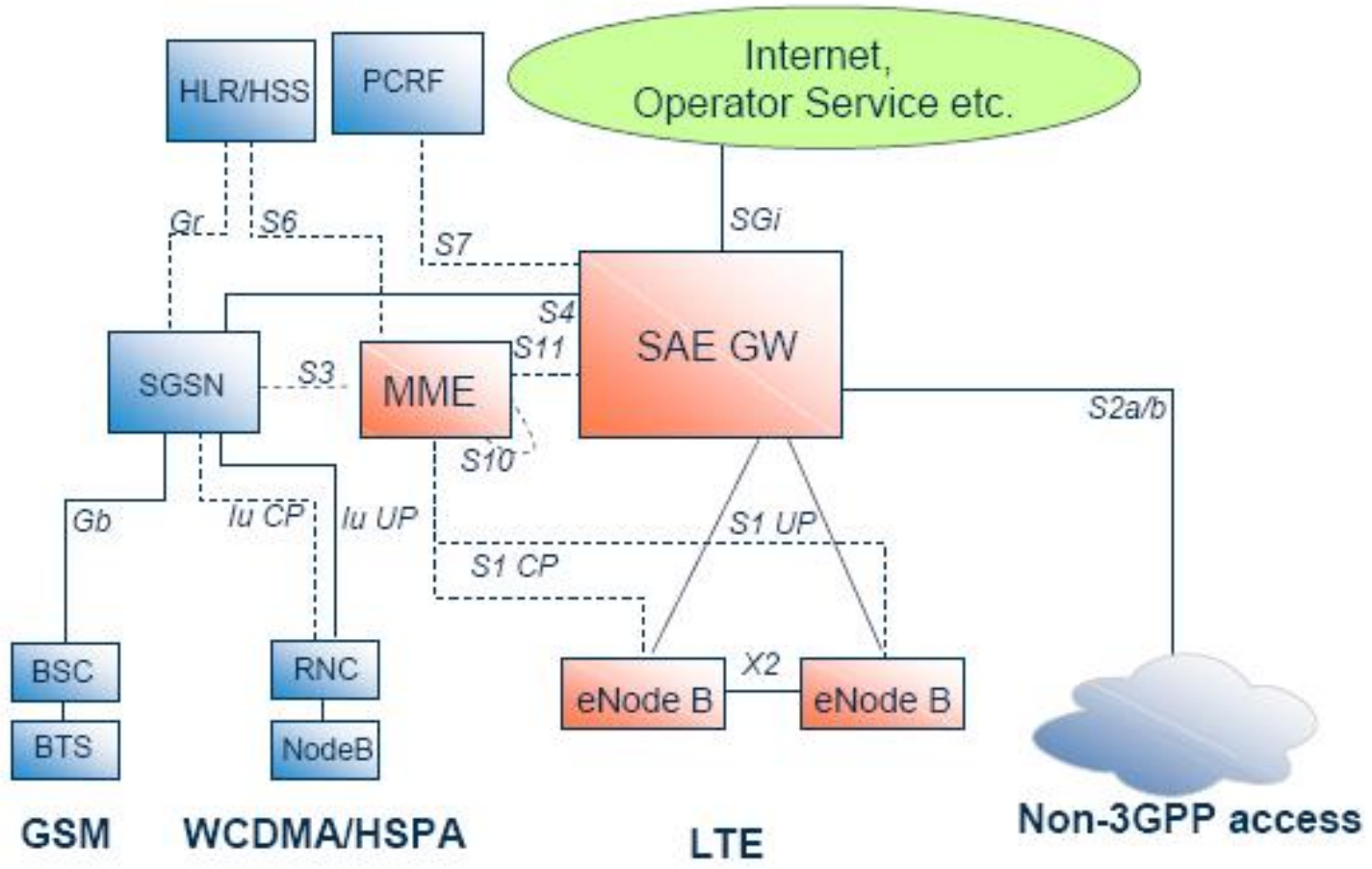
Electronics for body, safety, power train and infotainment

Tata Elxsi - LTE Program

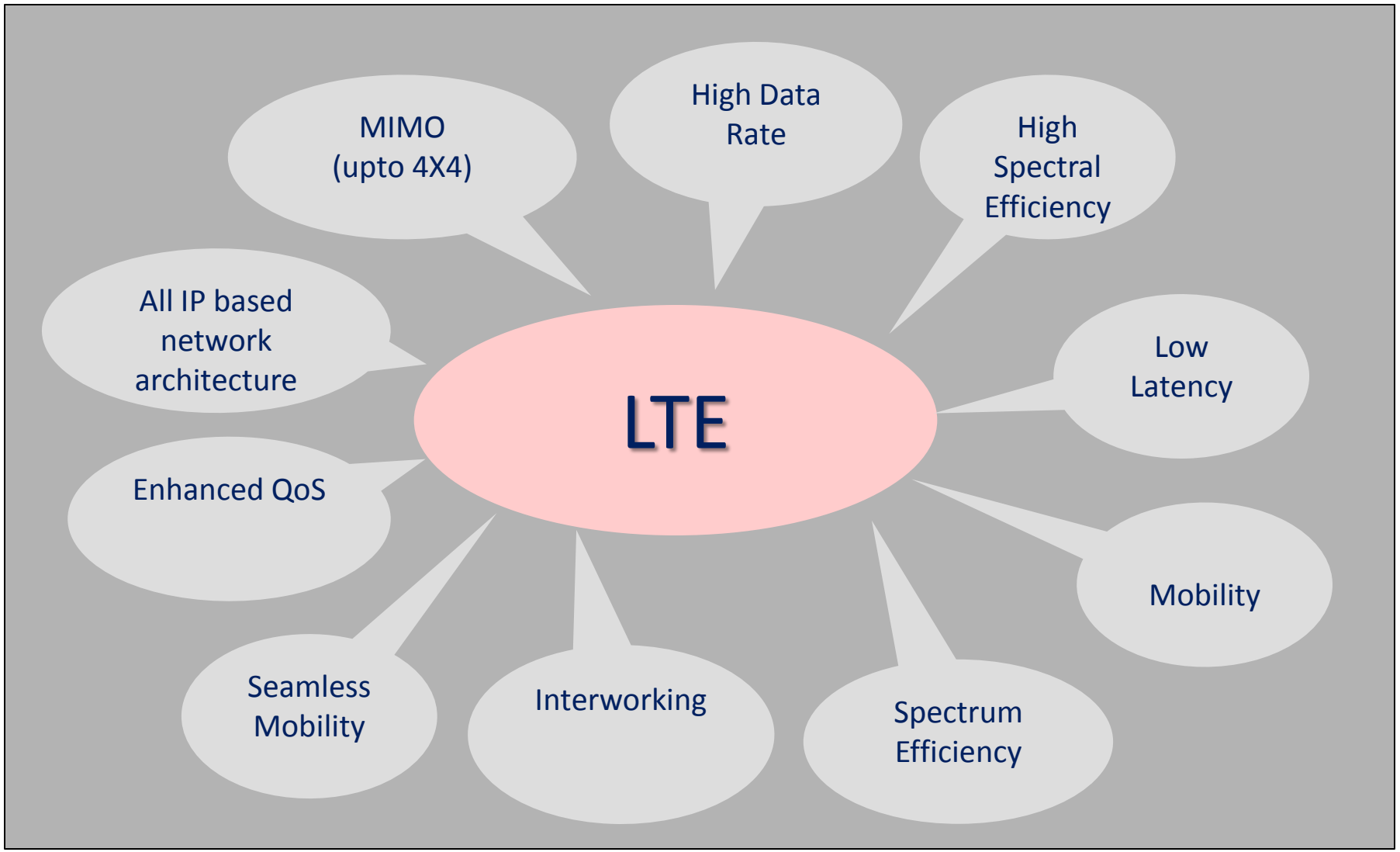
- **200+ engineering team**
  - 100 engineers dedicated to IP development
  - eNodeB Reference design integrated with Radio
  - UE emulator (complete UE L1 and L2/L3 protocol stack)
- **Product engineering Services for eNodeB and UE**
  - 100+ engineers engaged with leading customers
  - Custom engineering and IOT



LTE Network


HLR/HSS
PCRF
Internet,
Operator Service etc.
Gr
S6
S7
SGi
S4
S11
SAE GW
SGSN
S3
MME
S2a/b
S10
Gb
Iu CP
Iu UP
S1 UP
S1 CP
BSC
RNC
X2
eNode B
eNode B
BTS
NodeB
Non-3GPP access
GSM
WCDMA/HSPA
LTE

LTE Specifics Features



LTE eNodeB Design Requirements

- Latency
- High Throughput
- Spectral Efficiency
- 1 ms TTI
- QoS
- Carrier Aggregation
- Scalability of eNodeB to connect to multi MME and SGW

LTE eNodeB Design Requirements

- Power Control and Inter-cell Interference Coordination (ICIC)
- *Coordinated multipoint (CoMP) transmission/reception,*
  - where transmission/reception is performed jointly across multiple cell sites (mainly) to improve cell-edge performance
- Multi Antenna Transmission
  - Diversity for improved system performance
  - Beam-forming for improved coverage (less cells to cover a given area)
  - Spatial-division multiple access (MU-MIMO) for improved capacity (more users per cell)
  - Multi-layer transmission (SU-MIMO) for higher data rates in a given bandwidth
- Backhaul design challenges

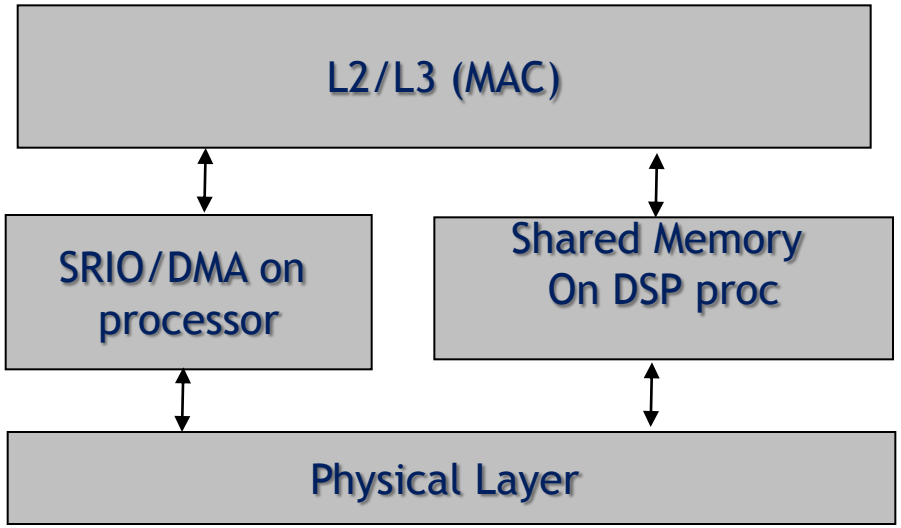
Platform specific

- Usage of multi core processors
  - Core partitioning –The key
  - High computational power
  - Optimum memory utilization
  - Usage of Data path accelerators
  - Usage of security engines
  - MPI interface (Gigabit Eth/SRIO/DMA/PCIXpress)
  - COTS platform for quick developments
  - Scalability
  - Portability to different platform
  - Time to market
  - Cost

Rationale For Core Partitioning

- Time critical and computationally intensive jobs such as scheduler in a separate core
- Parallelism between the sub frame preparation for current sub frame and scheduler input meta-data preparation for next sub frame as different cores
- Computationally intensive job such as RoHC in separate cores
- Control plane functions in separate cores, grouped

MAC-PHY Interface Possible Abstraction (Logical View)



OS Specific :

- Control plane on Linux and User Plane on Light Weight Executive
- Control plane on Linux and User Plane on RTOS (eg. Enea/ VxWorks)
- Control plane and User plane on SMP Linux with RT patch and thread affinity

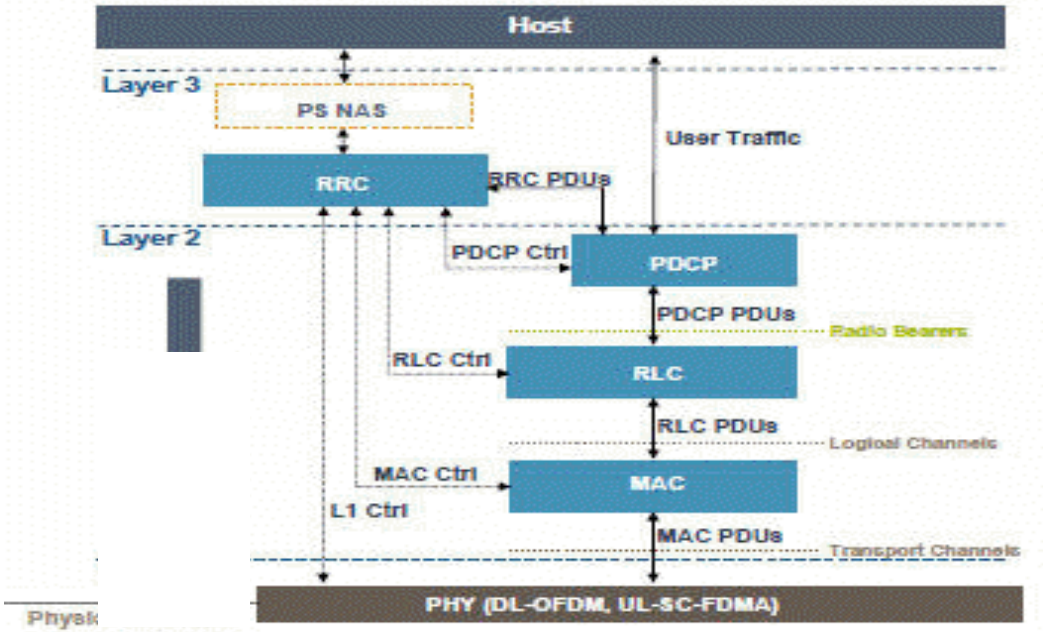
Software specific :

Task Partitioning And Prioritization

- Time critical jobs can be grouped under one task.
- Non time critical jobs can be grouped under a separate task
- Within the user plane, DL user plane and UL user plane can be grouped into separate tasks for effective DL transmissions
- Tasks handling time critical jobs assigned with higher priority
- User plane time critical jobs at higher priority than control plane tasks

Data Plane Performance Considerations

- Modules distribution and effective grouping
- Memory Pool Management
  - Deterministic Memory Allocation and De-allocation
- Buffer management
  - Zero Copy mechanism
  - Efficient Packet Processing w.r.t. Fragmentation, Concatenation, HARQ handling



Memory Management

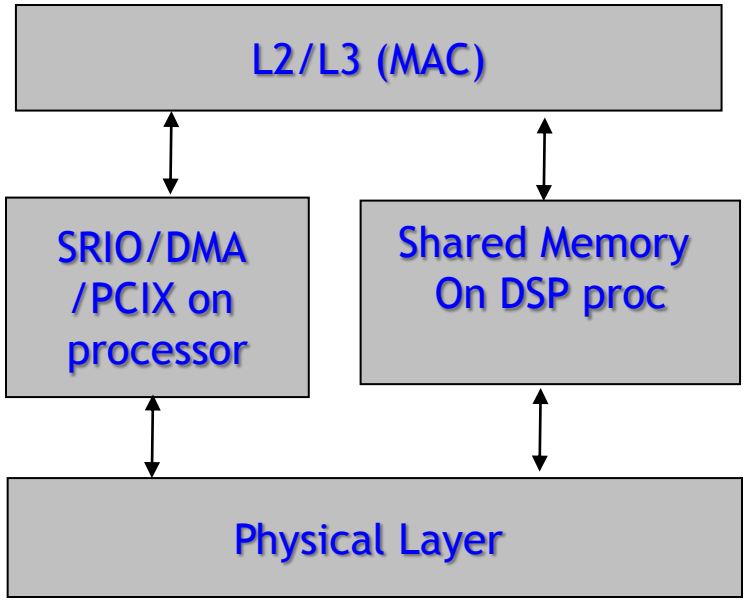
- Usage of Memory Pool mechanism and Buffer Management

  Services expected

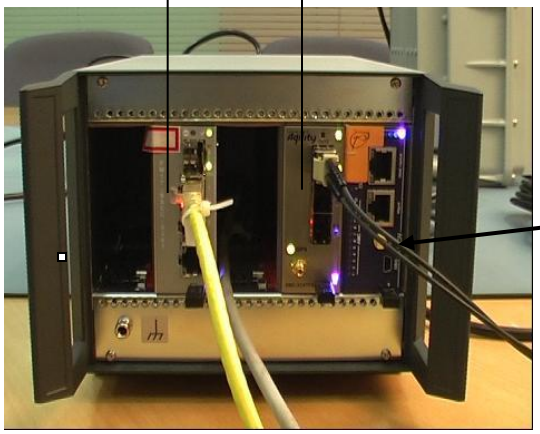
  - Memory Allocation, De-allocation
  - Measurement of current memory utilization
  - Error indication on Pool Underflow
  - Error Indication on memory segment release in wrong Pool
  - Error indication on Double Free
  - Statistics

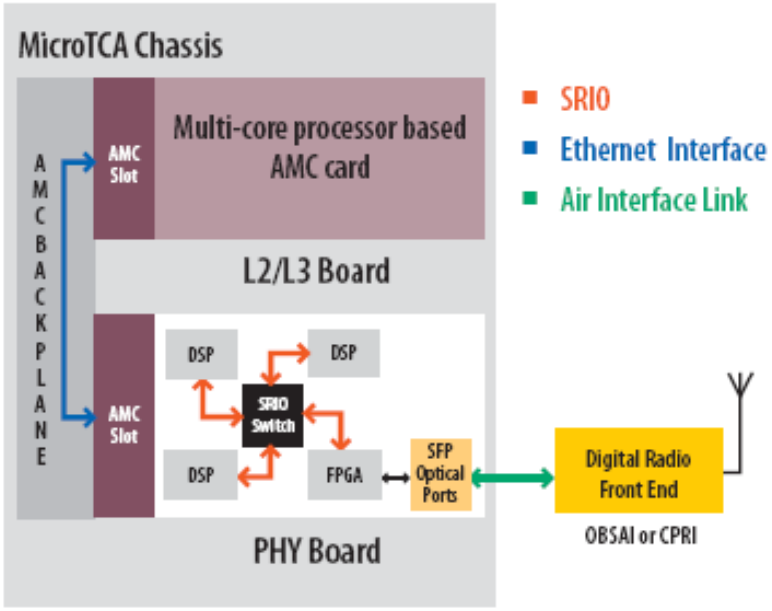
MAC – PHY Interface considerations

- MAC-PHY communication mechanism is independent on the physical link. It can be Gigabit Ethernet, SRIO, PCI express or any other communication interface
- MAC-PHY communication at every TTI
  - MAC – PHY communication considered to be error-free
  - PHY states are controlled by MPI
  - Need to supports Fragmentation and reassembly for normal/jumbo Ethernet
  - Maintains statistics information



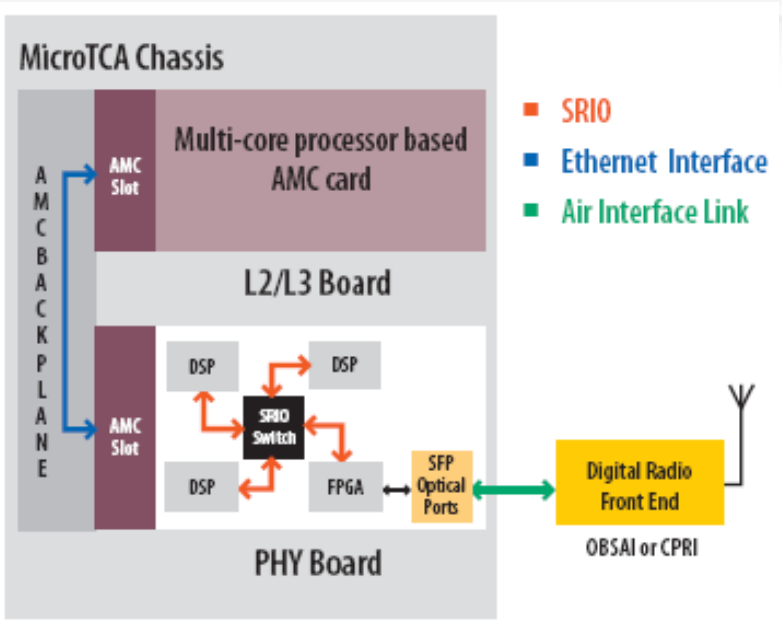
Tata Elxsi - LTE Reference design components





eNodeB Reference Design

- eNodeB Solution
  - 3GPP Release 8 compliant
  - 10 MHz; Scalable up to 20MHz
  - 2x2 MIMO; Scalable up to 4x4
  - FDD / TDD
  - Integrated with RF
  - Single / 3-sector solution



- Salient features
  - Architectures for Femto/Pico, and Micro/Macro configurations
  - Designed to support multi-core and multi-thread architecture to address scalability needs
  - Femto/Pico architecture optimized for next-generation SOC architectures
  - Well-defined interfaces for easy customization, or integration with 3rd party components
  - Readily available for demonstration on COTS platform

Thank you

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