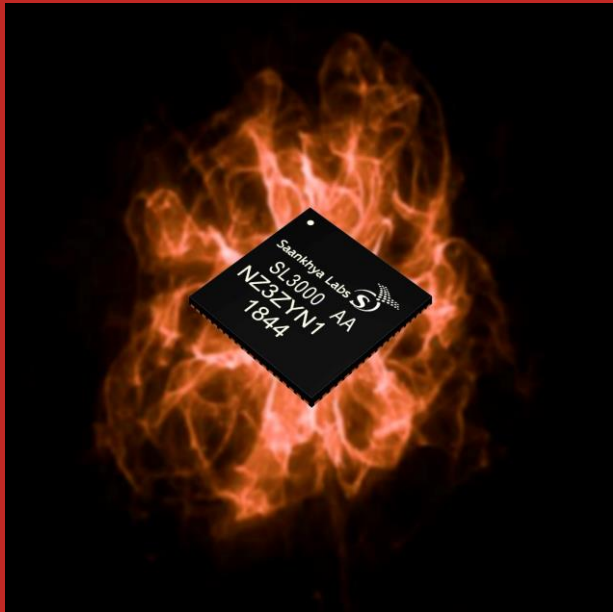# 5G Broadcast

Saankhya Labs

Saankhya Labs

Wireless Communication Semiconductors and Solutions Company

Chipsets and Systems for 5G Broadcast, 5G Broadband and Sat-com

Based on Saankhya' s patented Software defined Radio (SDR) semiconductor technology

Over $30 M Investment in technology

Revenue growing YoY at 50%

500 man years of experience from "Antennae to Bits", from systems to chips

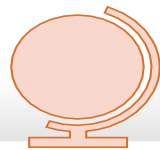ISRO's technology partner for all S band MSS terminals

30 international patents; SEP pool of about 5 patents covering next gen **"6G" RAN and convergence**

2 chips designed with first pass success and 1 in volume production

Field deployed indigenous Rural Broadband and Sat-com systems

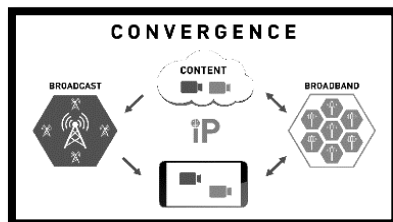India's first fabless semiconductor company with world's first production SDR

Founded in 2007; Headquartered at Bengaluru, India

170+ employees (full time + contract)

Global customer footprint across all geographies

Major Market Focus

5G Broadcast

- NextGen TV broadcast and Direct to Mobile TV (DTM)
- Converged network directing **video** intelligently to "overlay" broadcasting network
- Needs an intelligent EPC and a converged UE device with TV tuner and modem
- Strategic projects with SBG

Last Mile Access and Rural Broadband

- Last mile wireless connectivity, IoT M2M communications for the Base of the Pyramid
- Cashing on programs like **Digital India**
- Pioneers of TV White space (TVWS) solution; leads naturally to 5G
- Members of WSA and DSA

Satcom

- Satellite Phones, Modems, Location Tracking and Hub Equipment
- Technology partnership with ISRO and BEL
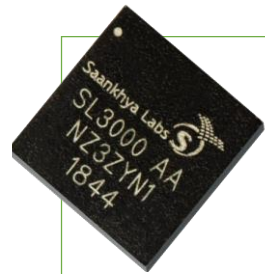- Strategic projects with CRIS and Coastal security

Defense Communication

- Over $10B serviceable market over the next 10 years
- Technology led play compared to traditional manufacturing
- India Focused/ PMA player due to Indigenous Product

Technology Platforms

Saankhya's patented innovative technology platforms

Software Defined Radio (SDR) platform for dynamic radio equipment

- Future proof platform that can be programmed to support multiple radio protocols at the price of dedicated ASIC.
- Custom designable radio platform
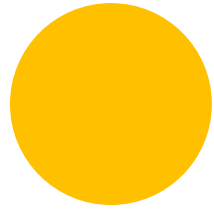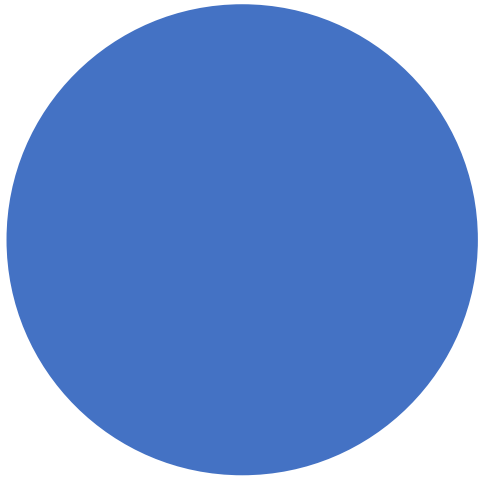- Proven in the field with multiple applications from defense, SATcom to Rural broadband applications

AI-RAN : AI based Cognitive RAN platform

- Dynamic design of Physical and Mac layer for more efficient use of available resource such as spectrum
- Leverages Big data, Cognitive radio and Machine learning to create Intelligent digital network.
- -Virtualization of the interface between UE and Network.
- "Open" Modem architecture to fuel innovation
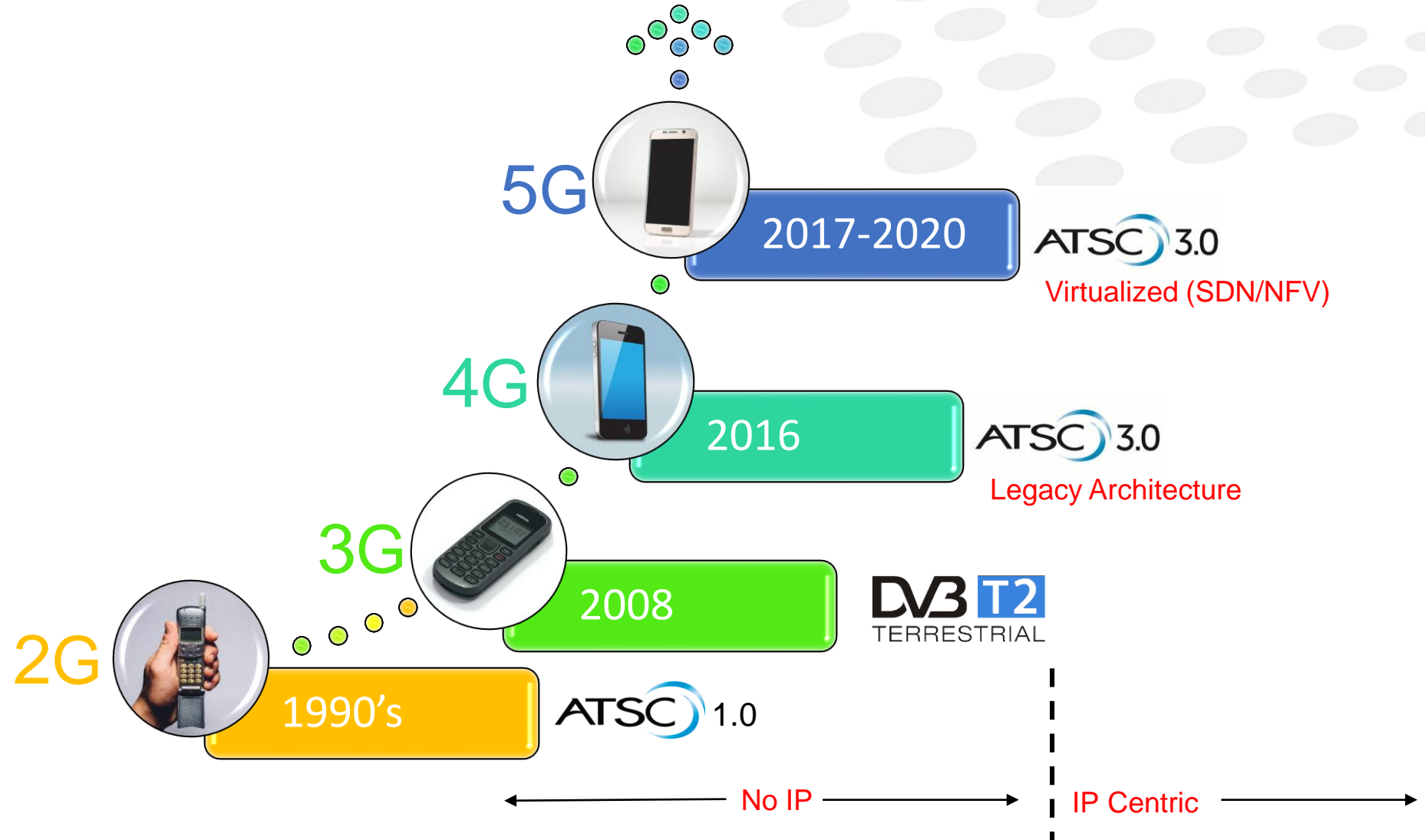
5G Broadcast

- Converged network which intelligently offload Video traffic from Mobile networks to a "overlay" Digital broadcast network.
- Platform for efficient Video and Datacast
- A whole range of IOT and vehicular services that range from radio services, FOTA, informatics, etc.
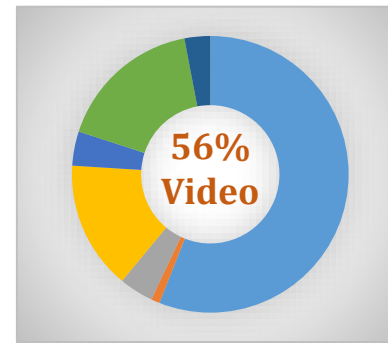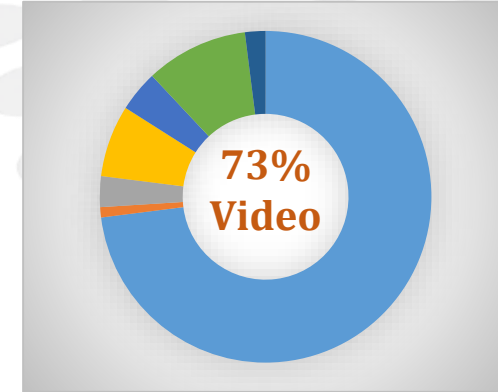
5G Broadcast

Evolution of Broadcast

5G 2017-2020 ATSC 3.0
Virtualized (SDN/NFV)

4G 2016 ATSC 3.0
Legacy Architecture

3G 2008 DVB T2 TERRESTRIAL

2G 1990's ATSC 1.0

← No IP → | IP Centric →

Motivation – Content Growth

- ➢ **Exponential growth of video consumption on mobiles**

56% Video

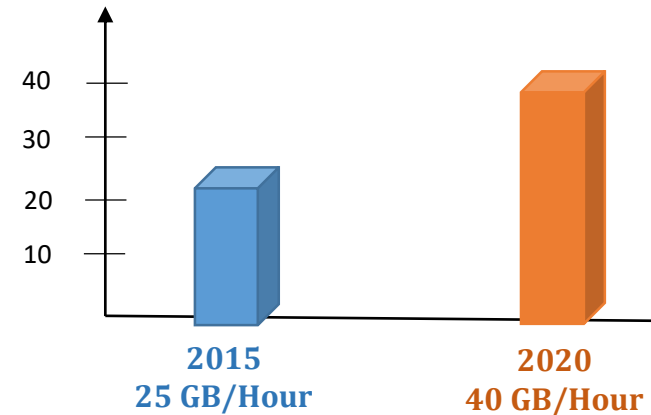**73% Video**

2017
15 Exabytes/Month

2023
107 Exabytes/Month

Mobile data traffic by application category per month (percent) [1]

Legend:
- Video
- Audio
- Web Browsing
- Social Networking
- Software Download
- Other Segment
- P2P File Sharing

- ➢ **Growth in "broadcast" bit consumption in cars**
  - ➢ Maps navigational data
  - ➢ FOTA

40
30
20
10

2015
25 GB/Hour

2020
40 GB/Hour
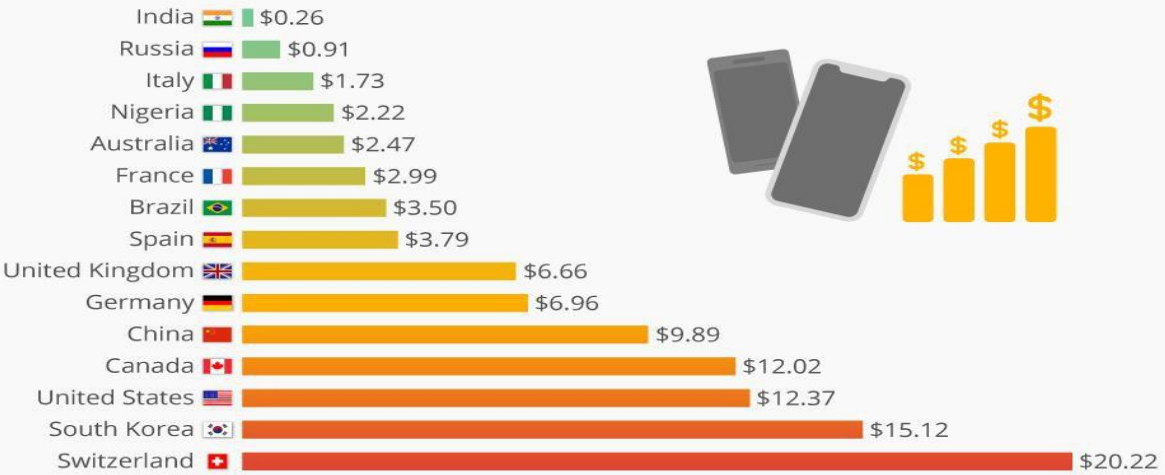
Connected car data usage [2]

Source
1 Ericsson
2 Hitachi

Motivation - Spectrum Economics

The Cost of Mobile Internet Around The World
Average cost of 1GB of mobile data in selected countries in 2019 (U.S. dollars)

- India — $0.26
- Russia — $0.91
- Italy — $1.73
- Nigeria — $2.22
- Australia — $2.47
- France — $2.99
- Brazil — $3.50
- Spain — $3.79
- United Kingdom — $6.66
- Germany — $6.96
- China — $9.89
- Canada — $12.02
- United States — $12.37
- South Korea — $15.12
- Switzerland — $20.22

6,313 mobile data plans in 230 countries were gathered and analyzed by Cable.co.uk
@StatistaCharts   Source: Cable.co.uk

Forbes statista

VS

Cost of Terrestrial Broadcast Data

USD 0.001 per GB

Motivation – Video Quality in 4G

- ➢ Non Linear relationship between download speed and video quality

- ➢ Video quality depends on "Instantaneous" speed not "Average" speed

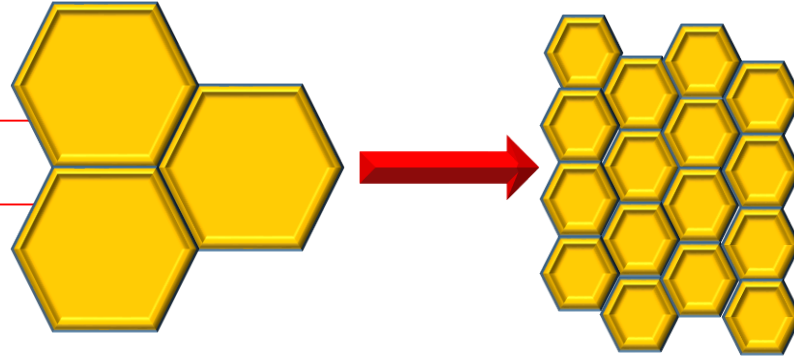- ➢ Improve "Instantaneous" speed and reduce latency to improve the video quality

Comparing Overall Video Experience and Download Speed

No Significant Effect on Video Quality

FASTER ➜
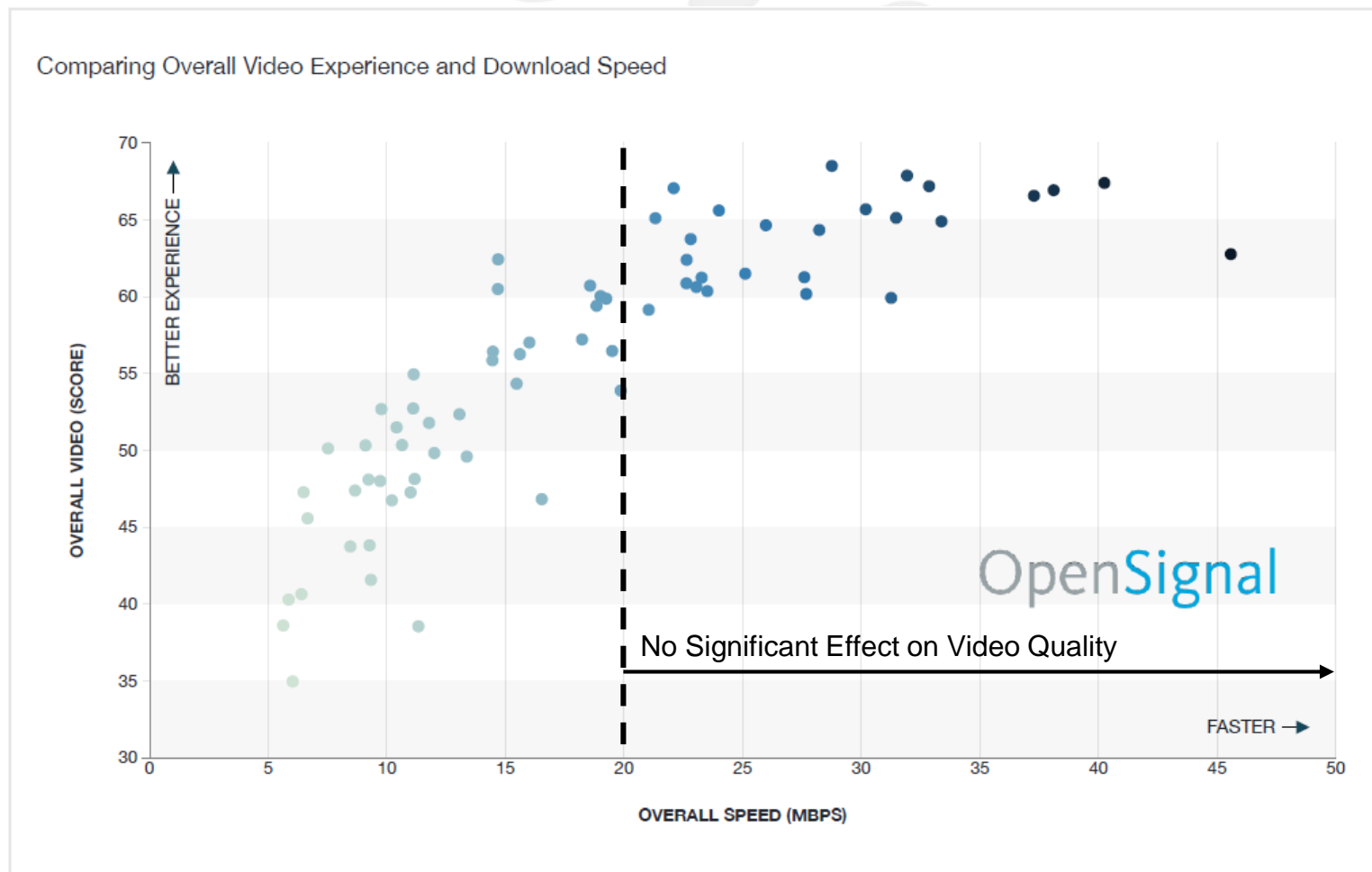
OpenSignal

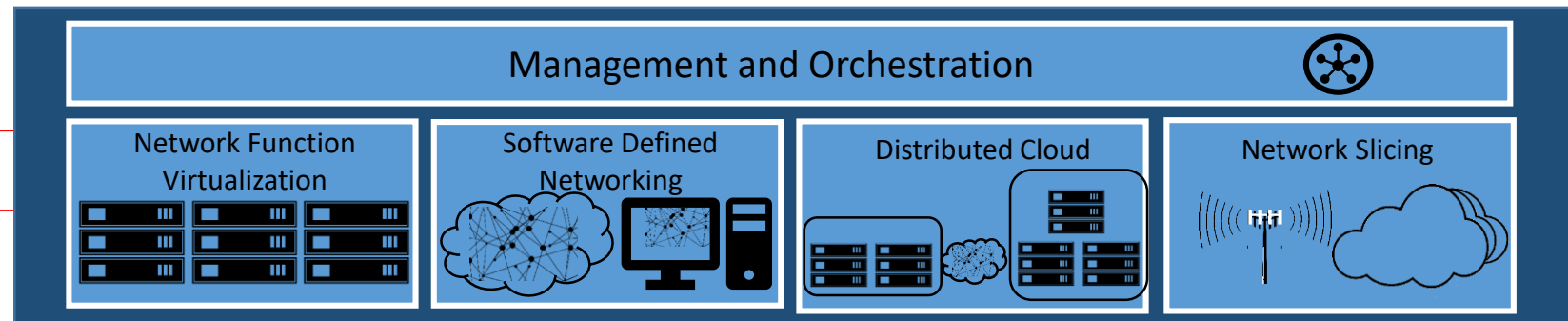# 5G Unicast will not solve these problems

Key 5G Concepts for Broadcast

➢ Densification

➢ Virtualization

Management and Orchestration

| Network Function Virtualization | Software Defined Networking | Distributed Cloud | Network Slicing |

➢ Disaggregation

All Outdoor Radio/
Split Mounted Radio

Indoor Networking
Unit & Software

Radio Element

Networking S/W Element

Networking H/W Element
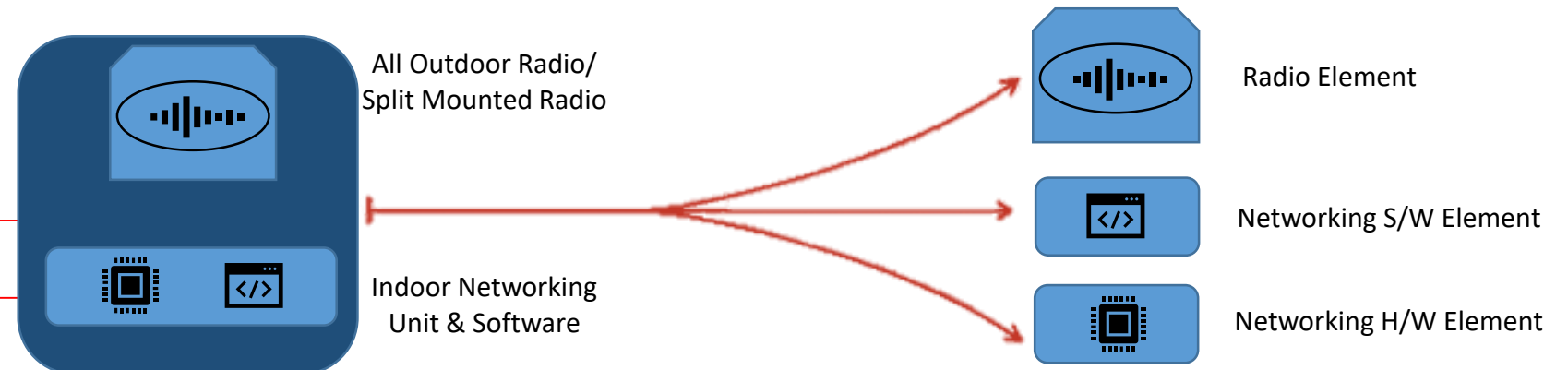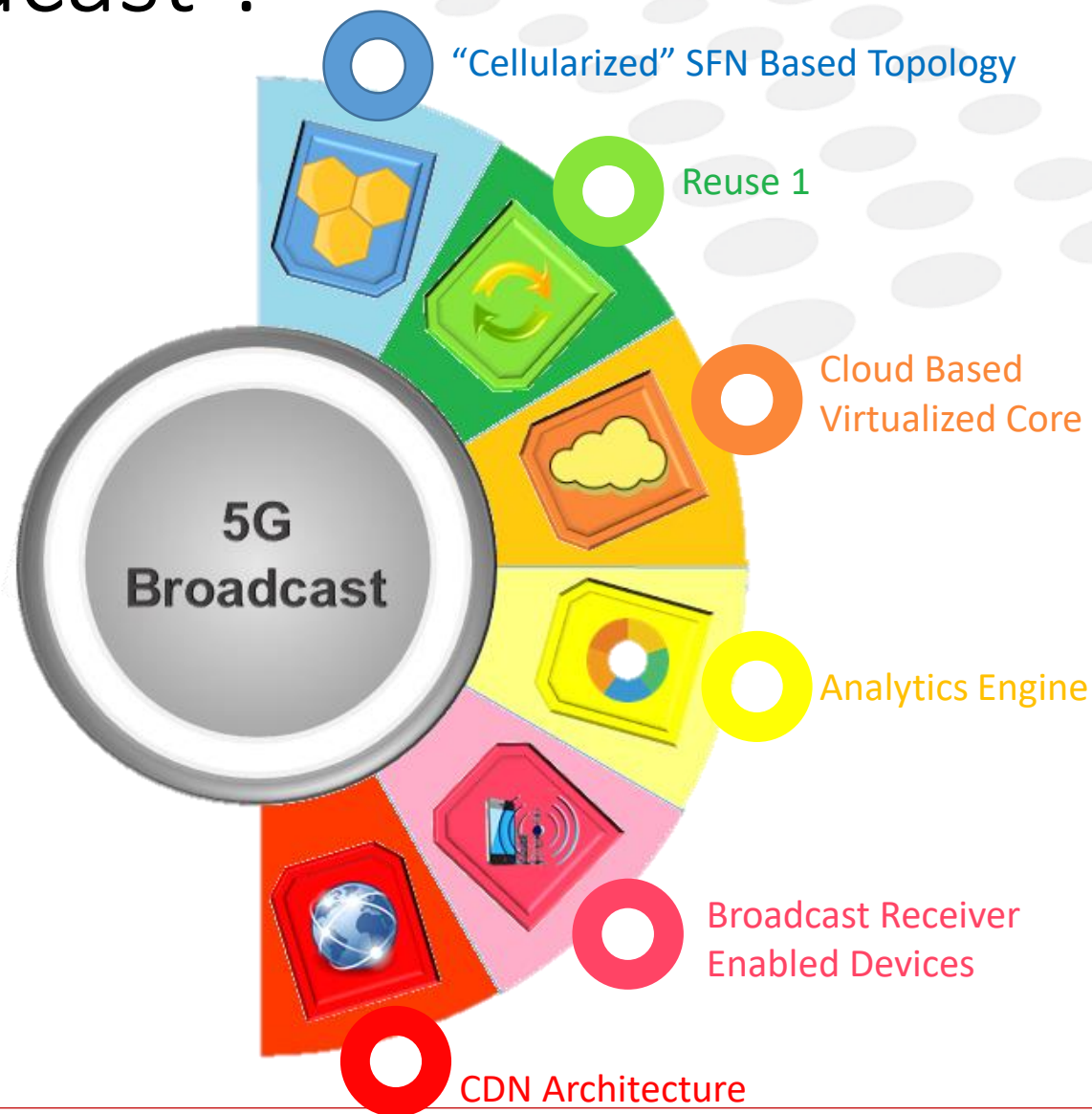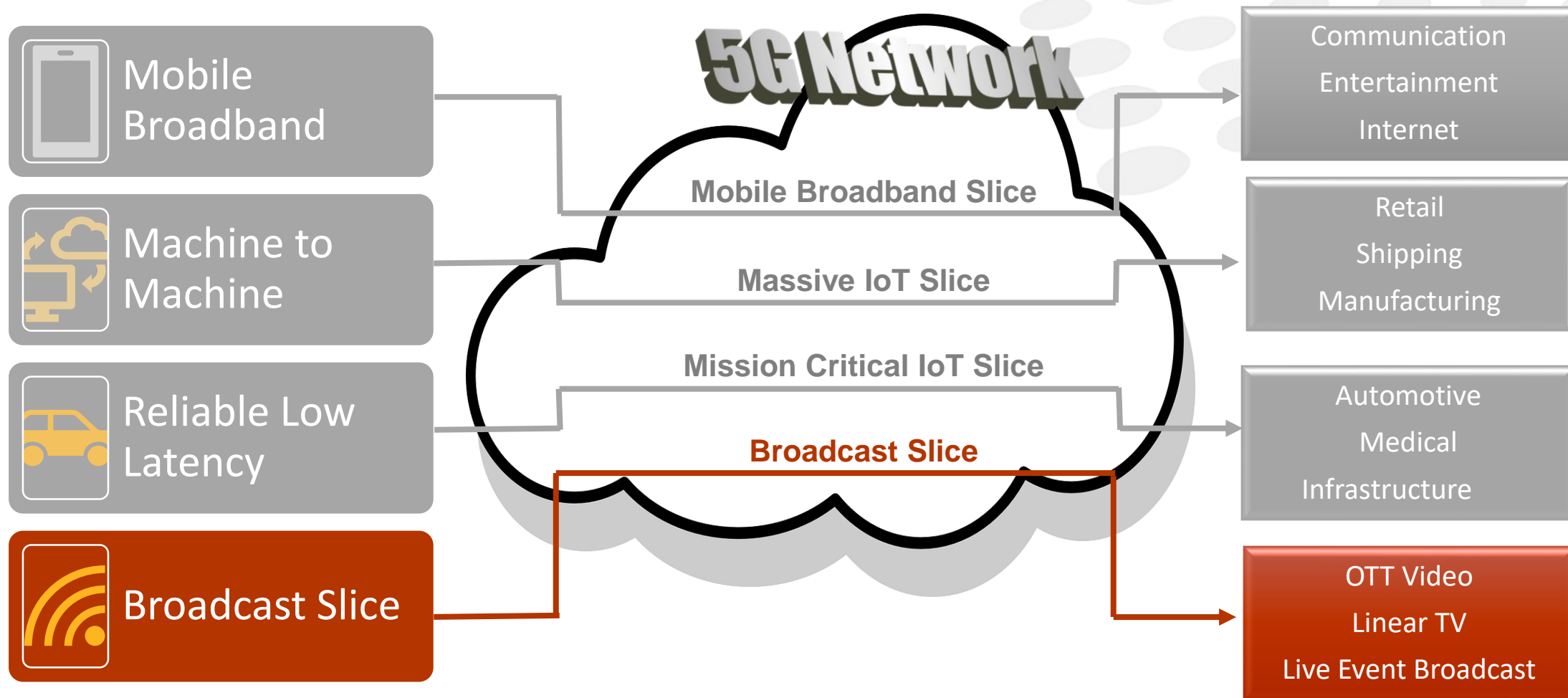
What is 5G Broadcast ?

- ➤ Not just "fat" but "smart" pipes

- ➤ Re-imagine video delivery by combining broadcast and broadcast networks

- ➤ Efficient use of the traditional UHF broadcasting spectrum

- ➤ Broadcasting pipe has infinite "elasticity"

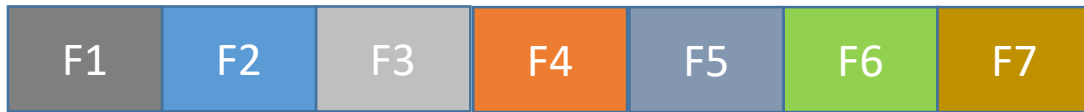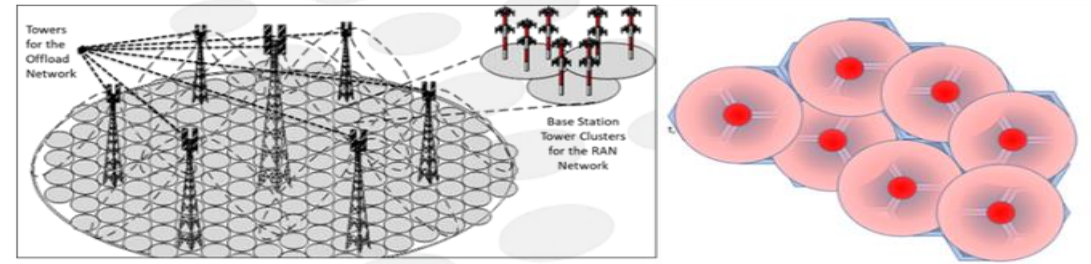- ➤ Lower cap-ex for a "giga byte" pipe

- ➤ L1 vs L3 convergence

"Cellularized" SFN Based Topology

Reuse 1

Cloud Based Virtualized Core

Analytics Engine

Broadcast Receiver Enabled Devices

CDN Architecture

5G Broadcast

Broadcast as a **5G** "Slice"

5G Network

Left inputs	Slices	Right outputs
Mobile Broadband	Mobile Broadband Slice	Communication / Entertainment / Internet
Machine to Machine	Massive IoT Slice	Retail / Shipping / Manufacturing
Reliable Low Latency	Mission Critical IoT Slice	Automotive / Medical / Infrastructure
Broadcast Slice	Broadcast Slice	OTT Video / Linear TV / Live Event Broadcast

Efficient spectrum usage : "**Cellularized**" SFN

F1 | F2 | F3 | F4 | F5 | F6 | F7

F4
F5, F3

F2
F3, F1

F6
F7, F5

HPHT with Reuse 1 of 3

For every Fn Frequency used in a DMA, Fn+1, Fn-1 can not be used
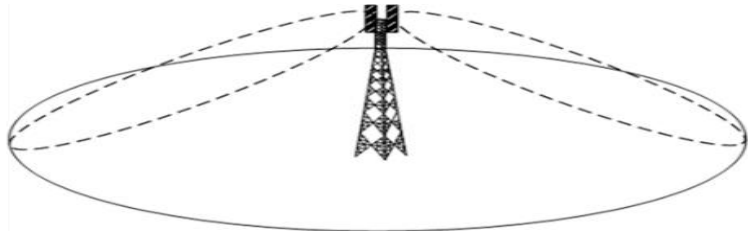
All Frequencies (Reuse 1)

Freq 1

Freq 1

Freq 1

Freq 1
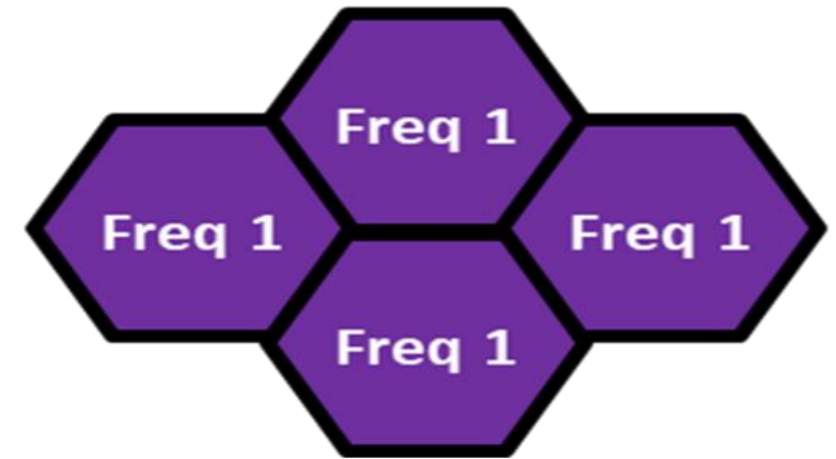
LPLT with Reuse 1

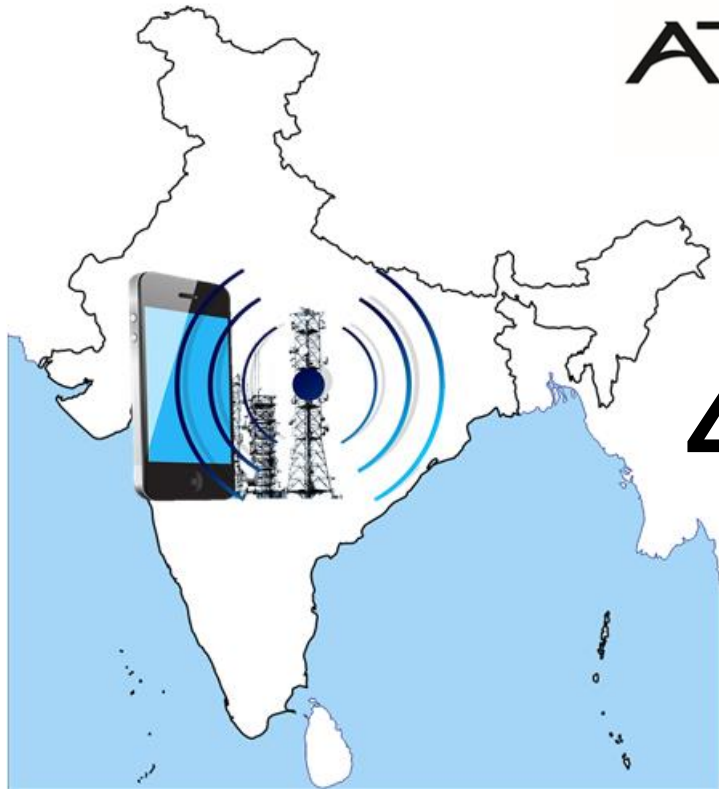*Example - an HPHT DTT provider that wants to deploy nationwide coverage with One 6 MHz RF channels will need to reserve Seven 6MHz channels. In other words,* ***the HPHT needs 42 MHz, vs 6 MHz for reuse- 1 BRH.***

Comparative Roll out costs – 3.0 vs 5g for India

Nationwide Rollout

ATSC3.0 Instantaneous throughput – 10 Mbps per subscriber

480 Million $

20 Mbps aggregate throughput per channel = 0.02 Mbps Instantaneous throughput

**3465 Million** $

4G$_{LTE}$

3 Million Subscribers

Assumptions -
1. Sites Ratio - LTE : ATSC3.0 – 250,000 : 125,000
2. Spectrum Cost not included for LTE / ATSC3.0.
3. Backhaul Cost (fiber/microwave) not included for LTE / ATSC3.0.
4. GBT Excluded. RTP / RTT - 50 / 50. ATSC3.0 on existing LTE sites. No additional RTP / RTT costs.

Standalone "Cellularized" Broadcast Architecture

- ➢ New Innovative Broadcast Architecture

- ➢ Reduced Capex and Opex

- ➢ Better utilization of existing spectral resources
  - ➢ Densification
  - ➢ Reuse-1
  - ➢ Massive SFN

- ➢ Better monetization by localizing content
  - ➢ Hyper local ads
  - ➢ More Capacity
  - ➢ Newer services like NB-IoT
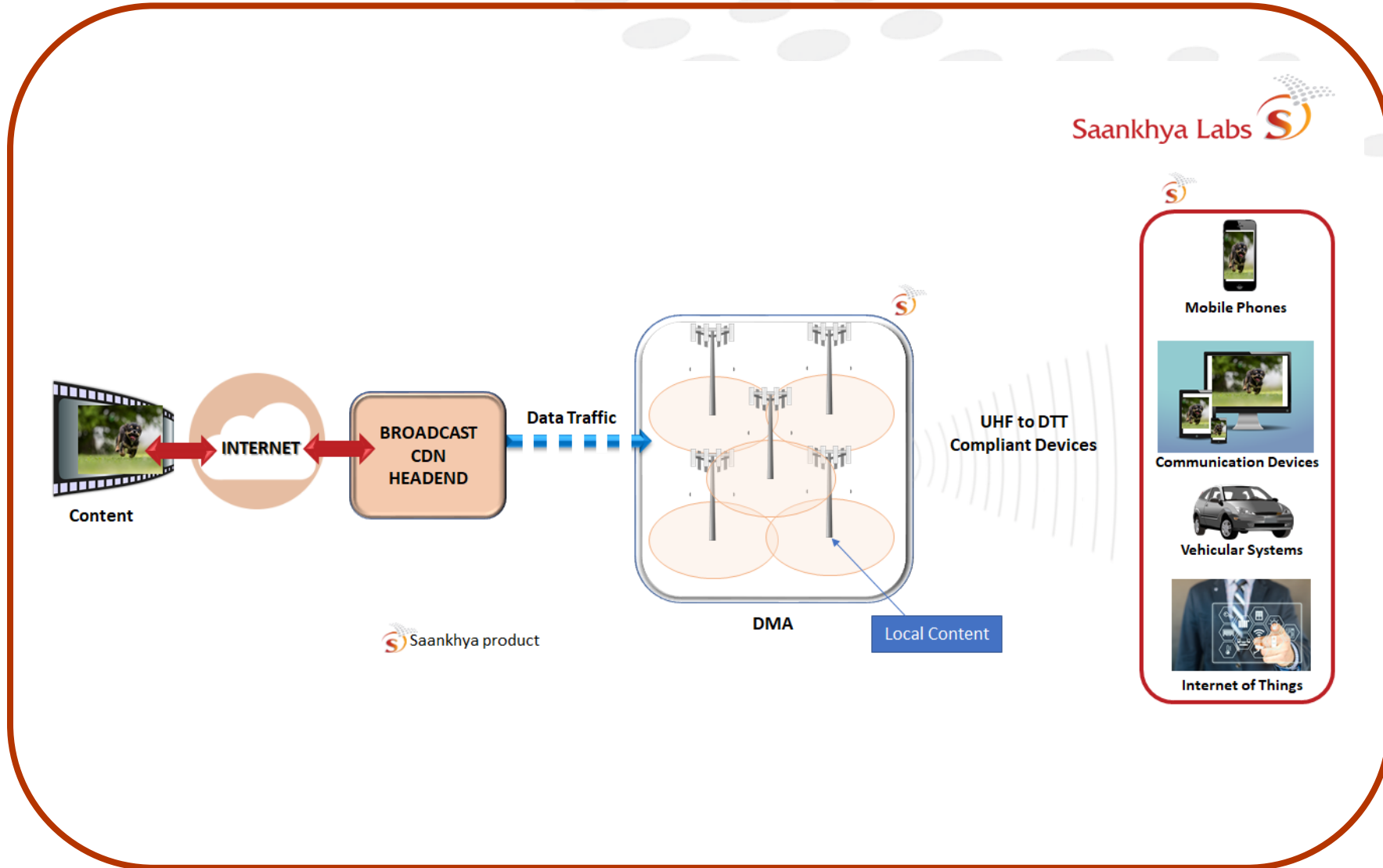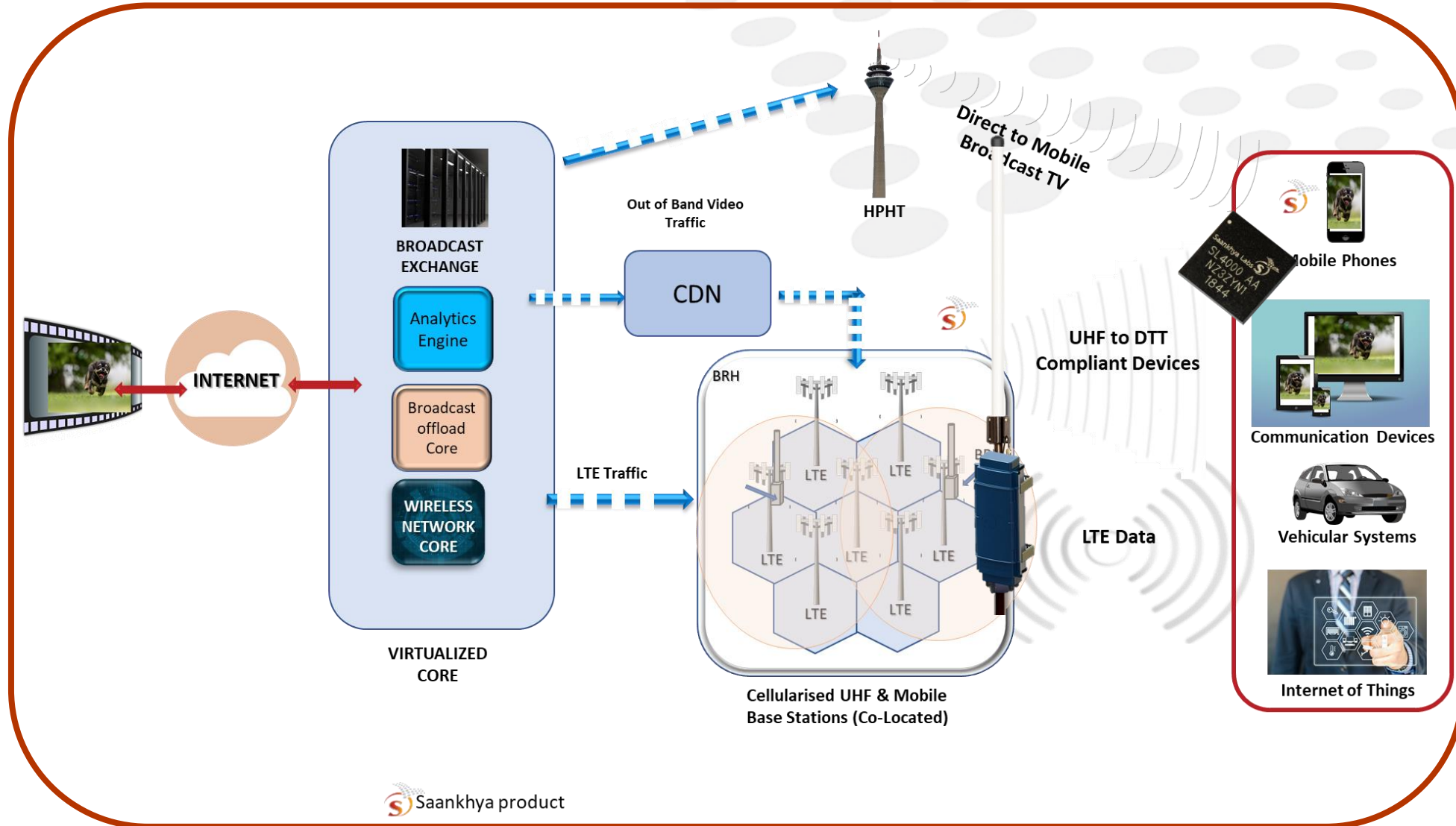
Converged 5G Broadcast Architecture

A "video" optimized network

Offloading video intelligently through a virtualized "Broadcast exchange"

A new "Broadcast" enabled CDN bringing it to the edge

**Reimagine video wireless internet !**

New Broadcast based service offerings to mobile through innovations

INTERNET

BROADCAST EXCHANGE

Analytics Engine

Broadcast offload Core

WIRELESS NETWORK CORE

VIRTUALIZED CORE

Out of Band Video Traffic

HPHT

CDN

LTE Traffic

BRH

LTE

Cellularised UHF & Mobile Base Stations (Co-Located)

Direct to Mobile Broadcast TV

UHF to DTT Compliant Devices

LTE Data

Mobile Phones

Communication Devices

Vehicular Systems

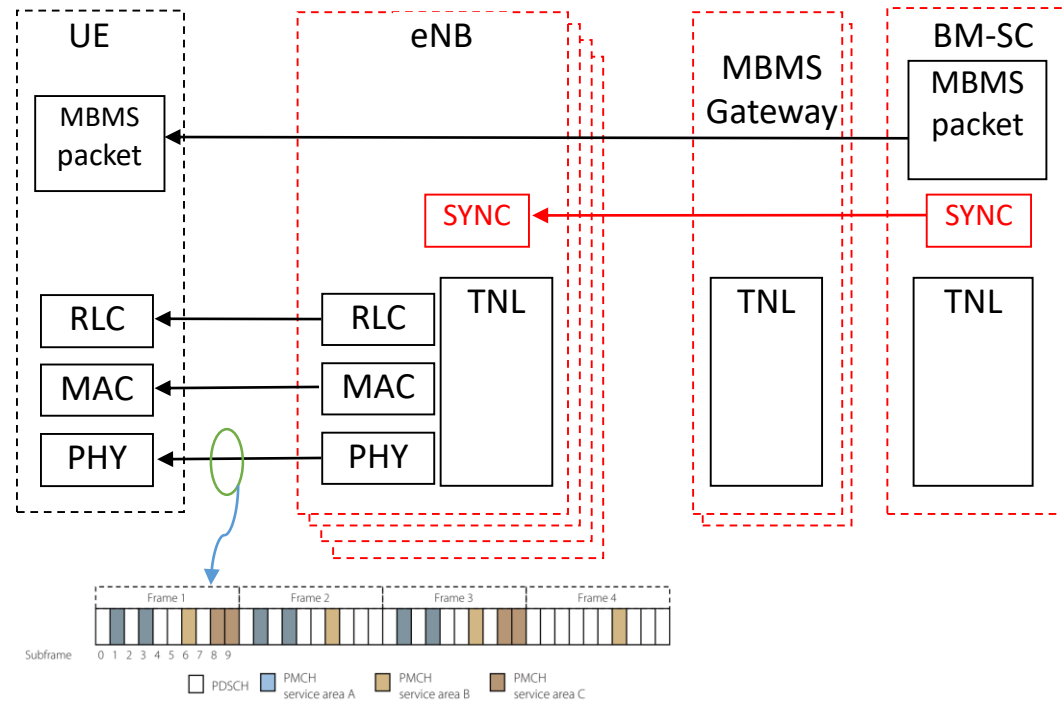Internet of Things

Saankhya product

OTT Services – Use case

- ➢ Push and timed OTT delivery
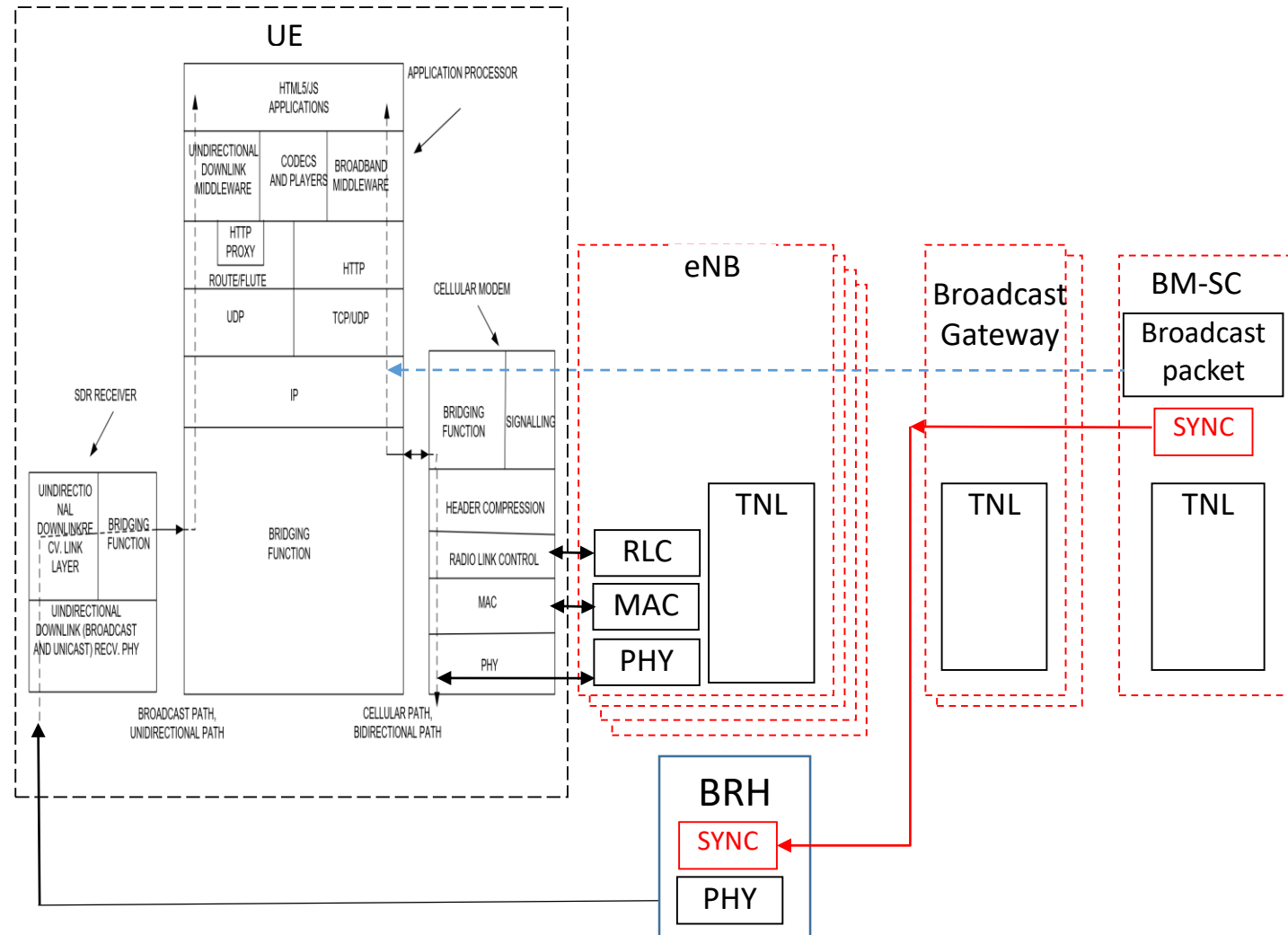- ➢ Out of order delivery
- ➢ Schedule bits on broadcast network
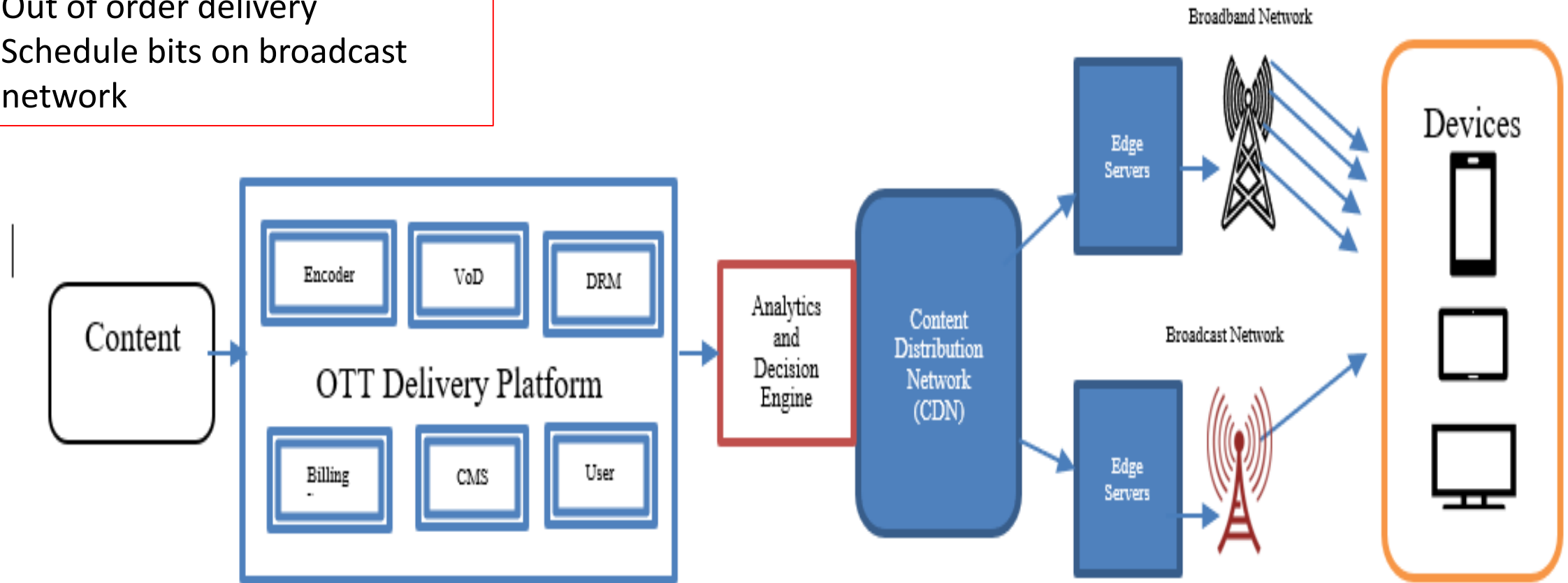
L1 Vs L3 convergence

L1 Convergence

L3 Convergence

PHY/L1- Layer shared between Unicast and Broadcast

PHY/L1- Layer separate for Unicast and Broadcast

Comparison of L1 vs L3 convergence

| Parameters	ATSC 3.0 variants	Release 16/5g xCast
FEC performance	QEF 10e-11; More stringent resulting in 1-2db improvement	Turbo with no HARQ; BLER is less stringent resulting in 1-2 db lesser performance
Doppler	Efficient BW by 8K/16K through time diversity	Through 2K without time diversity less efficient
Frequency interleavers	Yes	None , optimized for latency
Spectral efficiency	With proper use of LDM average improvement of 1.5 bits	Poor <1bit as optimized for cell edge
Reuse 1 performance	LDM as interference canceller	CoMP based; Poor cell edge performance
Dynamic signal design	Yes resulting in lesser pilot overhead	No
Receiver performance in SFN , LPLT	Sustain 0db echoes	No results

5G Broadcast Use Cases

HIGH VIEWERSHIP LIVE EVENTS

- Multilingual live broadcast to Mobile Devices
- High speed connectivity at the event location
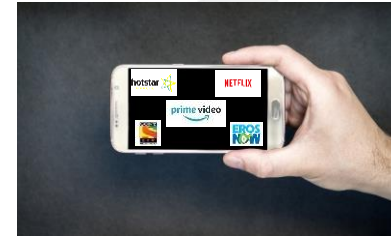
OTT SERVICES

Push and Timed OTT Videos

LINEAR TV SERVICES

- HDTV to Mobile Devices
- Next Gen Ultra HD TV

IoT

- Intelligent Lighting Systems
- Common Control Message for IoT

AUTOMOTIVE

- Firmware Upgrade Over the Air (FOTA)
- Broadcast of Mapping and GIS data for Driverless Vehicles

LOCATION SERVICES

- Synchronization for GPS denied 5G small / pico cells

Benefits to Stakeholders

CARRIERS

➤ Offload heavy content to broadcast
➤ Generate revenue share over OTT
➤ Optimize Opex and Capex Spend

BROADCASTERS

➤ Provide superior content quality access to mobile subscriber
➤ Monetization with access to mobile user base
➤ Offer seamless experience - home and mobile

CONTENT GENERATORS

➤ New 4K Content Distribution opportunity
➤ Additional subscription revenue through up-selling new high resolution content

CONTENT PROVIDERS

➤ New distribution dedicated channel for heavier rich content – better user experience
➤ Additional subscription revenue

DEVICE MAKERS

➤ Justification to develop and monetize superior handsets supporting 4K Displays and immersive experience capabilities

END USER

➤ Superior experience
➤ Video content without data caps

Thank you

Follow us on

For more information visit http://www.saankhyalabs.com