Identity Oriented Networking and Ubiquitous Mobility for IP 2020

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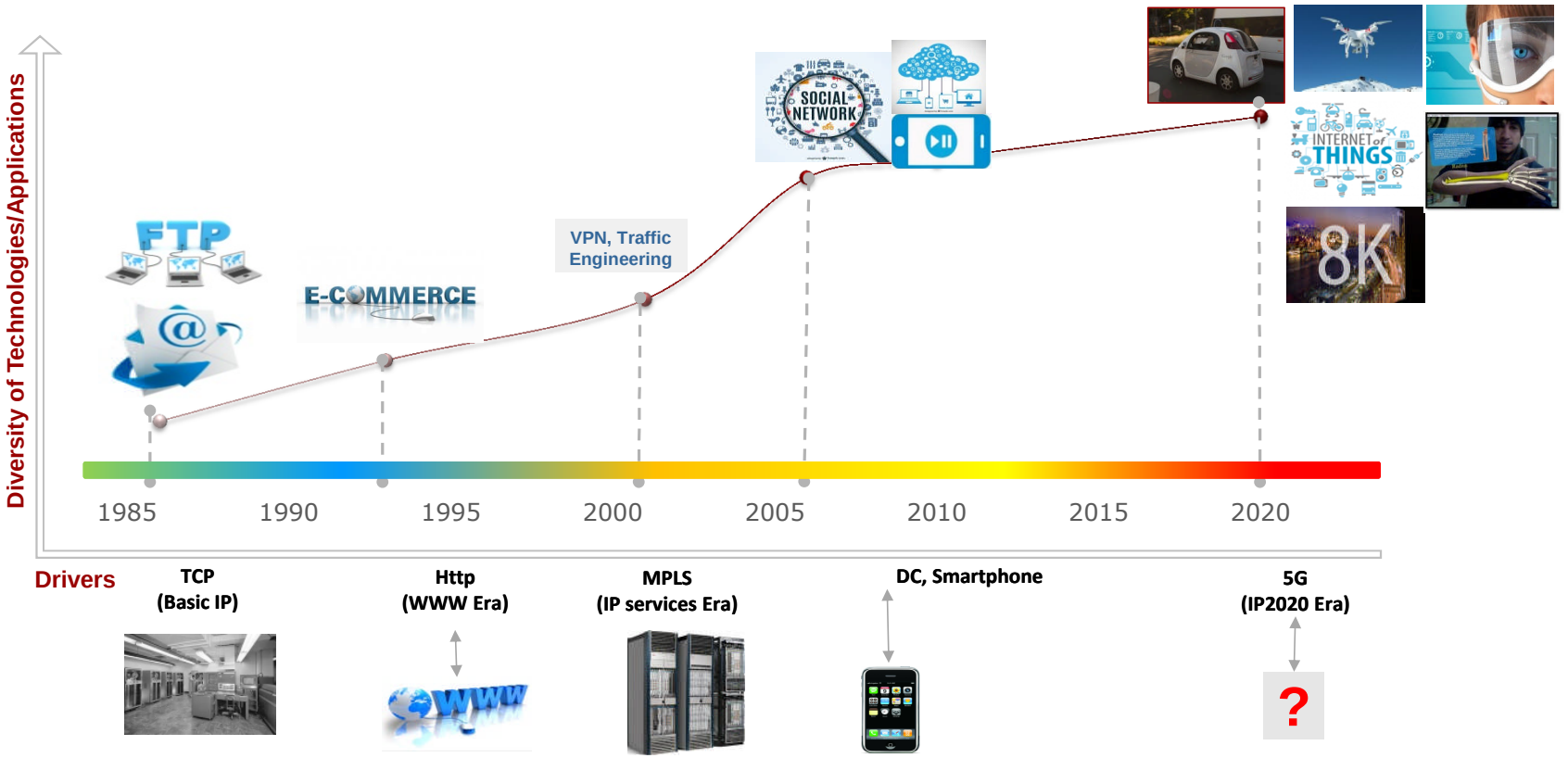
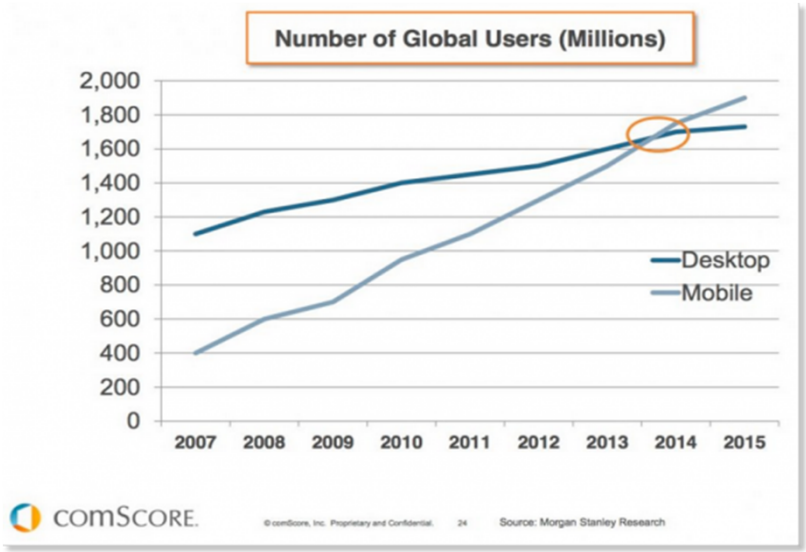
Agenda

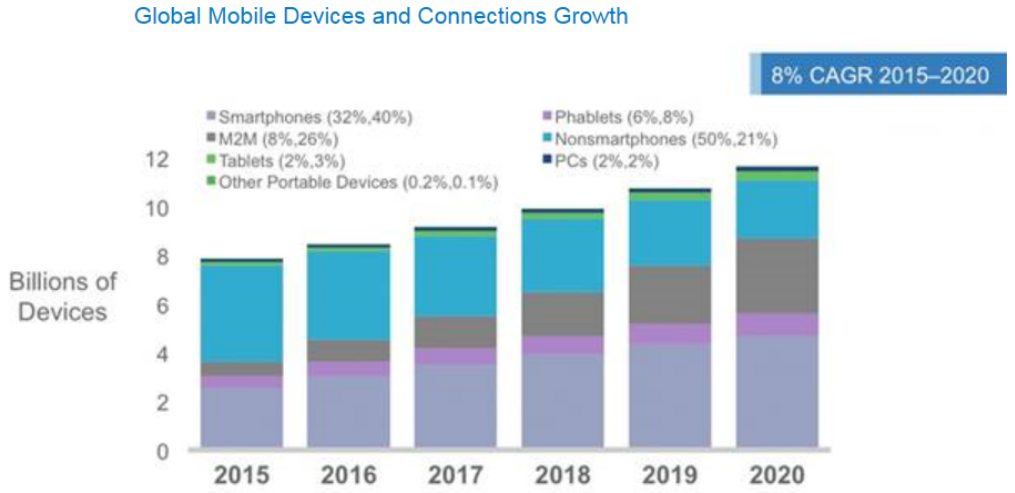
- Introduction – Trends
- Ubiquitous Mobility
- ID-Oriented Networking
- Unlocking future networks
- Concluding Remarks

Towards 2020: Landmarks in the Internet Protocol



Trends – Number of devices mobile vs fixed





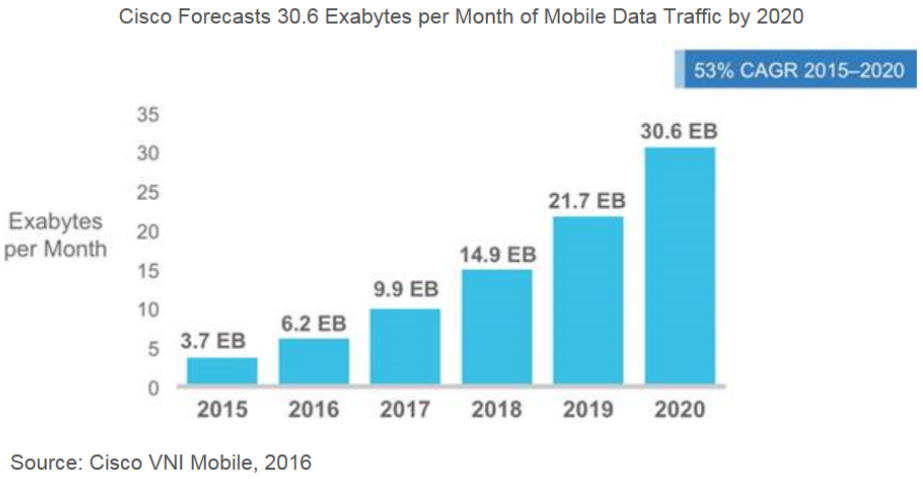
Figures in parentheses refer to 2015, 2020 device share.

Source: Cisco VNI Mobile, 2016

- **More than half a billion (563 million) mobile devices and connections were added in 2015**
- **By 2020 there will be 1.5 mobile devices per capita. There will be 11.6 billion mobile-connected devices by 2020, including M2M modules—exceeding the world's projected population at that time (7.8 billion).**

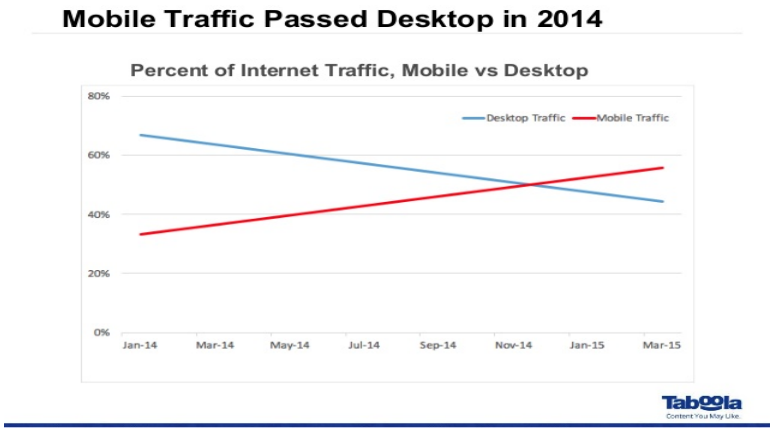
Mobility is the new norm!

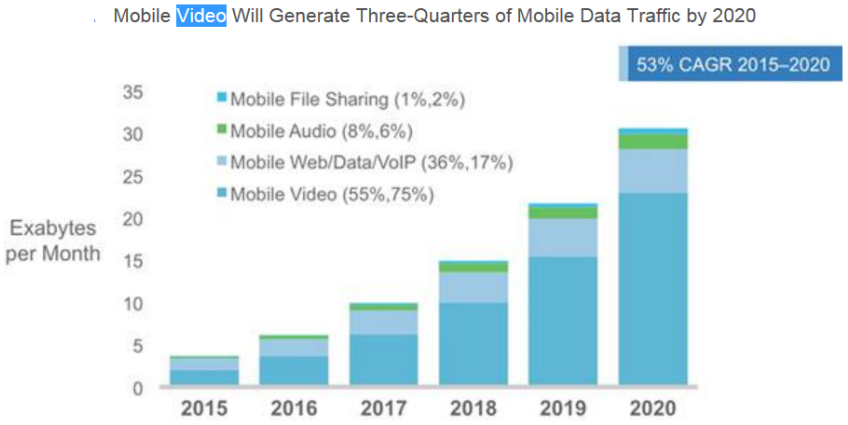
Trend – Traffic Mobile vs Fixed



Source: Cisco VNI Mobile, 2016

- **Global mobile data traffic grew 74 percent in 2015**
- **Mobile video traffic accounted for 55 percent of total mobile data traffic in 2015**
- **Three-fourths of the world's mobile data traffic will be streaming video by 2020**



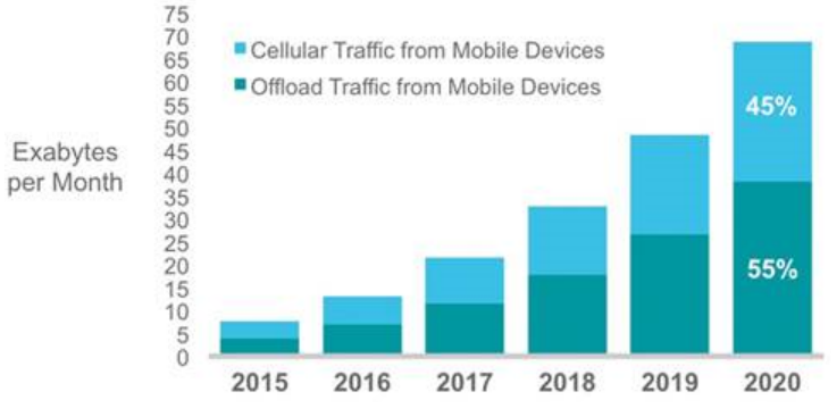


Figures in parentheses refer to 2015 and 2020 traffic share.

Source: Cisco VNI Mobile, 2016

Trend of Connectivity patterns Mobile vs Fixed

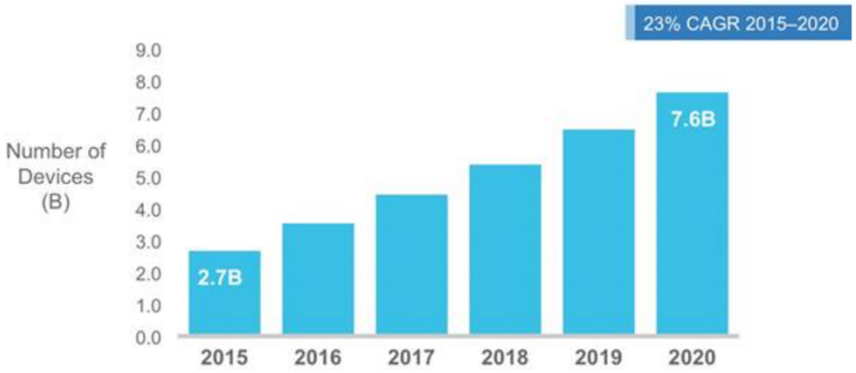
By 2020, 55 Percent of Total Mobile Data Traffic Will Be Offloaded



Offload pertains to traffic from dual-mode devices (excluding laptops) over Wi-Fi or small-cell networks.

Source: Cisco VNI Mobile, 2016

Global IPv6-Capable Mobile Devices



Source: Cisco VNI Mobile, 2016

- **Mobile offload exceeded cellular traffic for the first time in 2015**

- **In 2015, 34 percent of mobile devices were potentially IPv6-capable.**
- **By 2020 there will be 7.6B ipv6 capable mobile devices out of the 11.6B mobile devices which is almost 66%**

What's the next gen network?

Everything is ....

The Bliss Point is ....

Technology +
- **Simpler**
- **Faster to deploy**
- **Mobile**

Financial +
- **Almost zero-touch config (less opex)**
- **Virtualized (Less capex)**
- **Everything over anything (commodity HW)**

User +
- **Accessible anywhere**
- **Fast and customized services**
- **Self aware apps**

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- Ubiquitous Mobility – 5G and New requirements
- ID-Oriented Networking
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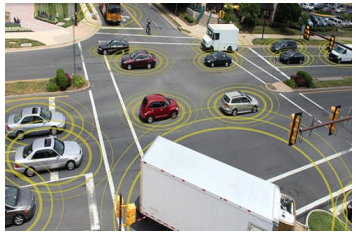
Mobile Data Services as a Pillar to New Experiences in 2020

Near Reality Experience

Tele-surgery

Robot Assisted Care



Connected Cars Collision avoidance

Drone delivery

Wearables, sensors, Monitors

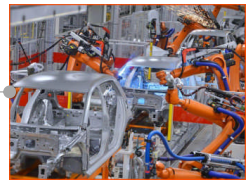
Internet Of Things

Immersive Technologies

Tactile Networks

Smart Mobility

Artificial Intelligence



Industrial Robots

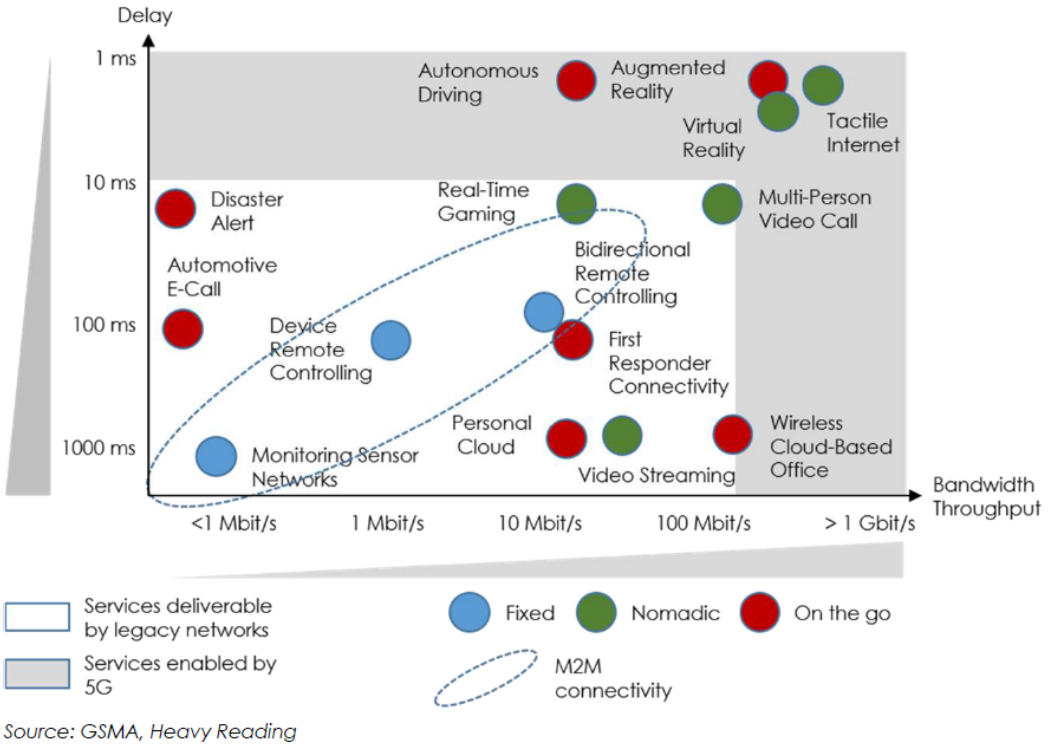
Always On

Pervasive bandwidth

Near Zero Latency

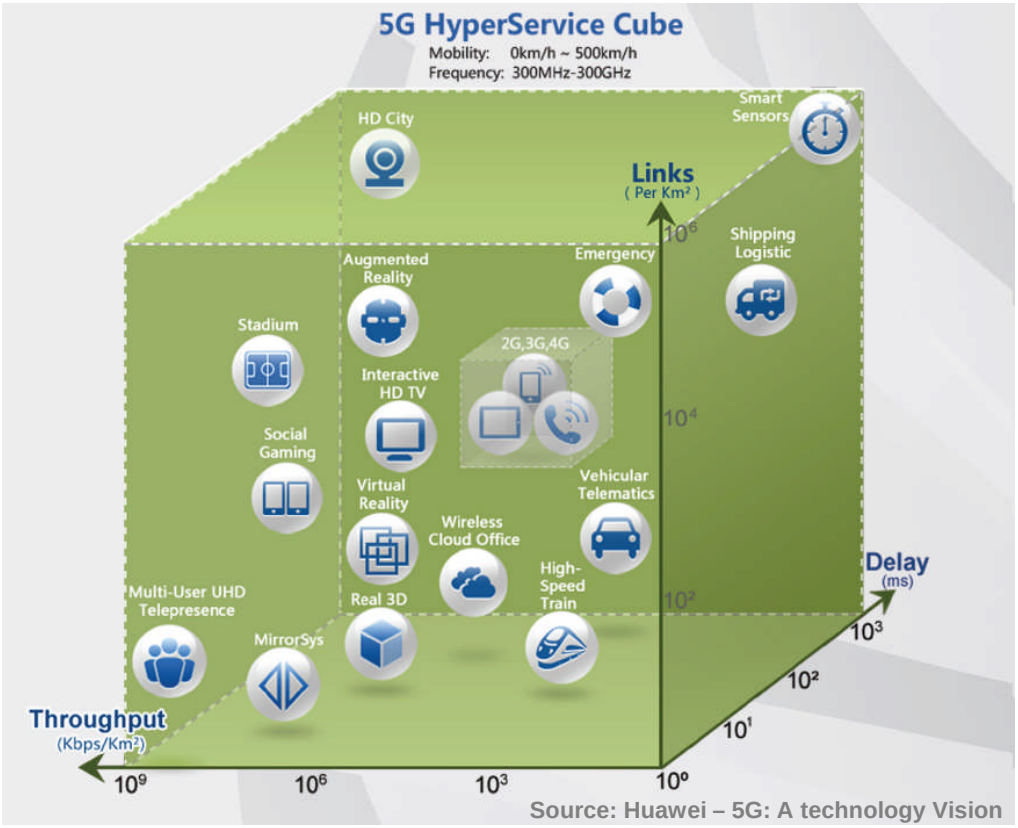
No perceived data loss

Applications have Heterogenous Requirements



Source: GSMA, Heavy Reading

Newer Applications - Multidimensional Requirements

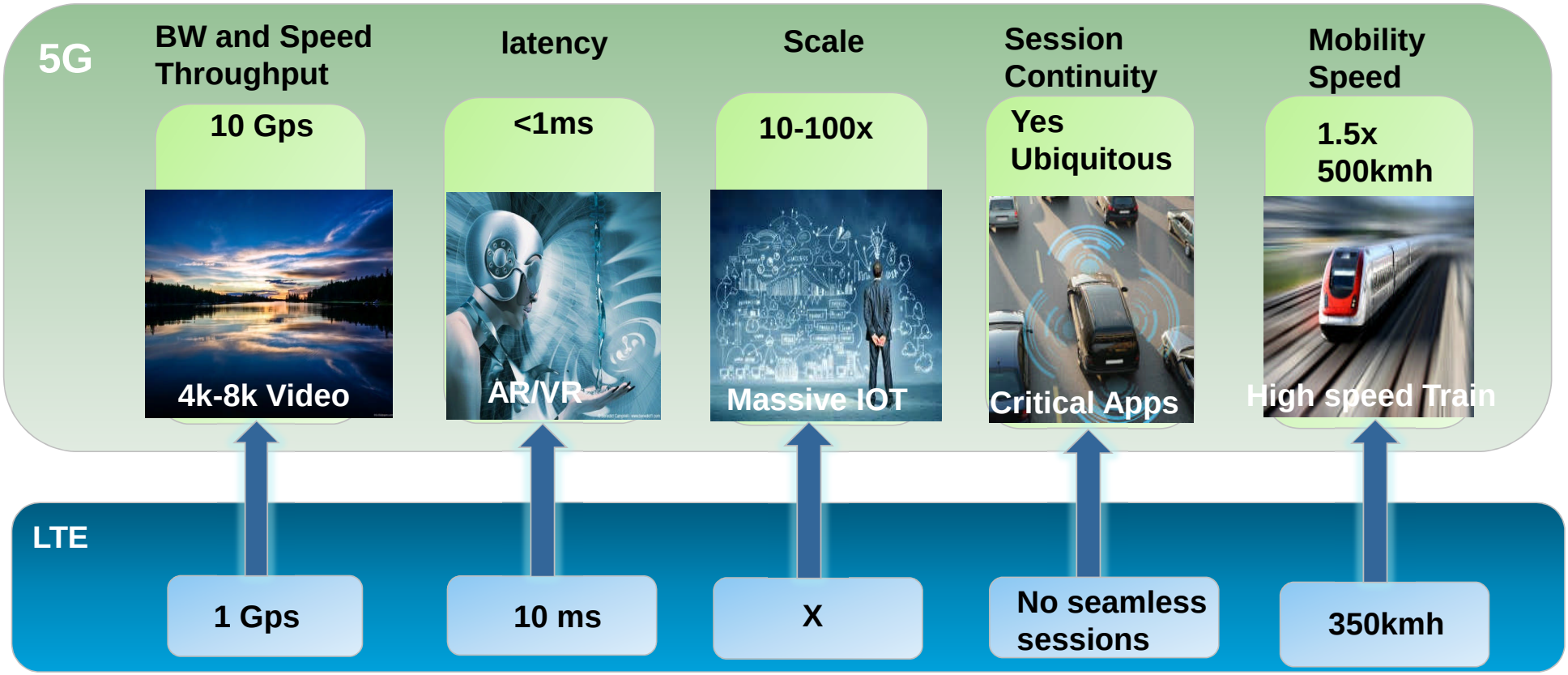


Source: Huawei – 5G: A technology Vision

Requirements are actually n-dimensional

- **Low power device**
- **Security**
- **Context awareness**
- **Retention of profile**
- **Single signon**
- **QOS**
- **Session continuity**
- **….**

5G - Redefining Mobility in Future Networks

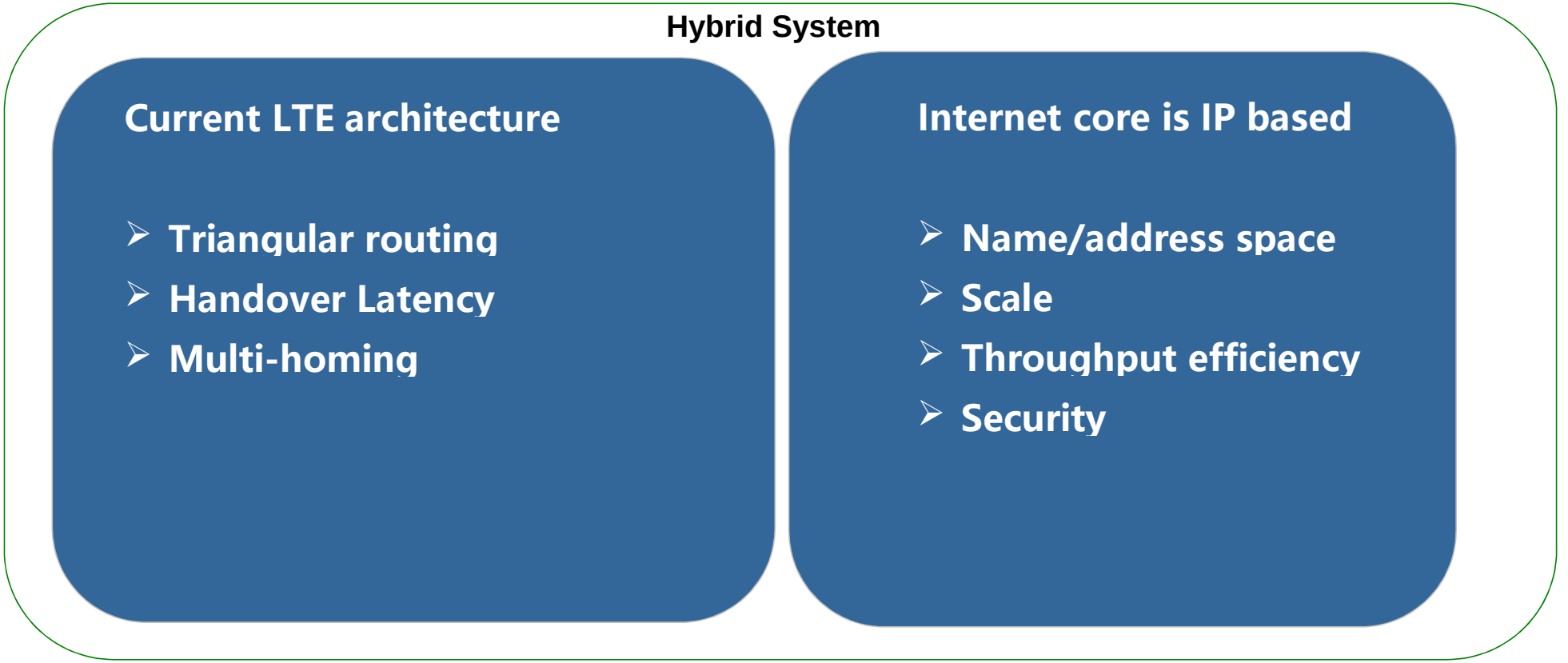


Various Sources for Data: Huawei – 5G: A technology Vision & 3GPP

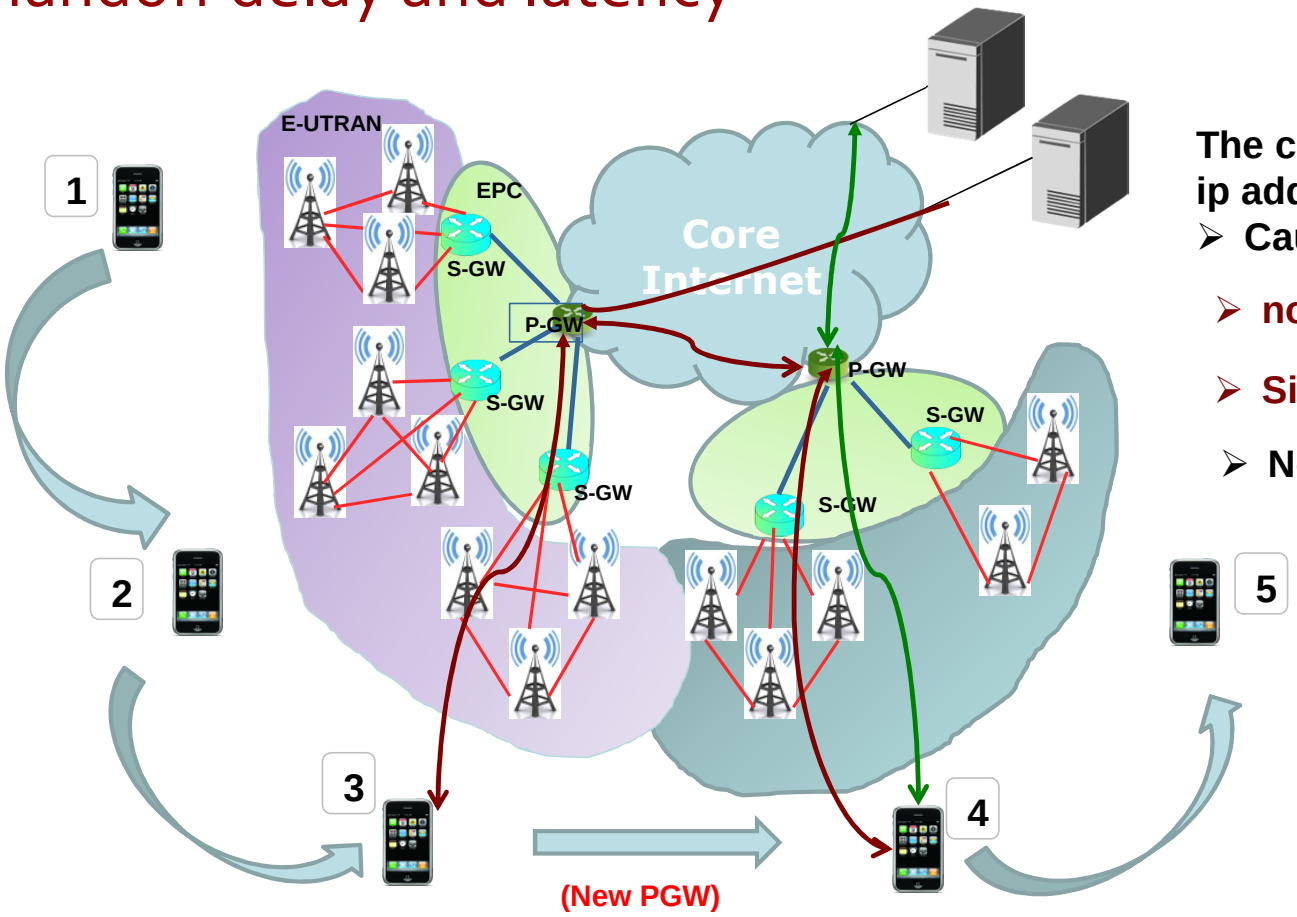
Tomorrow's needs and today's network …

- **The adoption of 5G with its new requirements are going to challenge the infrastructure.**
  - **Mobility (large range and fast)**
  - **High throughput and low latency**
  - **Deployment over a heterogeneous Access**
  - **Security**
  - **Master Identity for single sign-on for contextual and privacy**
  - **Energy preservation and low power consumption for devices**
  - **Session continuity**
- **The Internet was originally designed as a static network.**
- **The EPC/RAN interconnects with the core IP network - hybrid of 2 Architectures**
- **Good enough for 5G and beyond?**
  - **Scale with more density?**
  - **Bigger "pipes" & Faster CPU vs Green**
  - **Context Awareness?**
  - **Identity Awareness?**
  - **Session continuity?**

Some known or anticipated difficulties/issues ?



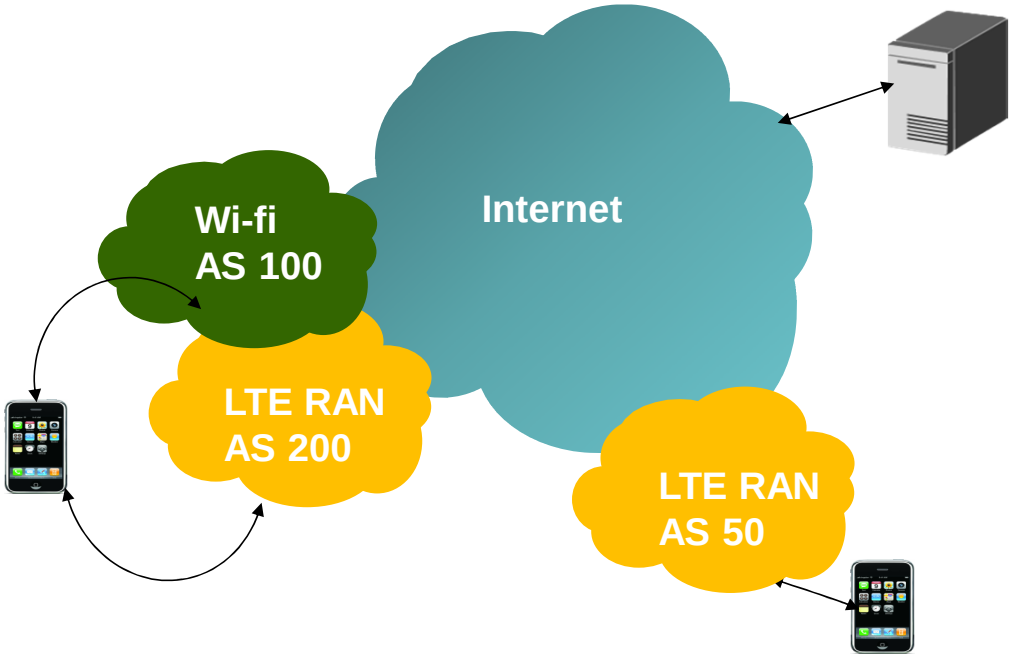
Handoff delay and latency



The change of P-GW and change of ip address pool will

- Cause change in IP address in UE
- no TCP session continuity possible
- Significant latency due to mobility ancho
- Newer sessions are optimized

Multi homing features with heterogeneous access



A single host may be connected to multiple networks.

A UE might be simultaneously connected to a WiFi network and RAN and each will have a different ip address which will need to be advertised.

Advantages
Opportunistic BW use is the way to go
Redundancy
Loadbalancing

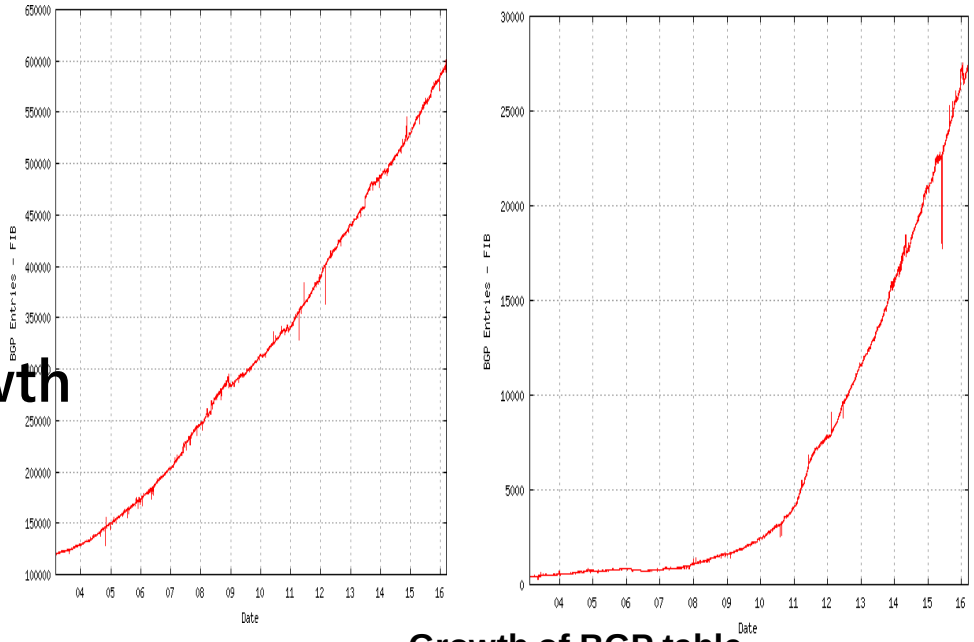
Multihoming has global repercussions
Larger RT on routers as the address is not aggregatable and need to be known across multiple AS

IP Addresses

- The IP address semantic is overloaded
  - Name/Identifier of the node
  - Physical Address of the node/Locator of the node
- As the ID is tied to the node “Bob” at the office ID will be different from “Bob” at home
- **TCP can only work with no break if we retain the IP address which implies sub optimal routing in mobility**

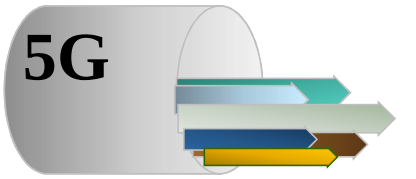
IP Scale

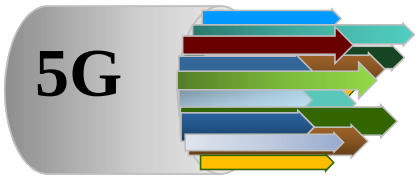
- As addresses get harder to aggregate the RT are growing
- Multi-homing requires the addresses to be globally
- TE is also contributed to RT growth



Growth of BGP table

Throughput Matters!





- User experience is more related to the session throughput.
- The session throughput is dependent on TCP which is an end to end solution
- Links of varying quality can be perceived by TCP as congested causing unnecessary throttling
- Throughput issues which will not work for UHD and other sensitive applications

Overview of standardized mobility solutions

SDO	Solution	Methodology	Advantages	Limitations	Market Proven
IETF	Mobile IPv4	Home Agents, Home Address, Care-of addresses	Use of IPv4, retain same ip address	Handover latency, signaling overheads in transition, suboptimal triangular routing, Limited QOS	
IETF	MIP V6	Address Autoconfig, autodiscovery of neighbors, Care-of-Addresses use of ipv6 hdr options for destination options	Always On Use of IPv6 Session persistence	Handoff latency, Limited awareness of heterogeneity, requires kernel changes,Security issues -	
3GPP	3G/GTP	Tunnels through eNB, S-GW and P-GW	Fast handoff	Tunnel re-creation on move, no session continuity.	Yes
3GPP	4G/LTE/GTP	Tunnels through eNB, S-GW and P-GW	Fast handoff	Tunnel re-creation on move. Service continuity is limited within a P-GW	Yes
IETF	Proxy Mobile IPv6 (PMIPv6)	Mobile Access Gateway (MAG) and Location Mobility Anchor (LMA)	Fast handoff retain same ip address	Session continuity limited to local administrative domain, centralized LMA may not scale well.	Yes
IETF	Distributed Mobility Management (DMM)	Mobility anchors, partial session distribution	Fast handoff	Triangular routing only for on-going sessions same as Mobile IP. Optimized for new sessions only. No RFC yet	
IETF	LISP	ID separation from location. Both ID and locator are IP address based	Use of ID over IP	Under Research	Experimental, ongoing trials through beta-network, waiting for multi-vendor market adoption.

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- ID-Oriented Networking - Overview
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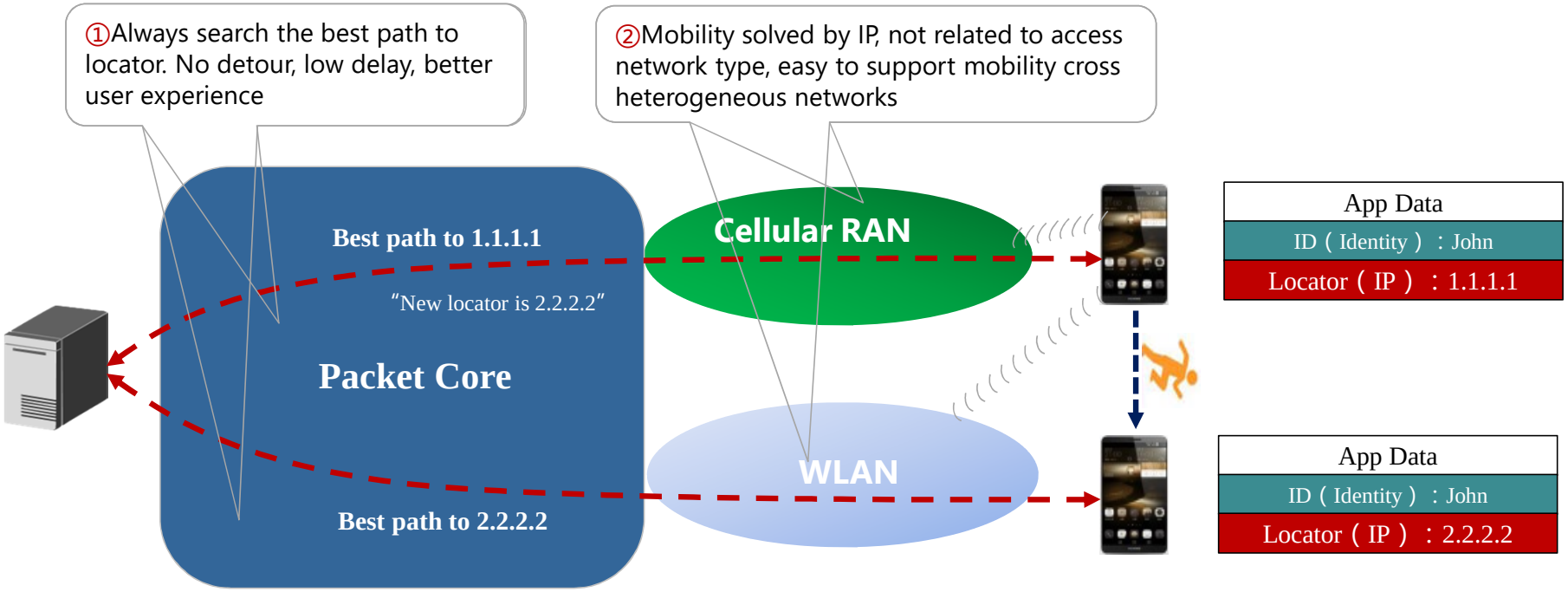
ID Oriented Networks - Basics

- Simple Principle : Need to dissociate the name and location and make them independent.
- ID can be the name of a node, an app or anything
- The Identifier movement is transparent to the higher layers.
- The forwarding is achieved by binding the ID with an ip address or locator.
- Usually there are mapping servers that bind the ID to a location.
- One user can have multiple IDs (fixed known or anonymous for privacy as needed

ID Oriented Networks

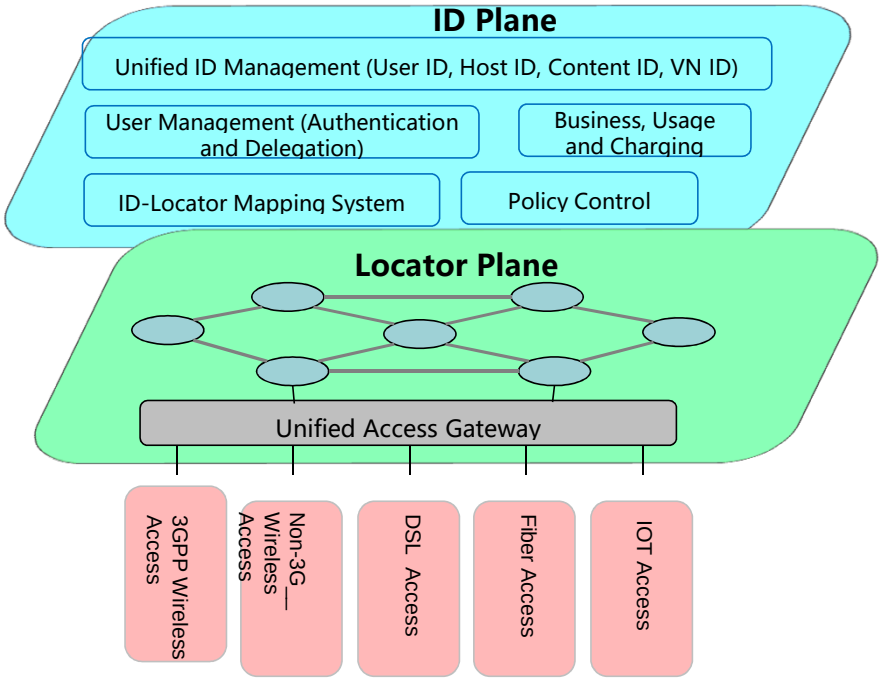
- Native mobility – It does not matter where “Bob” is
- Apps can be based on ID
- Addresses multi-homing ID have global significance(scope),
- Context awareness based on ID profile
- Security also can be ID based
- Fast deployment – Reuses already deployed and working (if IP)
- For scalability the Mapping Servers are distributed and redundant

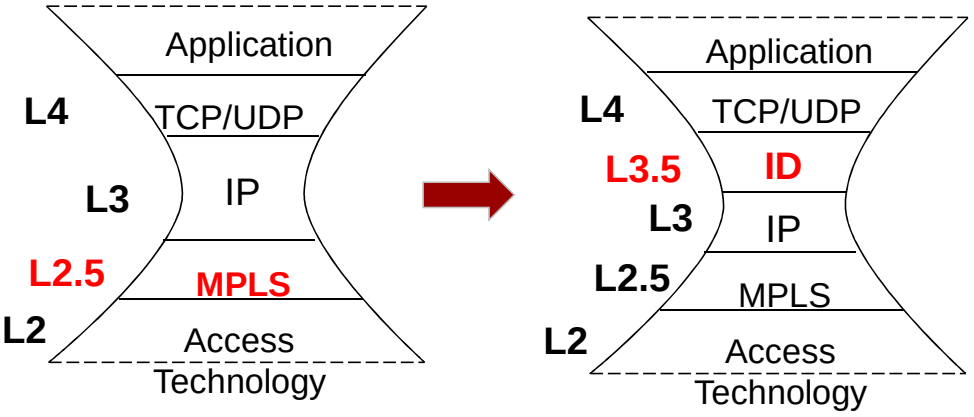
ID - Native Mobility



1.No Detour to EPC Anchor: End-to-End latency is minimized
2.Mobility is independent of the access network type

ID-Oriented Networking (ION)

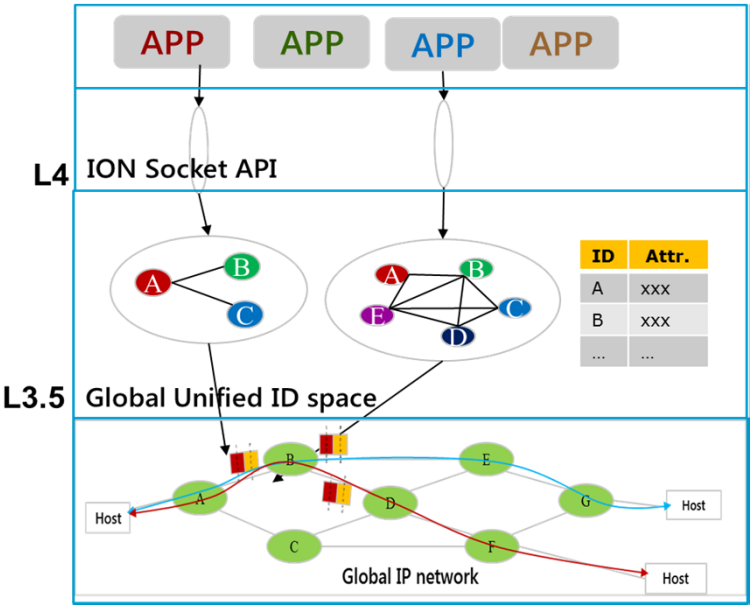




- **No need for clean slate**
- **Reduced Capex and Opex**
- **Global Reachability Possible: Everything, allocated with a unique ID,**
- **Innovation Speedup：Locator plane as a transport layer, while ID plane as a service and business layer. New services and business can be developed on top of ID without changing the underlying locator plane.**
- **Map and Encapsulate packets which can run on an IP core**

ION: Application Model

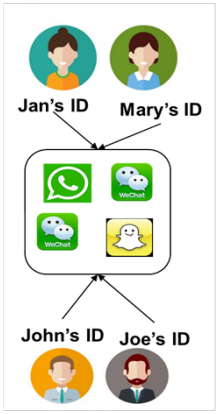
Enables Everything through an ID Aware Model



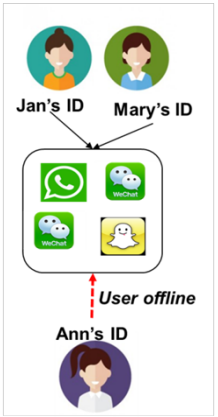
ION Sockets

- Applications connect with ID based sockets
- IP layer locates source and destination ID accurately and sets up path

1. Point to Point



2. P2MP & MP2MP



3. Asynchronous

Easier To Manage Communication Relationships with IDs

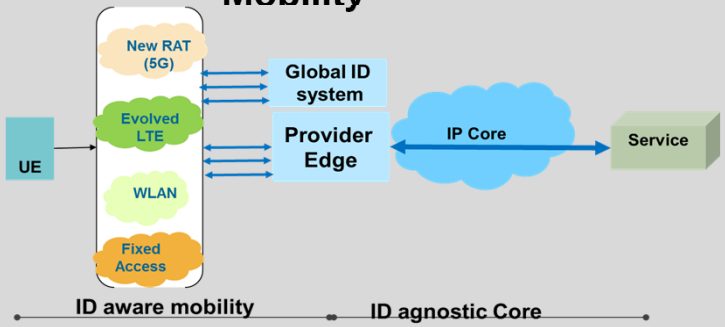
1. **Point to Point**
   - Single ID For Multiple Applications
   - Cross-application Channels
2. **Group Communication with ID**
   - Both P2MP and MP2MP
   - Same as (1)
3. **Support Active/Passive Comm.**
   - Synchronous when ID is online
   - Asynchronous when offline.

Unified ID Space

- All apps get same unique ID ('who is').
- ID Mapping system ensures ID is unique and globally accessible
- Possibility of having anonymous ID if needed

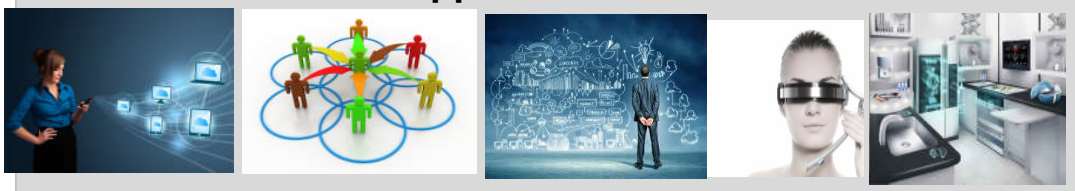
ION Unlocks New Opportunities Beyond Mobility

Mobility



- Delivers Better Service Experience
  - Optimal traffic path selection
  - No detours to mobility anchor point
- Simplified Network Operations
  - Unified ID plane for any fixed and mobile access
- ID Agnostic Stable Core
  - FIB remains locator based
  - As user moves, no route change triggers

Benefits and Opportunities



- Anonymous IDs for privacy
- Context Aware
- Security based on ID
- Communication
  - P2P Communications without servers
  - Cross-silo communication possible
  - ID based Group-communication (PIM free)
- Accelerated applications deployment
  - Network/Topology change agnostic
  - Focus on business logic not network
- Refined Edges
  - Fine grained ID aware TE, Policy, LBs
  - ID based End to End Security

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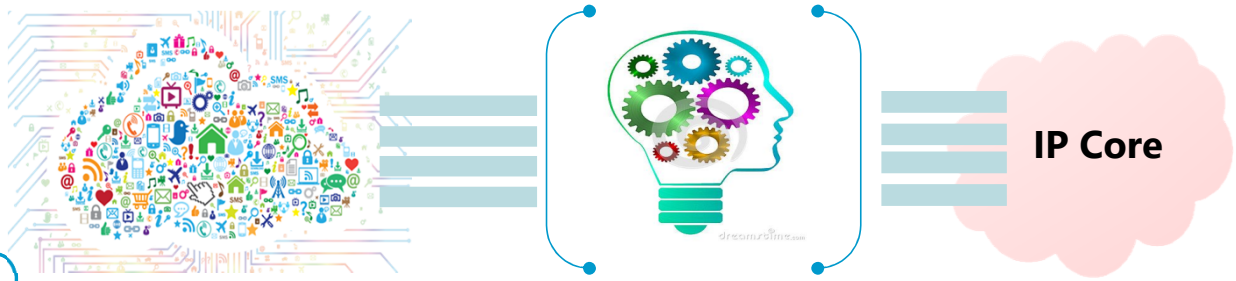
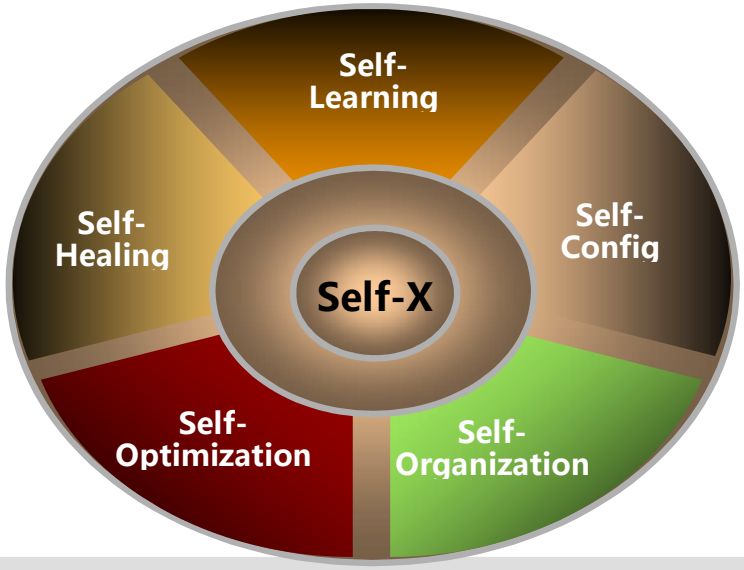
Intelligent Networking – An Urgent Need



Massive Connections (100b by 2025)

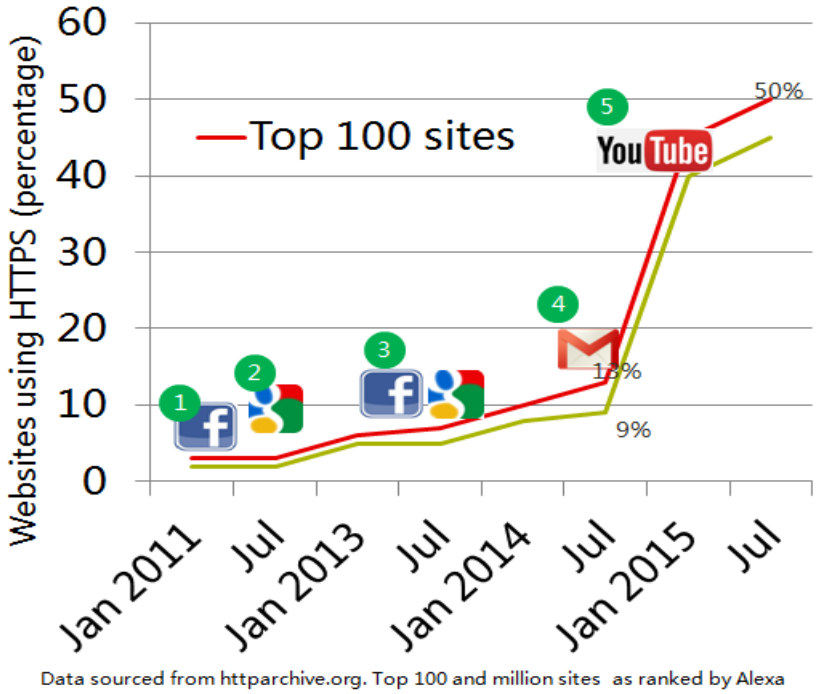
- Light-weight network
- Self-organized network
- Thing to thing connect
- Mobile

Intelligent Edge



- Network modeling based IT service and network node auto-connect Zero – touch config
- Optimized Delivery/Scale - Protocol and algorithm for self-organization network
- Proactive not reactive - Auto detect, self protect for network attacking
- Efficient Use of Big Data Auto monitoring, self-repair for network defects

Security and Encrypted Traffic in Higher and Higher Demand



Data sourced from httparchive.org. Top 100 and million sites as ranked by Alexa

1. **2011 : Facebook adds an option for secure login**
2. **2011 : Google Search provides secure search**
3. **2013 : Facebook, Google Search are encrypted**
4. **2014 : Gmail is encrypted**
5. **2014 : YouTube traffic is encrypted**

- Internet traffic encryption are implemented and provided by Google, FB, Twitter, Yahoo and Snapchat, which accounts for 45-50% (source from VDF, Mozilla)
- Content providers are increasingly planning to provide encryption for their traffic, for example, Netflix and BBC are testing their networks for encryption.

Encrypted traffic is growing after 2011. Now it accounts for 45-50% of the total Internet traffic, and it continues to increase.

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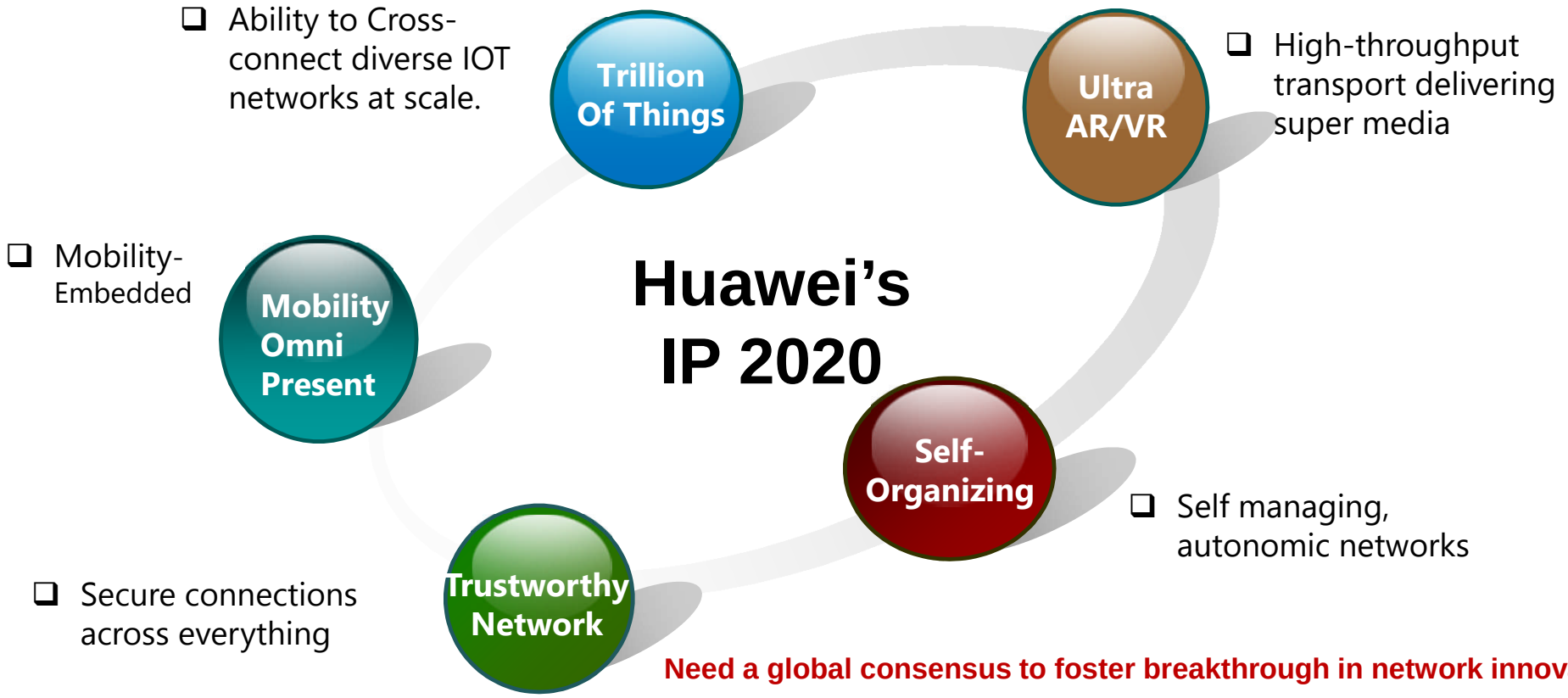
Moving towards a Connected Digital Society

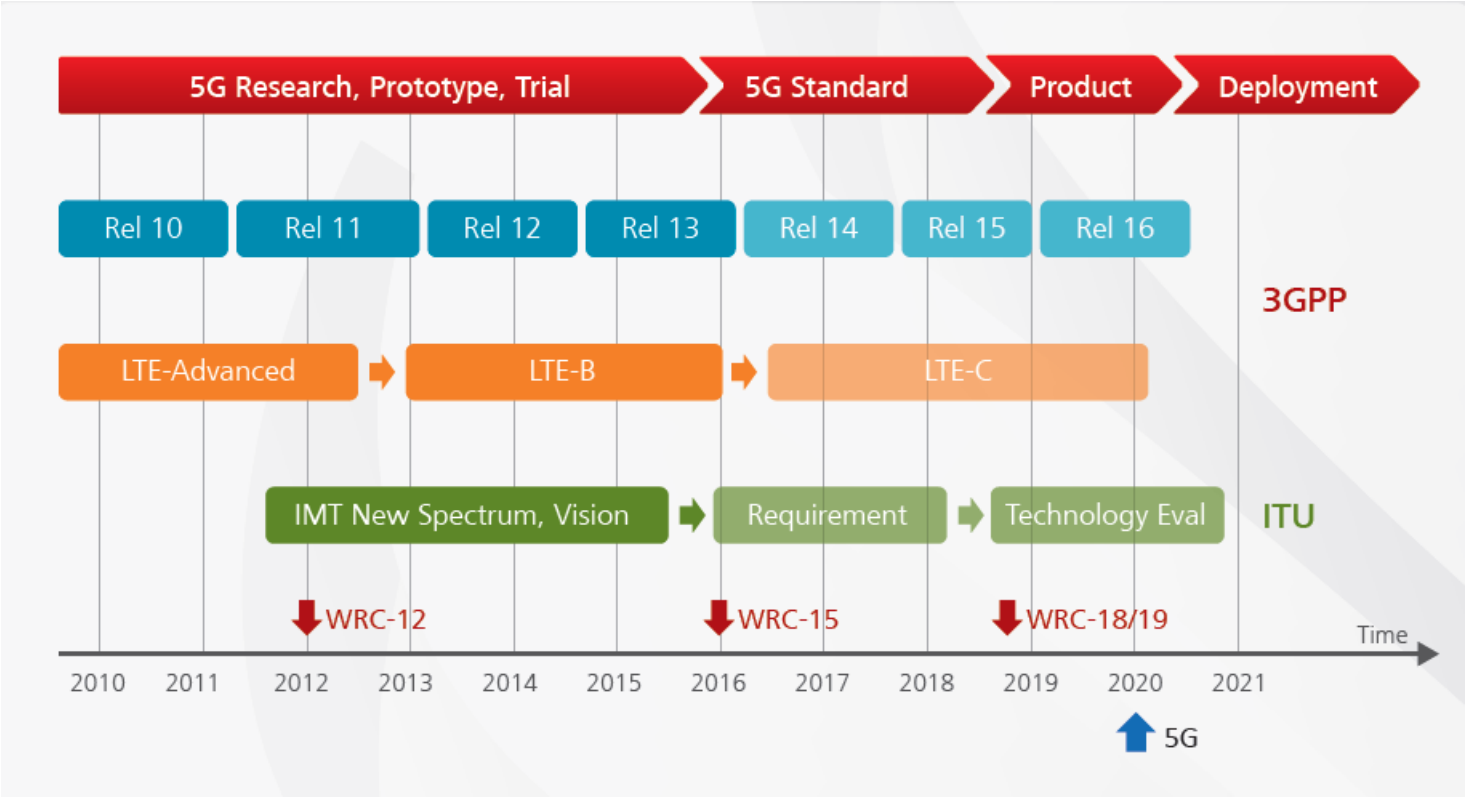


Need a global consensus to foster breakthrough in network innovation

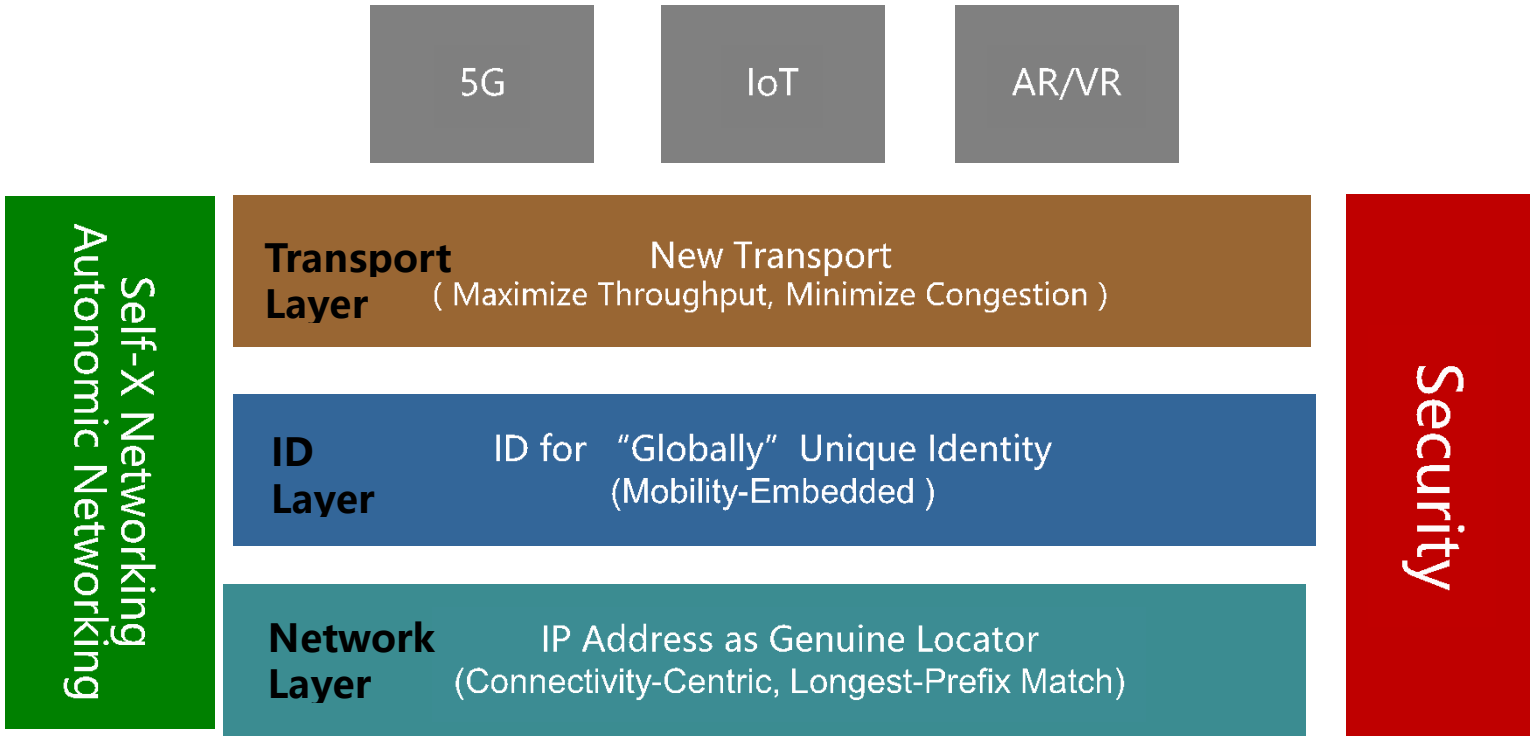
Where are we at regarding standards?

- **5G will intersect with many technologies**
- **A practical approach is necessary to aim for a deployment in 2020.**
- **It is a unique opportunity to have a holistic view and to simplify/flatten the topology.**
- **Mutliple Standard bodies are working on different aspects**
  - ✓**IETF/IRTF**
  - ✓**3GPP**
  - ✓**ETSI NGP**

The timeline for 5G (3GPP)



Protocols for IP 2020: A Summary



Thank you

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