

What can Virtualization do for 5G&B Networks: Our experiences from building a 5G Testbed

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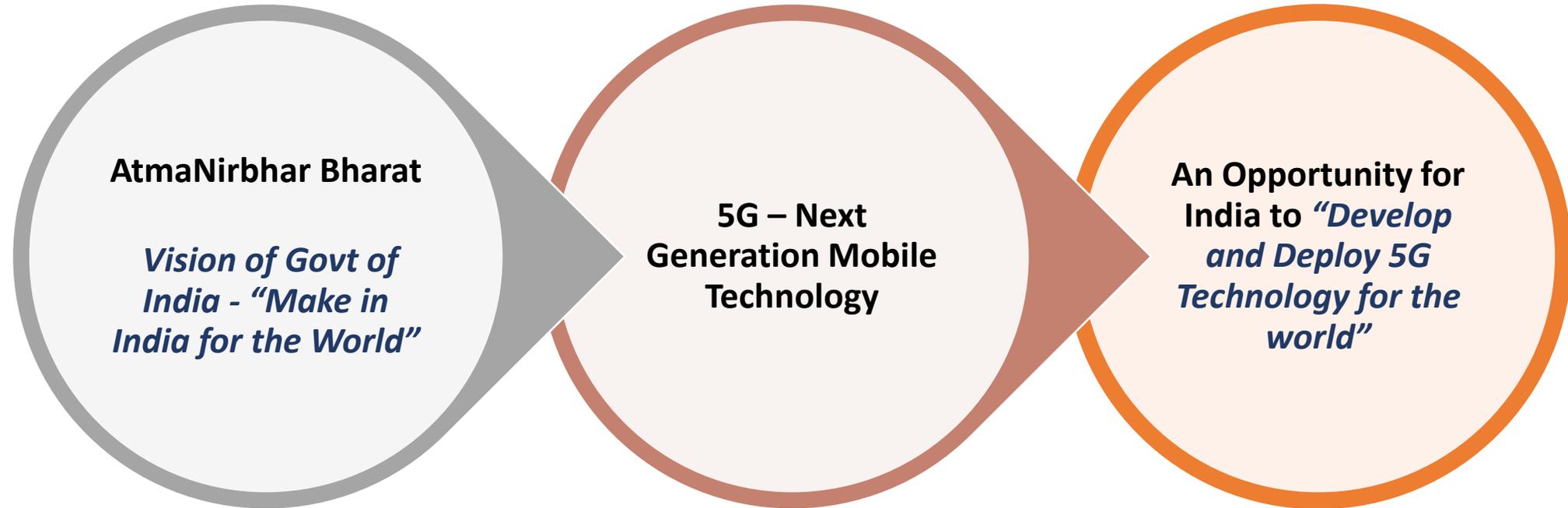
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Agenda

- Indigenous 5G TestBed
- 3GPP 5G System Architecture
- 5G Testbed Development Activity @IITB
- SDN and NFV
- Virtualization of 5G TestBed @IITB

5G - Opportunities for India



Make in India Strategy for 5G

Research & Development

- R&D at Leading Institutes: IITs, IISC
- Collaborative Research
- IPR Creation
- Capability Enhancement

Standardization

- Standardization in India - TSDSI
- Standardization in Global Forums - ITU, 3GPP, IEEE

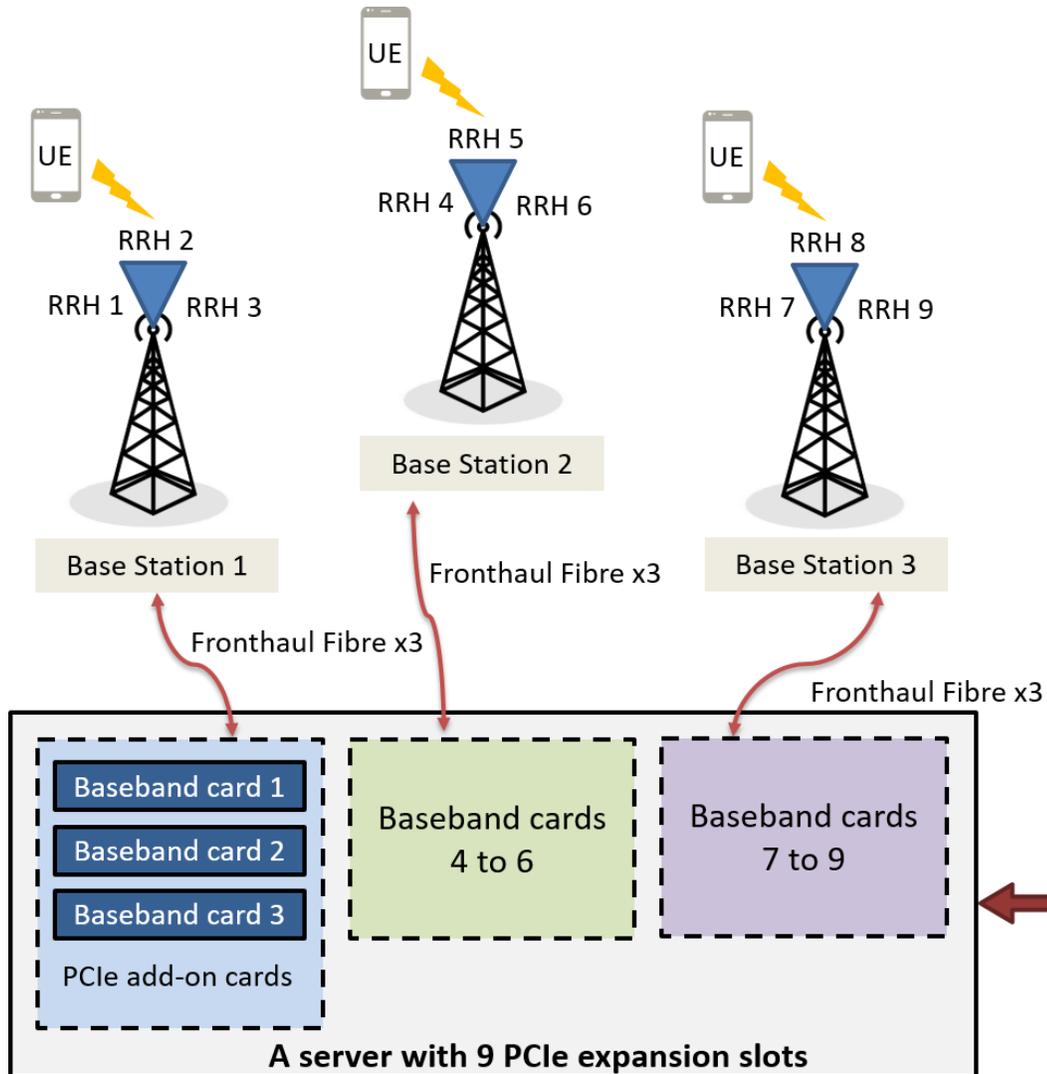
Product Development & Deployment

- Prototype Development
- Startups
- Product Design & Development
- Deployment

Indigenous 5G Test Bed

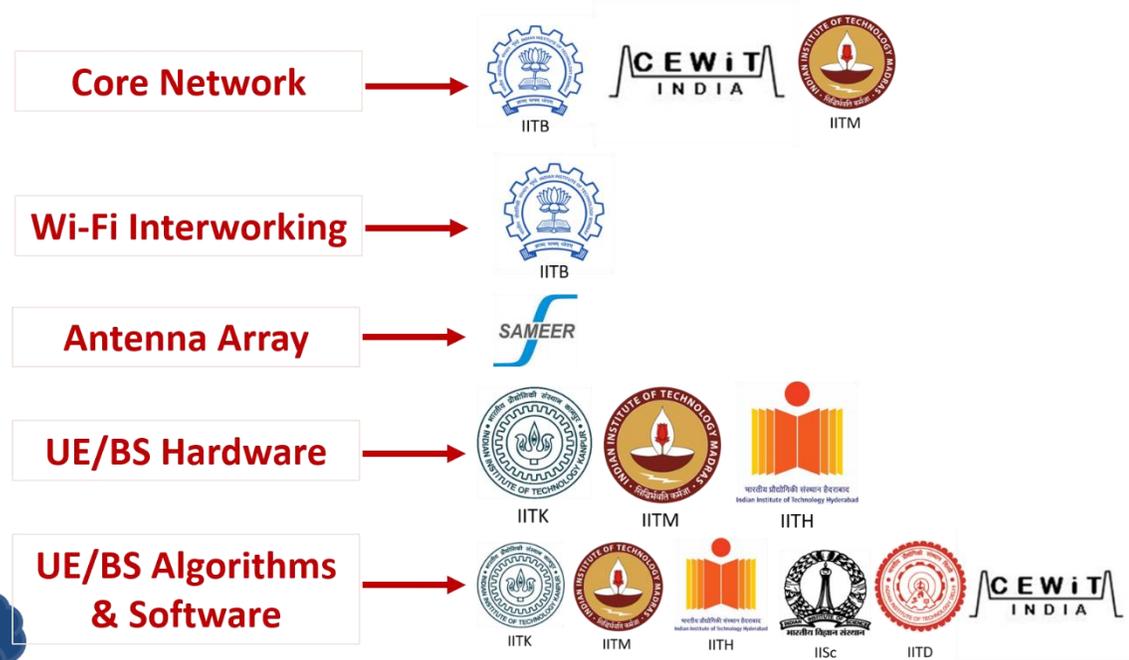
- A Key Component of 5G Strategy
- A Multi-Institute Project
 - To Enhance 5G Capabilities in the Country
- Goals
 - Enhance 5G R&D Capability in the Country
 - Boost Product Design and Manufacturing
 - Increased Participation in Global Forums/Standardization
 - Encourage telecom Product Start ups
- End-to-End 5G Testbed to develop
 - User Equipment
 - 5G NR Radio Node - gNB
 - 5G Core
 - WiFi – Interworking Support

Indigenous 5G Testbed - A Multi Institute Effort

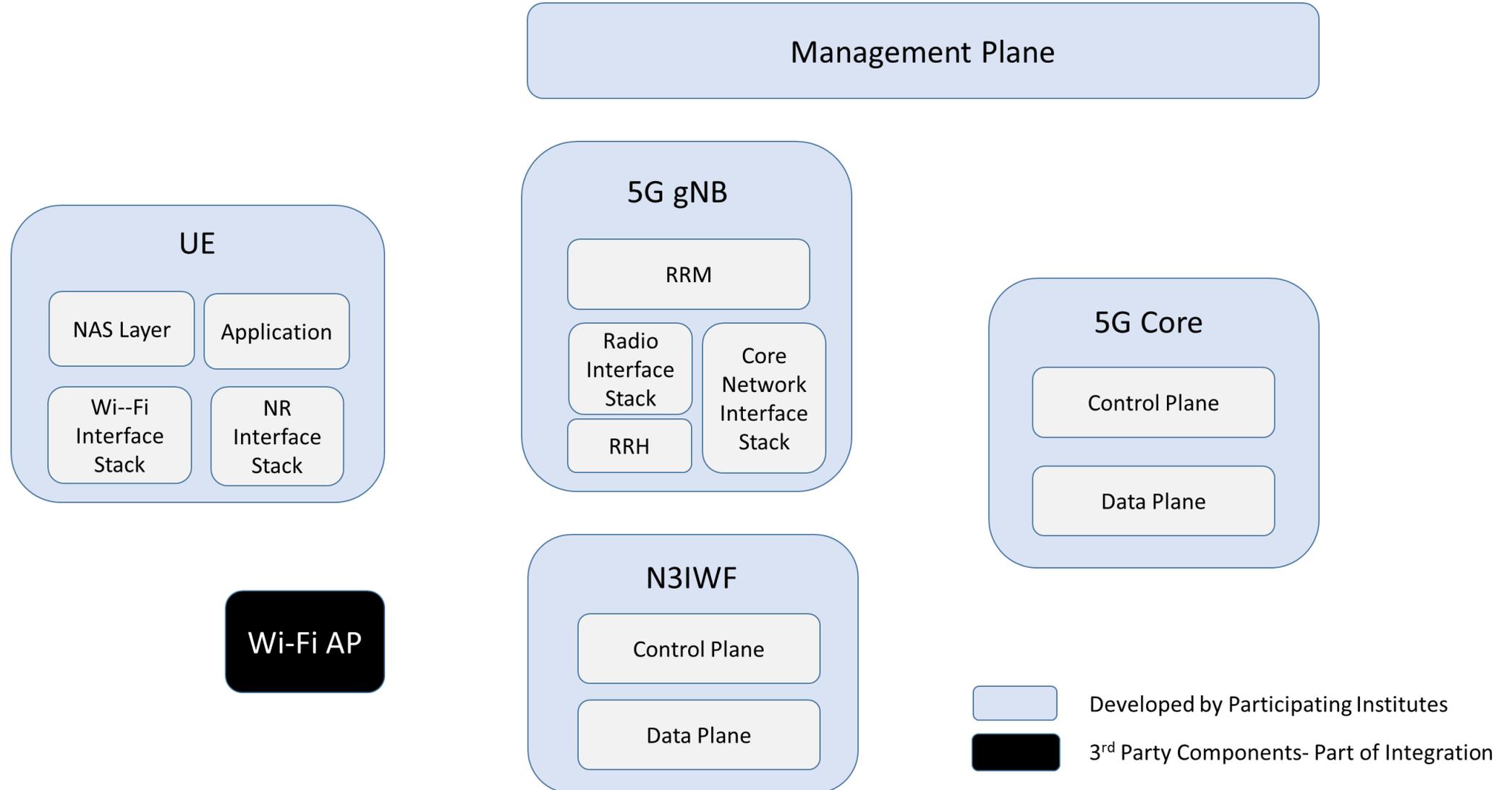


Work

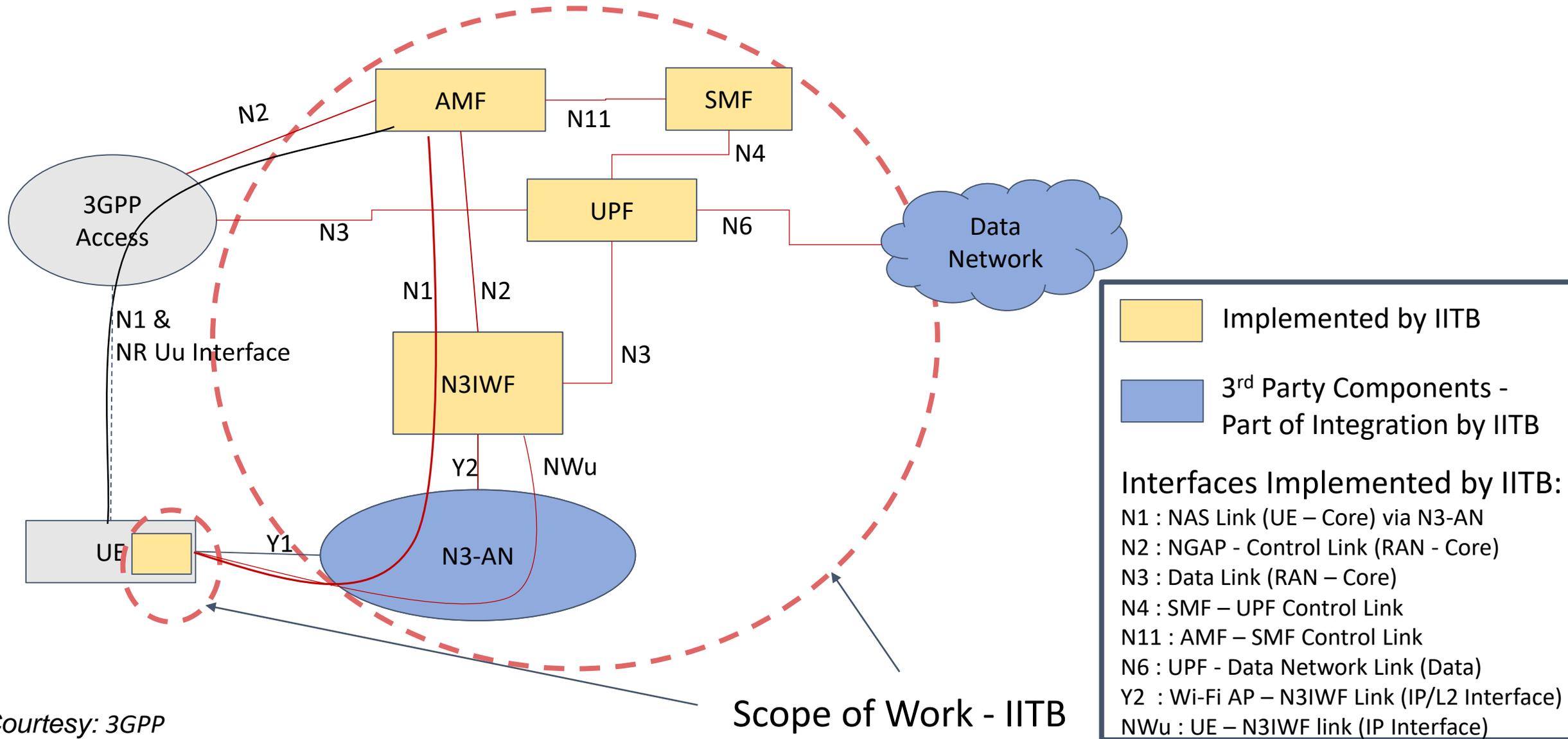
Responsibility



Indigenous 5G Testbed - Components



5G Testbed - Scope of Work IITB

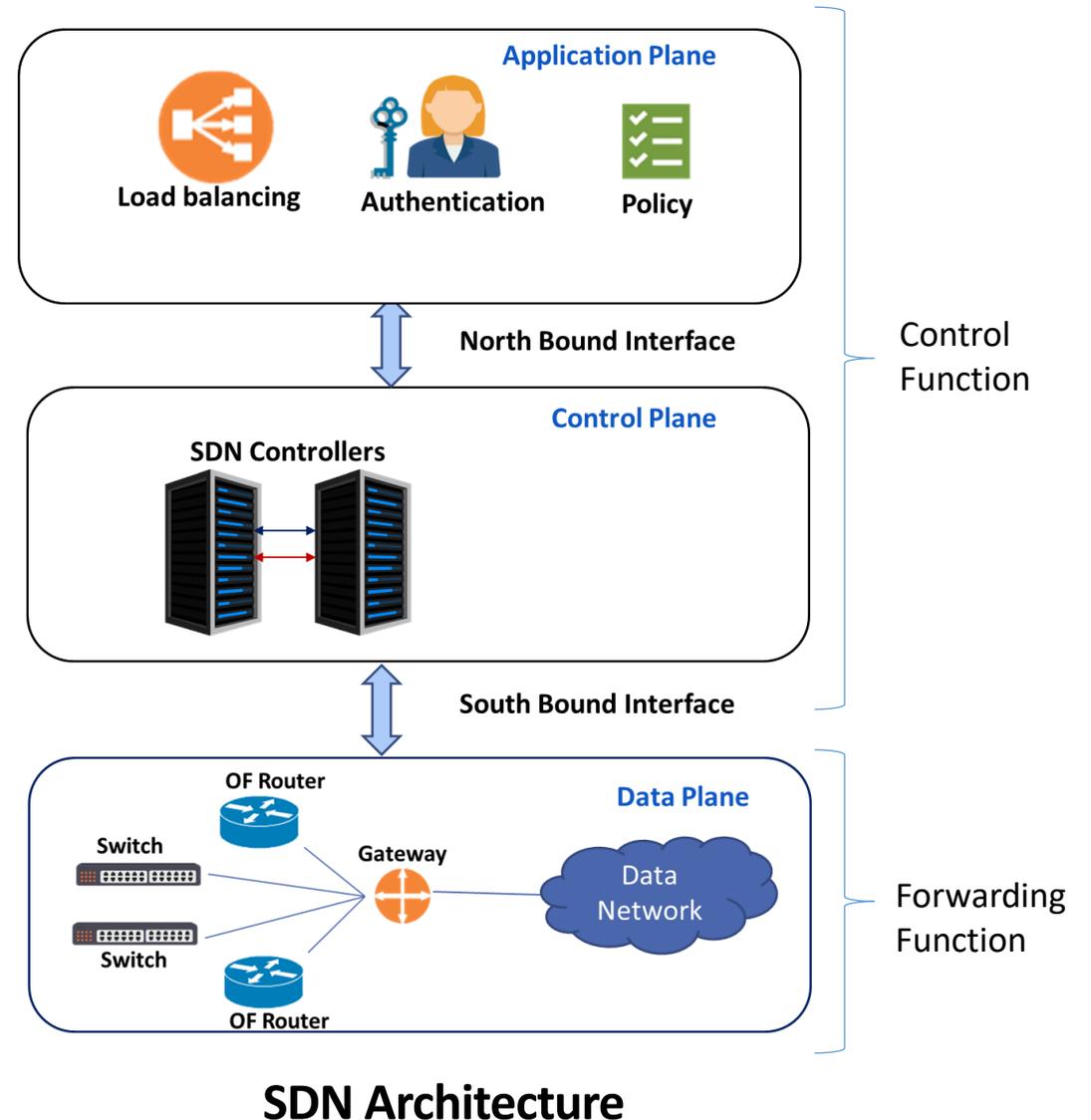


5G Testbed - Scope of Work IITB contd.

- **5G Core** (*IITB working on following NFs*)
 - **Control Plane**
 - Access & Mobility Management Function (AMF)
 - UE Registration, Access Control
 - Idle Mode Mobility Management & Paging
 - Session Management Function (SMF)
 - User Data Session Management
 - **Data Plane**
 - User Plane Function (UPF) - Data Forwarding through Core
- **Non 3GPP Access (Wi-Fi Support)**
 - User Equipment (UE)
 - UE Protocol Stack over Wi-Fi Radio
 - Non-3GPP Interworking Function (N3IWF)
 - Enables access to 5G Core for a UE using Wi-Fi access
- **Integration via Non 3GPP Access Point (Wi-Fi AP)**

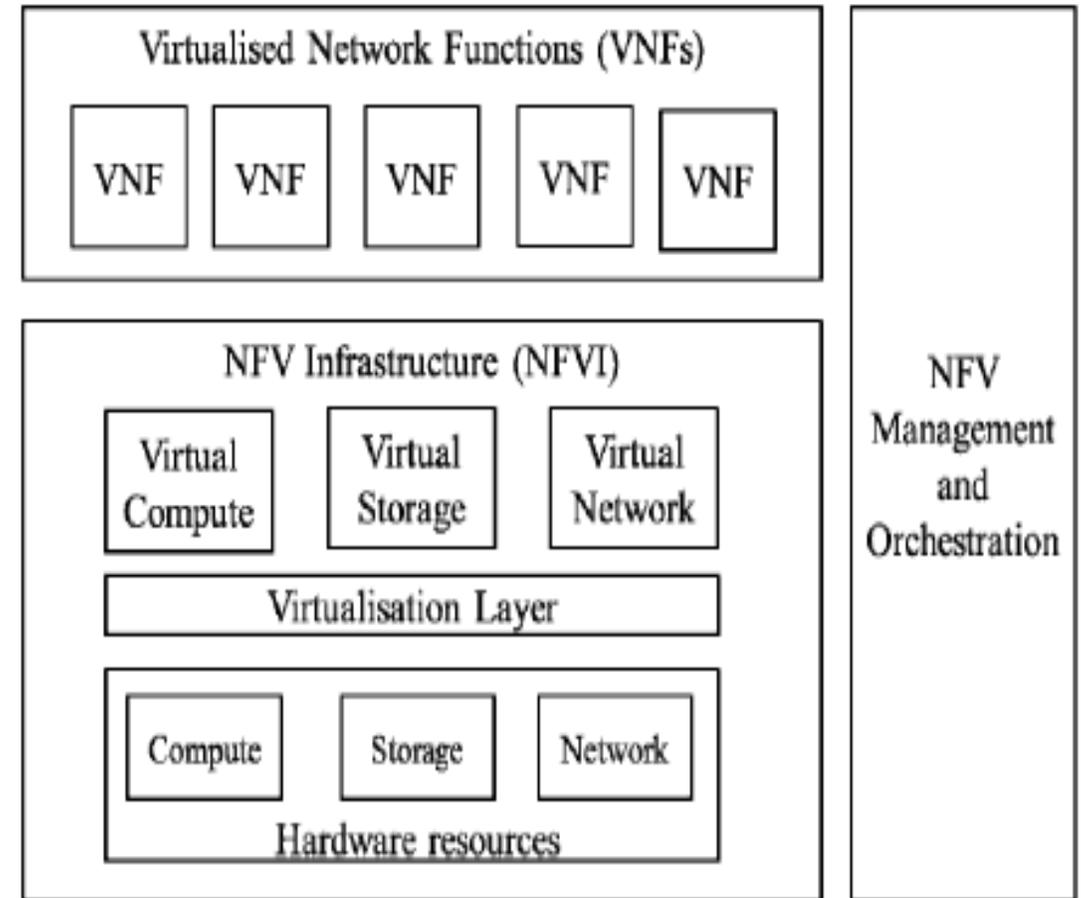
Software Defined Networking (SDN)

- Network divided into two set of functions
 - Control Function
 - Programs forwarding elements
 - Forwarding Function
 - Responsible for Data Forwarding
- Functions separated through an open programmable, standardized Interface
- Programmable Interface
 - Virtualization of Forwarding Plane
 - OpenFlow - Flow/Port Level Virtualization



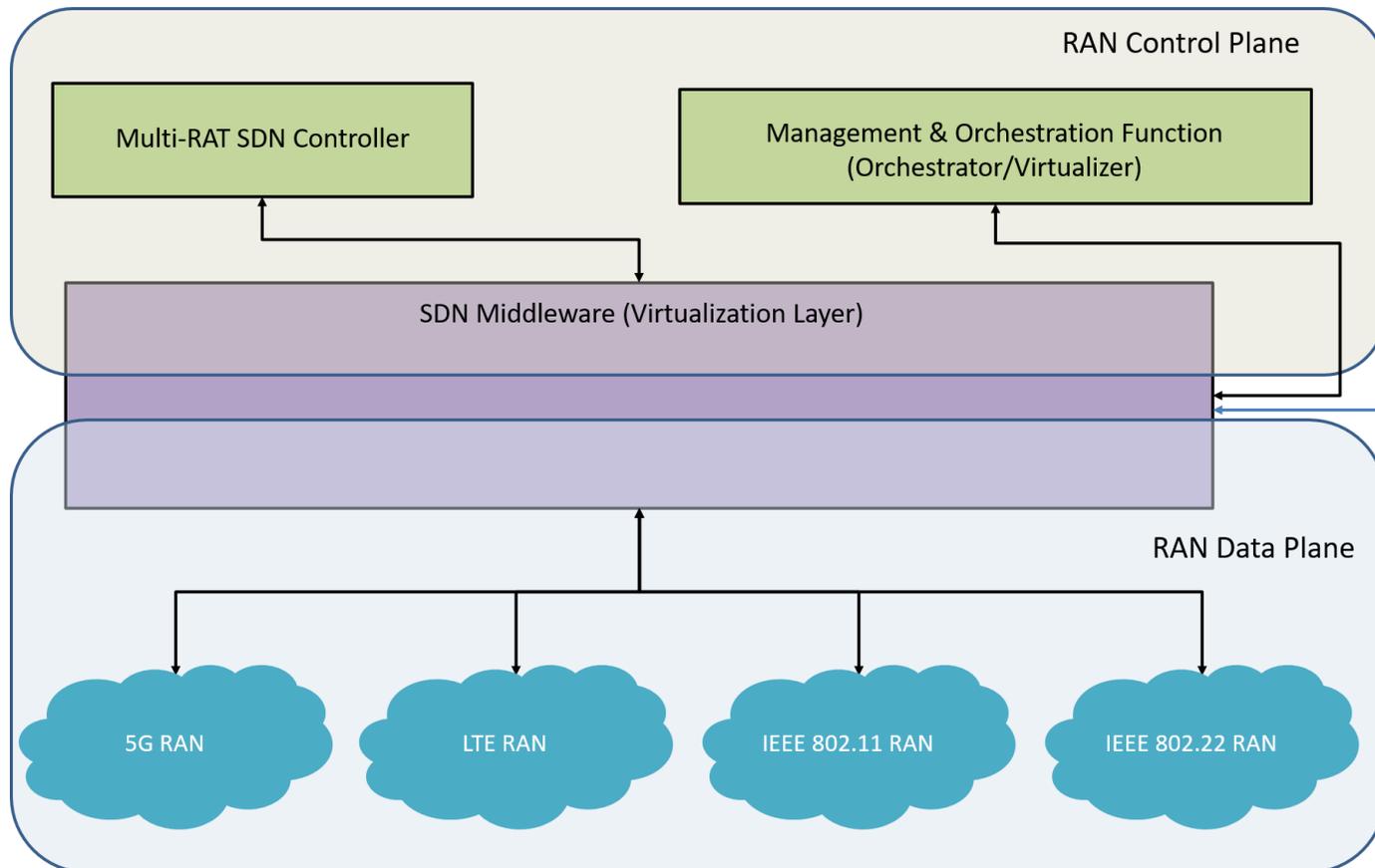
Network Functions Virtualisation (NFV)

- Network Function (NF)
 - A Functional block within a network infrastructure
 - well-defined external interfaces
 - well-defined functional behaviour
 - Typically a network node or a physical appliance
 - eNB/gNB, N3IWF, Wi-Fi AP, AMF, SMF, UPF
- Network Functions Virtualisation
 - Decouples Network Functions from the underlying Hardware
 - Through virtual hardware abstraction
 - Network Functions typically implemented using software



Courtesy : ETSI

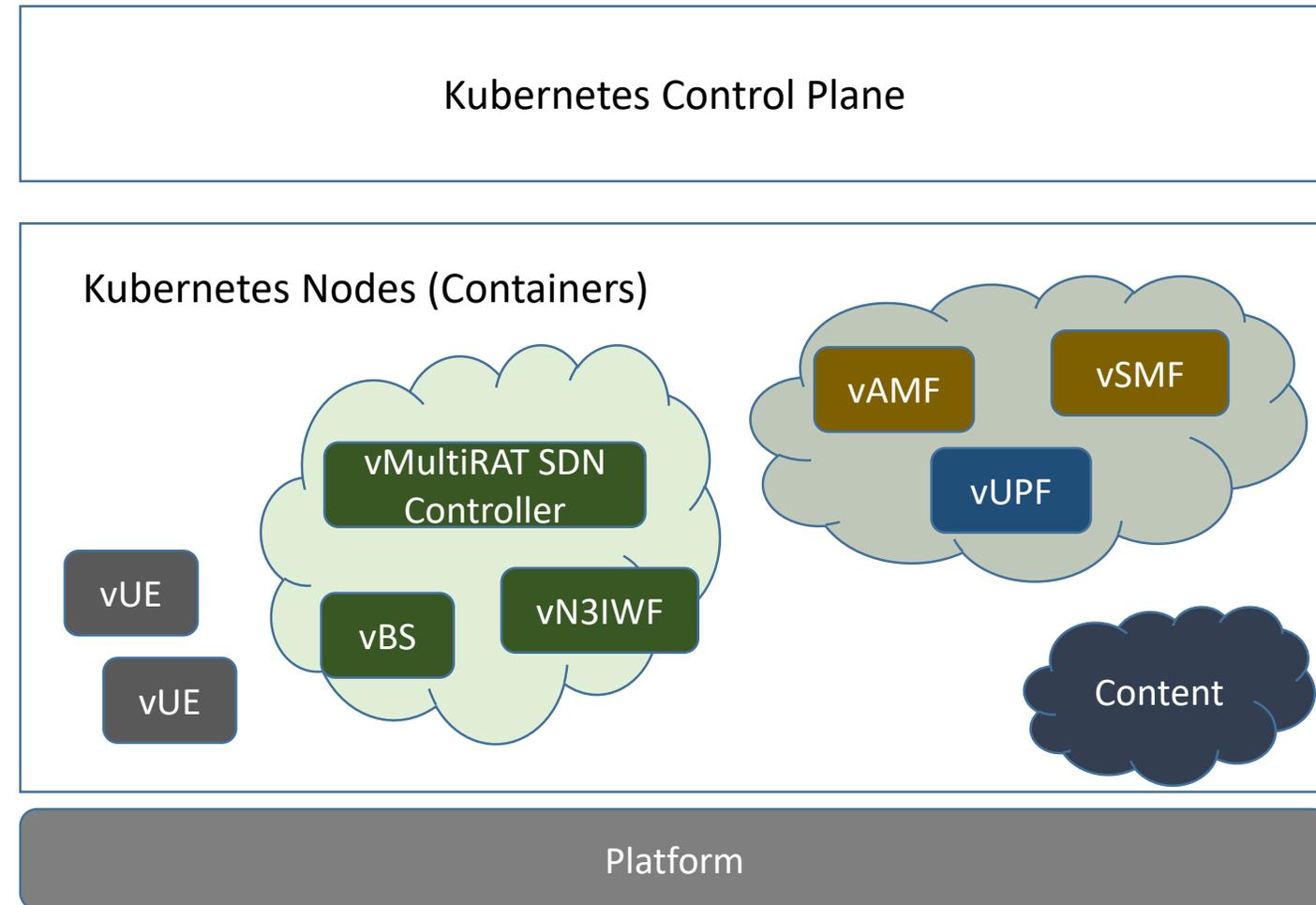
SDN based Multi-RAT RAN



- **3GPP 5G Core Network**
 - Unified Core supports 5G-NR RAN, LTE, WLAN etc.
- **5G Access NW - Fragmented**
 - Individual RATs Controlled and Managed Independently
 - Each 5G gNB has a Control function in gNB CU
 - LTE eNB has its own control logic
 - Wi-Fi APs controlled by Access Controllers
- **No Unified Architectural Framework to manage Multi-RAT RAN in 5G**
- **IEEE P1930 – Unified RAN Control**
 - Multi-RAT SDN Controller for RAN
 - Currently manages Wi-Fi
 - Other RATs to be added
 - Developed at IITB - part of 5G Testbed

Virtualization of 5G Testbed @ IITB

- Network Functions virtualized as lightweight Containers
 - 5G Core
 - AMF, SMF, UPF
 - RAN
 - N3IWF
 - Wi-Fi AP
 - Virtualized as an OpenFlow Switch (vBS)
 - SDN Controller
 - User Equipment
- All Containers managed by Kubernetes



Virtualization of 5G Testbed - Summary

- Flexible
 - All components including Wi-Fi AP virtualized
 - No dependency on any specific physical component
 - Complete Setup can be deployed anywhere
 - In the Lab or in the Cloud (say Amazon Cloud)
 - Virtually Uninterrupted Development & Testing During Lockdown
- Resilient
 - Components restart automatically after failure
 - Testing can continue w/o interruption
- Improved Resource Utilization
 - Resource (CPU and Memory) allocation to Containers as per the Load

THANK YOU

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