



# The Evolving Mobile Network

Cisco Systems

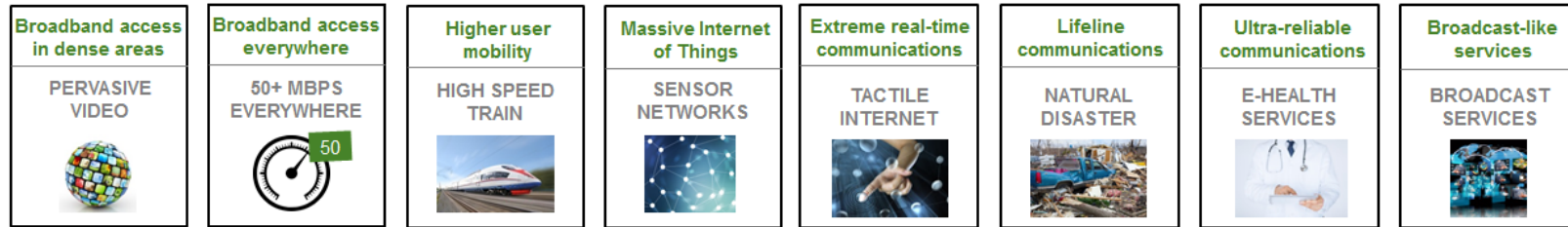
Sam Samuel  
Mobility CTO

May 2015

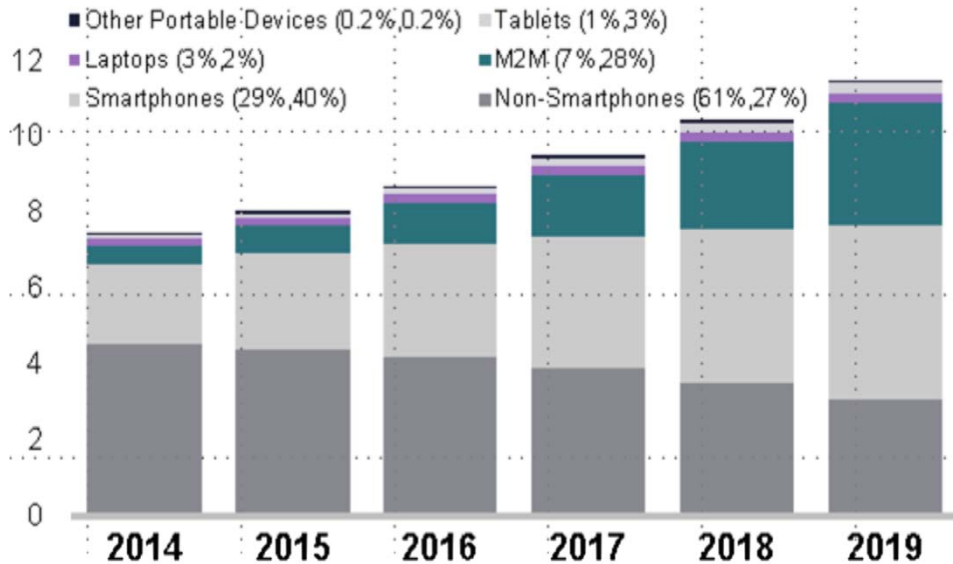
# Some things to consider ...

# The Drivers

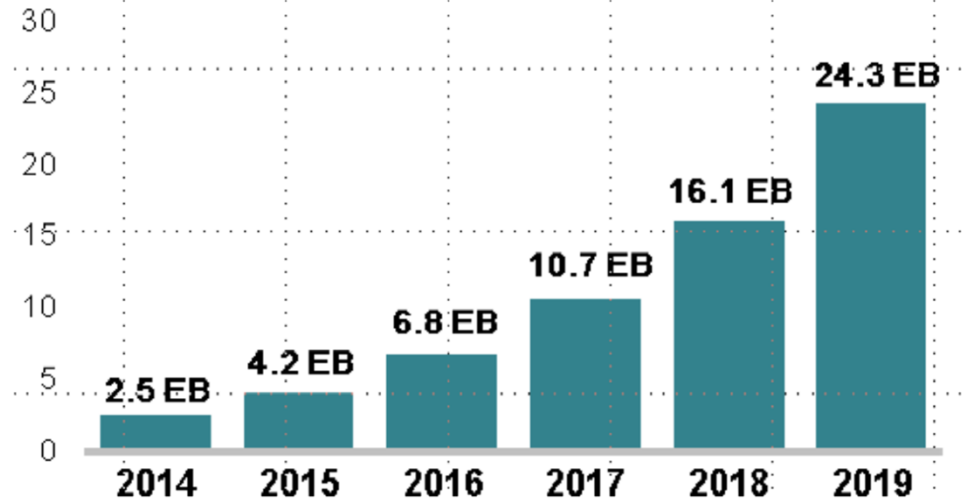
Source: NGMN [https://www.ngmn.org/uploads/media/NGMN\\_5G\\_White\\_Paper\\_V1\\_0.pdf](https://www.ngmn.org/uploads/media/NGMN_5G_White_Paper_V1_0.pdf)



Billions of Devices



Exabytes per Month



Continued demand for mobile broadband everywhere and new use cases driving the mobility evolution towards 5G

Source: Cisco VNI Global Mobile Data Traffic Forecast, 2014–2019

# 10-fold Mobile Data Growth from 2014 to 2019

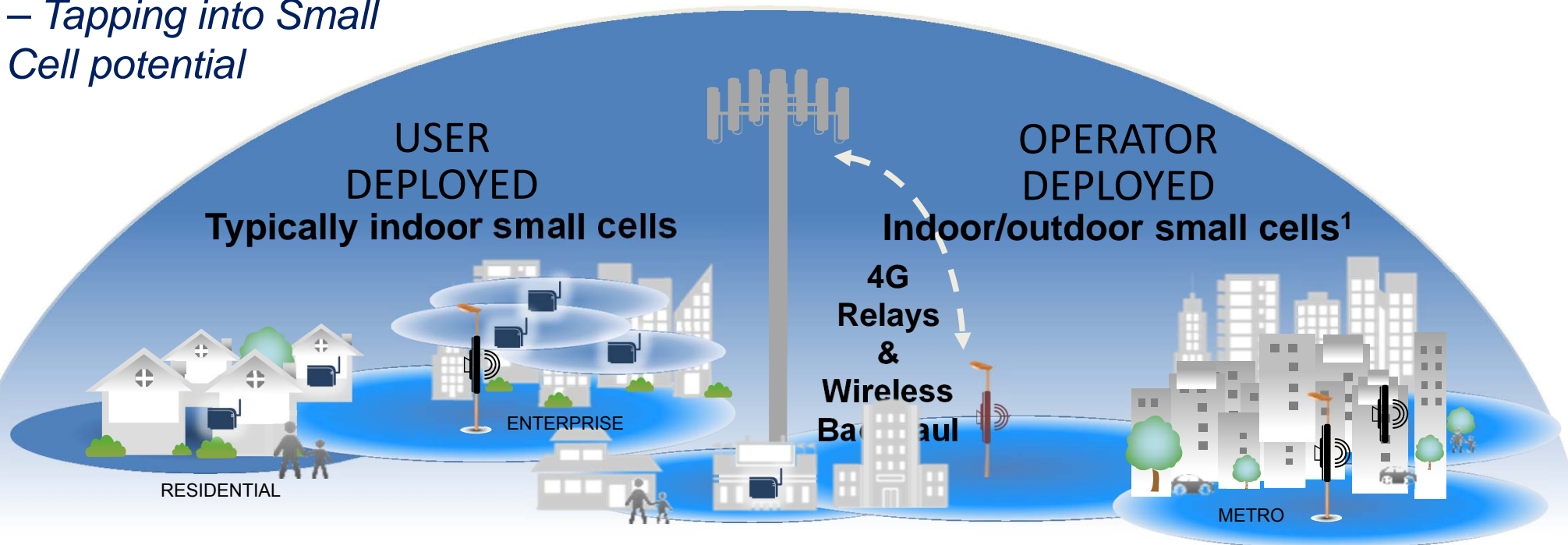


- 2.8 GB/mo. per mobile device by 2019 Globally; 51% CAGR  
3.9GB/Mo; 43% CAGR for Western Europe
- 11B mobile connected devices by 2019: up from 7B in 2014  
2.8 per capita by 2019 in Western Europe
- 54% global mobile traffic offloaded by 2019\*: 46% in 2014
- VoWi-Fi traffic will exceed VoLTE by 2017
- 3.2B M2M connections by 2019
- 34-fold growth in M2M traffic from 2014 to 2019; 103% CAGR  
Healthcare, Energy, Security, Smart Transportation

# Opportunities this brings ...

# Bringing The Network Closer To The User

– Tapping into Small Cell potential



**Wi-Fi integrated with 3G/4G for opportunistic offload**

**Extreme Densification—3G/4G+Wi-Fi Small Cells Everywhere**

<sup>1</sup>Such as relay and Pico/Metro/RRH small cells for hotspots. RRH= Remote Radio Heads, in addition Distributed Antenna Systems are used in HetNets

# The Battleground: Competing Approaches to Communications Network Architecture

## Traditional Communications Architecture

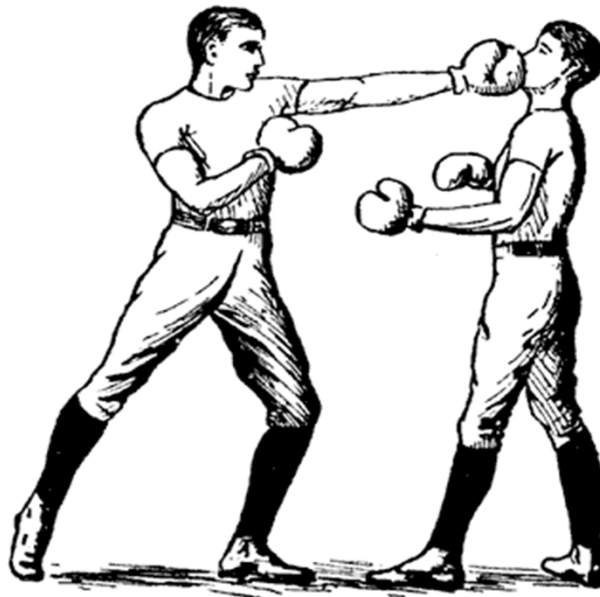
Consolidates hardware & software into a single NE

Highly specialized hardware comprising custom ASICs, DSPs, and NPUs

Highly proprietary software

Design for stateful fail-over between mated pair system

Deploy only after extensive testing and integration cycle



## Cloud-based Communications Architecture

Decoupled hardware from software from systems integration

Hardware is standard x86 compute, standard switching, and storage

Significant component of open source

Design for system level resiliency with small failure groups

Build for DEVOPS which means continuous development and operations

# Reliability in Cloud-Based Communications Architecture

- HW is inherently unreliable: why depend on it?
  - In Warehouse Scale Computing: “Don’t treat failure as an exception. Treat it as another normal operation” and “Everything fails, all of the time” (Werner Vogels – Amazon CTO)
- Cloud-Based Communications Architecture aspire to be Secure, Highly Scalable, and very High Performing
  - Not bounded by resources or geography: the cloud can exist anywhere
  - The cloud is **highly automated** with push-button orchestration of resources
- Can it be achieved:
  - Yes! And operators agree with a high degree of focus on “Network Function Virtualization”!
  - Numerous POCs across the industry
  - It is about the software!

Should we care about our hardware resources the way western society cares about cattle? (they don’t)



Or are hardware resources more like pets? (people care!)

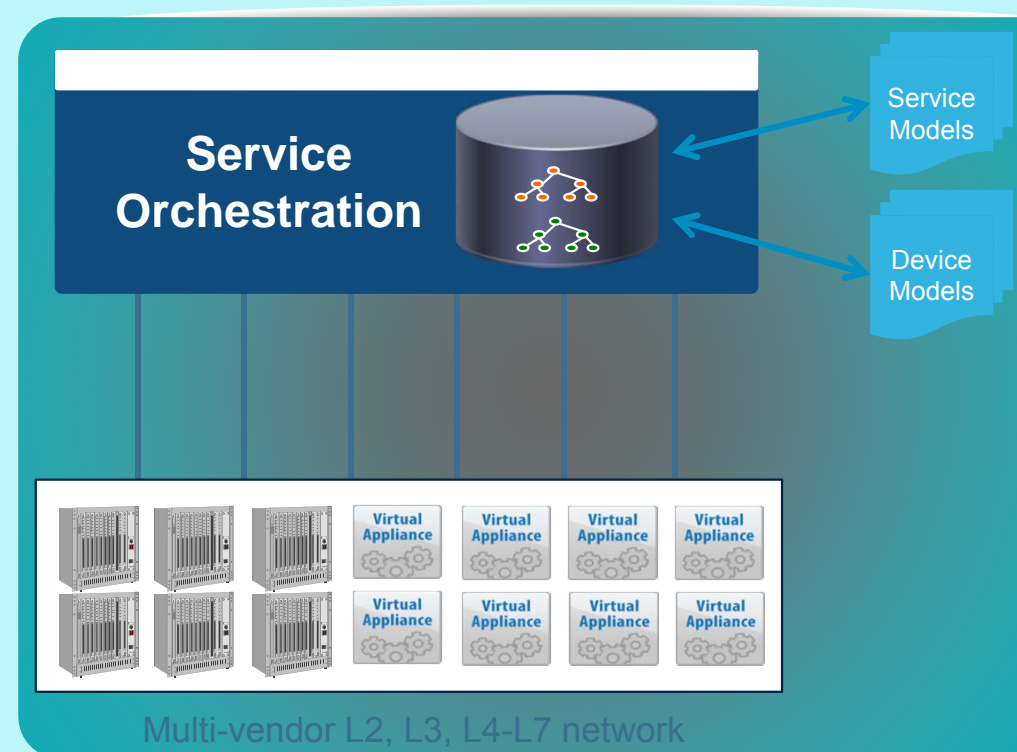




# Evolution: Model-Driven Service Architecture

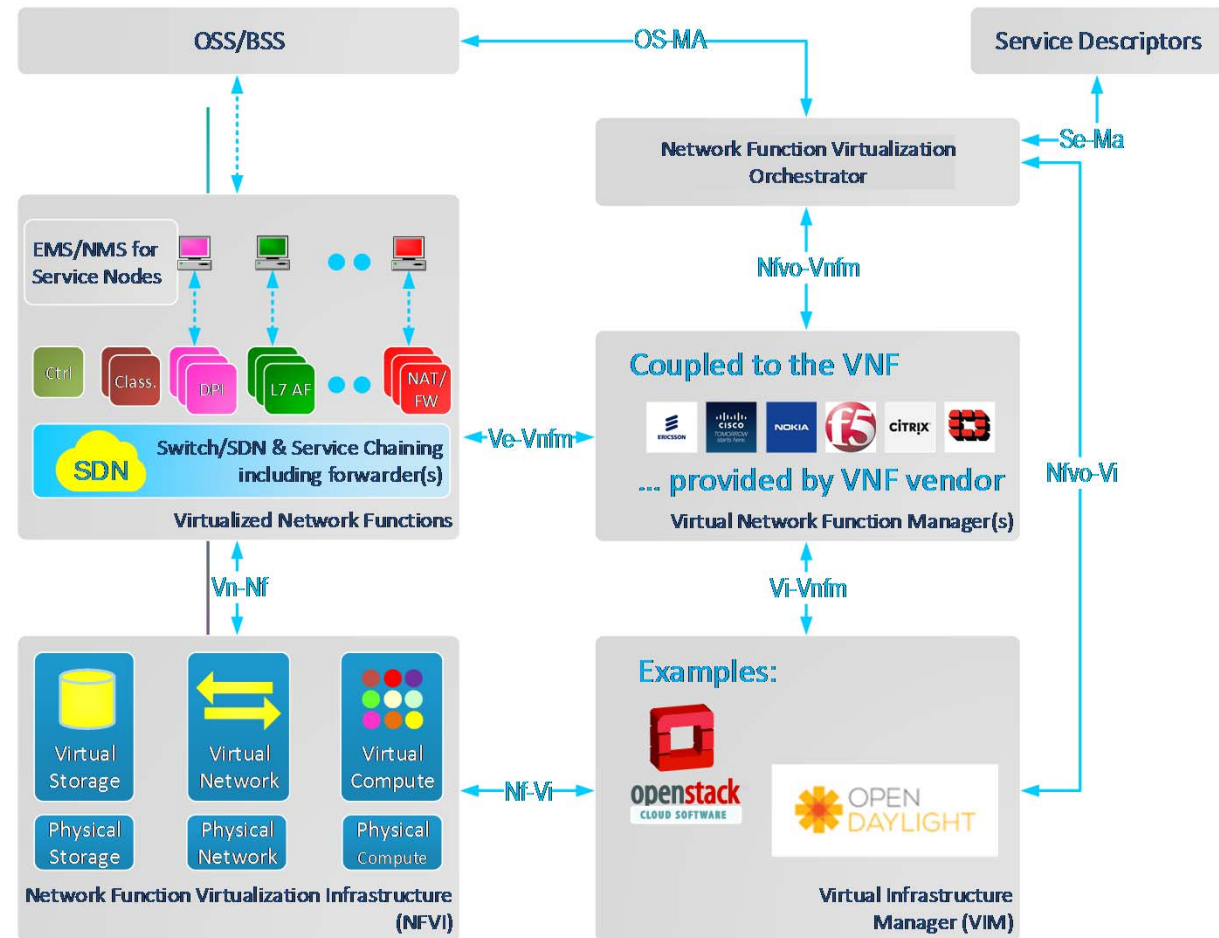
## This means:

- No hard-coded assumptions about network services, topology, policy and devices
- Instead:
  - Data models written in YANG
  - YANG data models automatically translate to User interfaces, NB-APIs, South-bound command sequences
- Benefit:
  - Applies to all service and network types, both physical and virtual

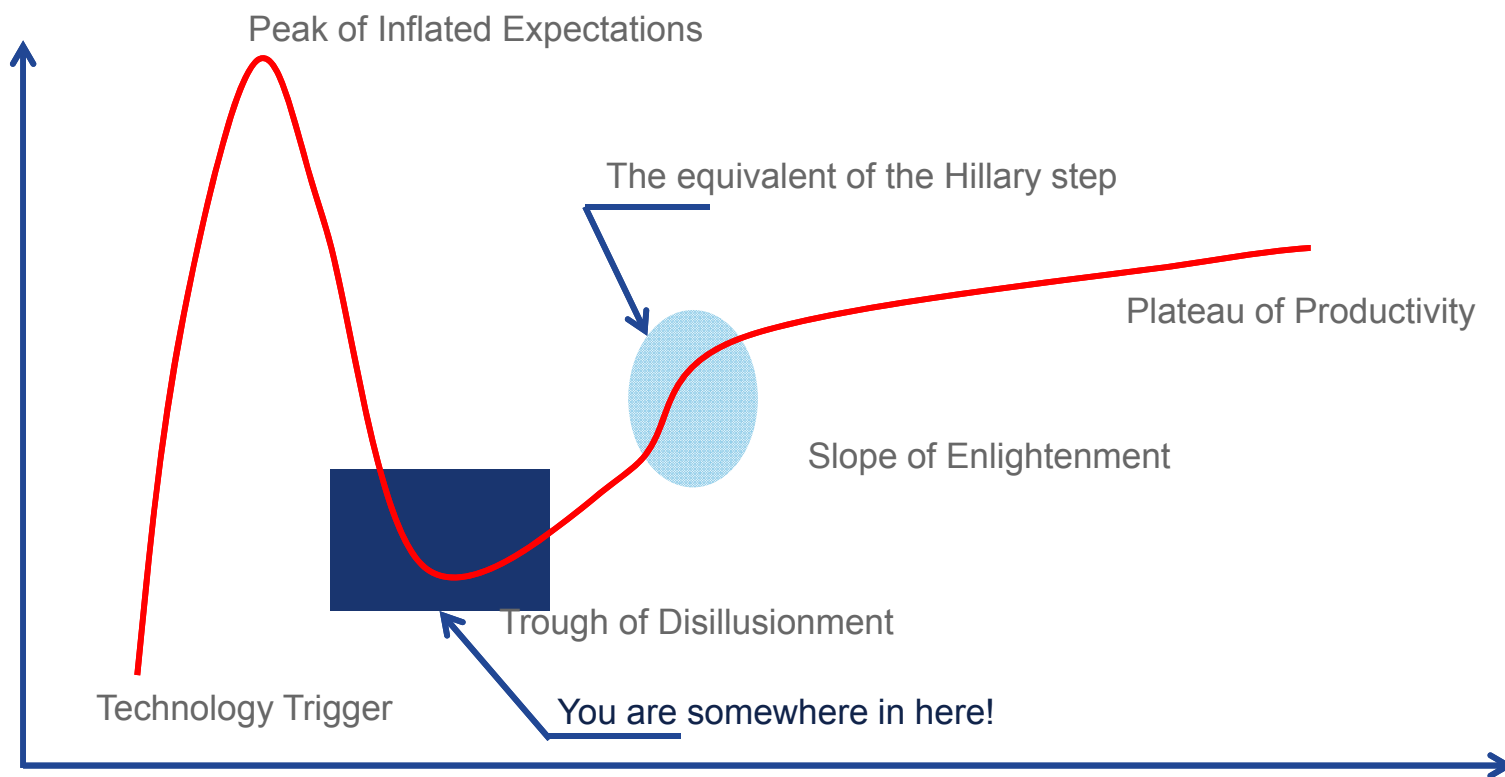


# Operator Cloud Focus: Highly Automated Functional Models

- The ETSI NFV model focuses on automation and openness as major architectural tenets
  - Day-0 through Day-N automation is covered by a VNF manager and a top level orchestrator
- Quality and reliability are not built into the architecture and are “innovation within the model”
- What is lacking is a framework for introducing continuous development and operations (DevOps)
  - The current model: convert NEs to VNFs
  - The future model: Platform for service velocity and service innovation



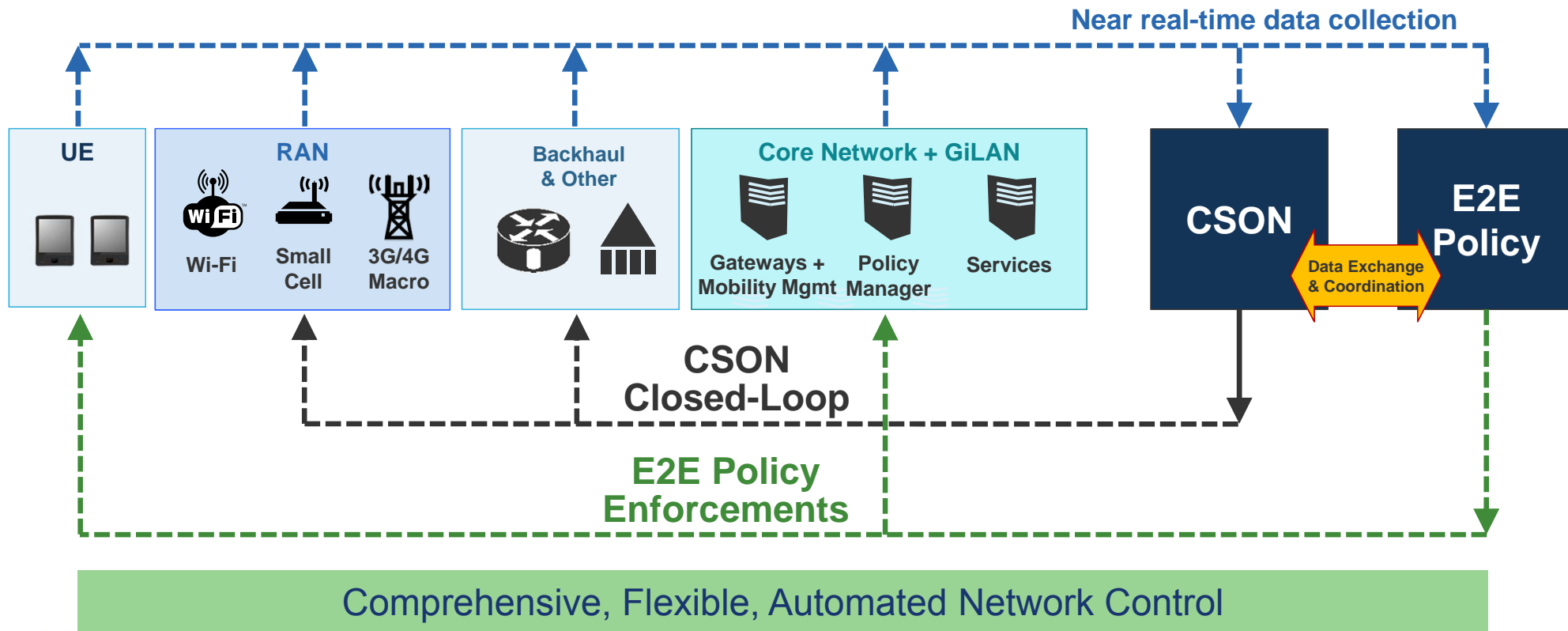
# Cloud and Virtualisation ... where are we today: The Infamous Gartner Hype Cycle



# Extending the structure ...

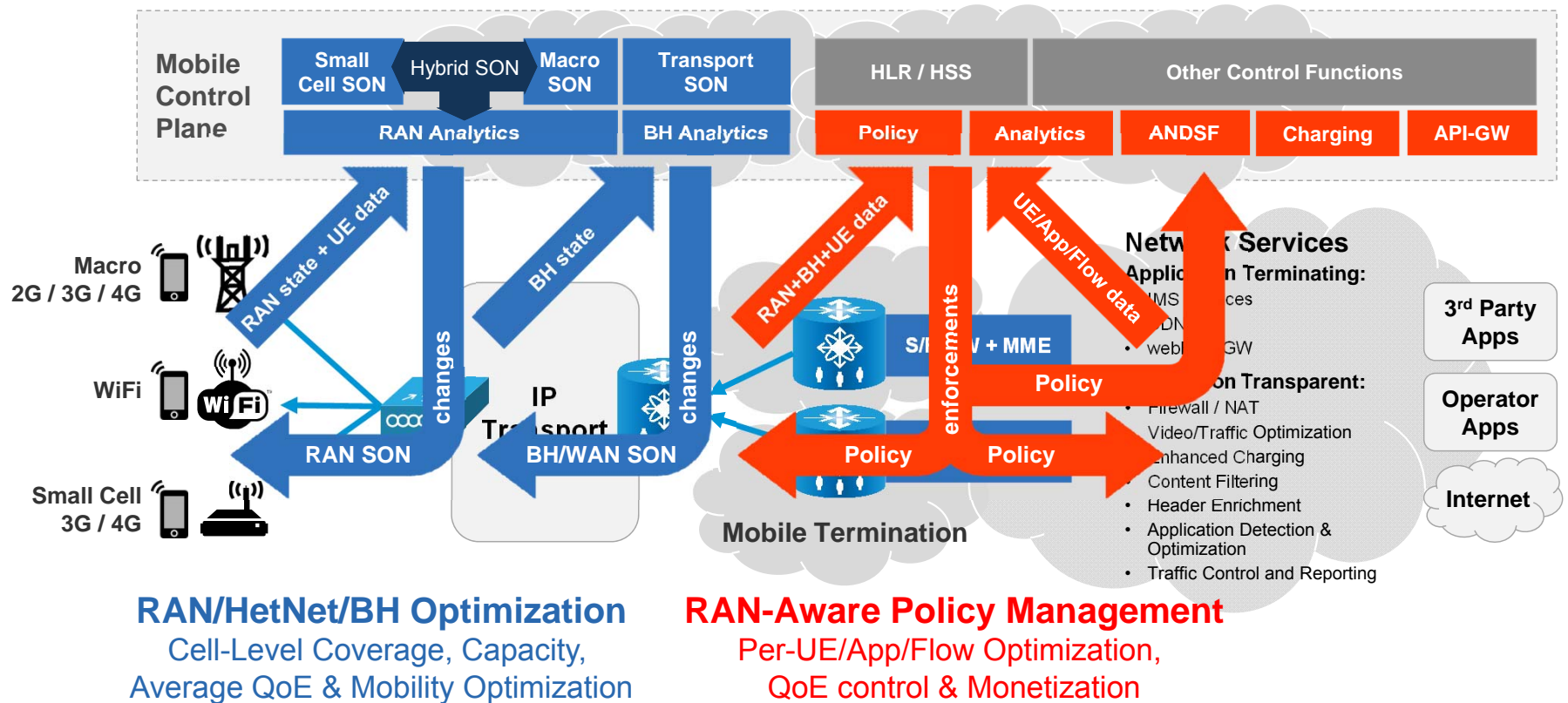
# Multi-Dimensional Network Control

Extending Self-Optimization End-to-End with Network Knowledge



# Wireless Network Optimization & Control

## RAN/HetNet/Backhaul SON + E2E Policy Management



Add all that up ...

# SON facilitates the zero-touch network

## Achieving the goals of:

- Shorter planning
- Quicker rollouts
- Simpler Integration
- Automatic optimization
- Less tuning
- Lighter audits



## Via a practical touch points:

- Extending existing auto – configuration capabilities
- Integration with GEO / planning tools
- Auto planning / site selection (macro / small cells)
- Improved network automated visibility – example, via crowdsource, probes
- Self healing
- Wider Impact on service assurance (e.g. VoLTE)

Self  
Planning

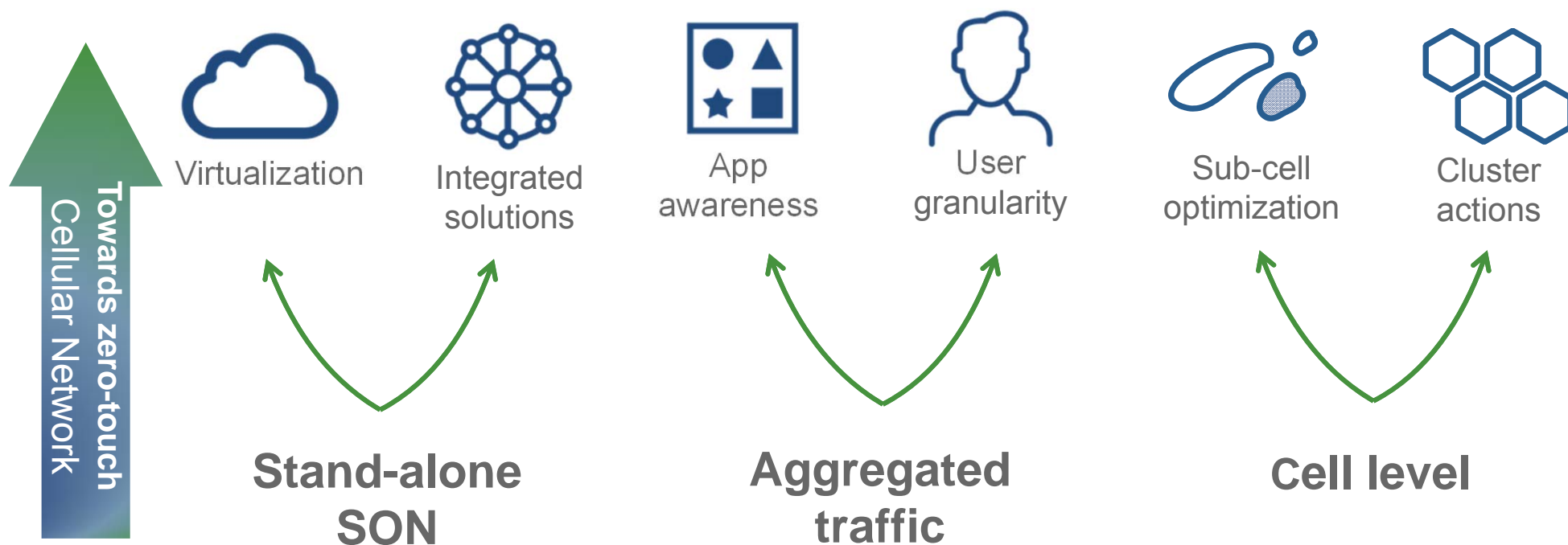
Self  
Configuration

Self  
Optimization

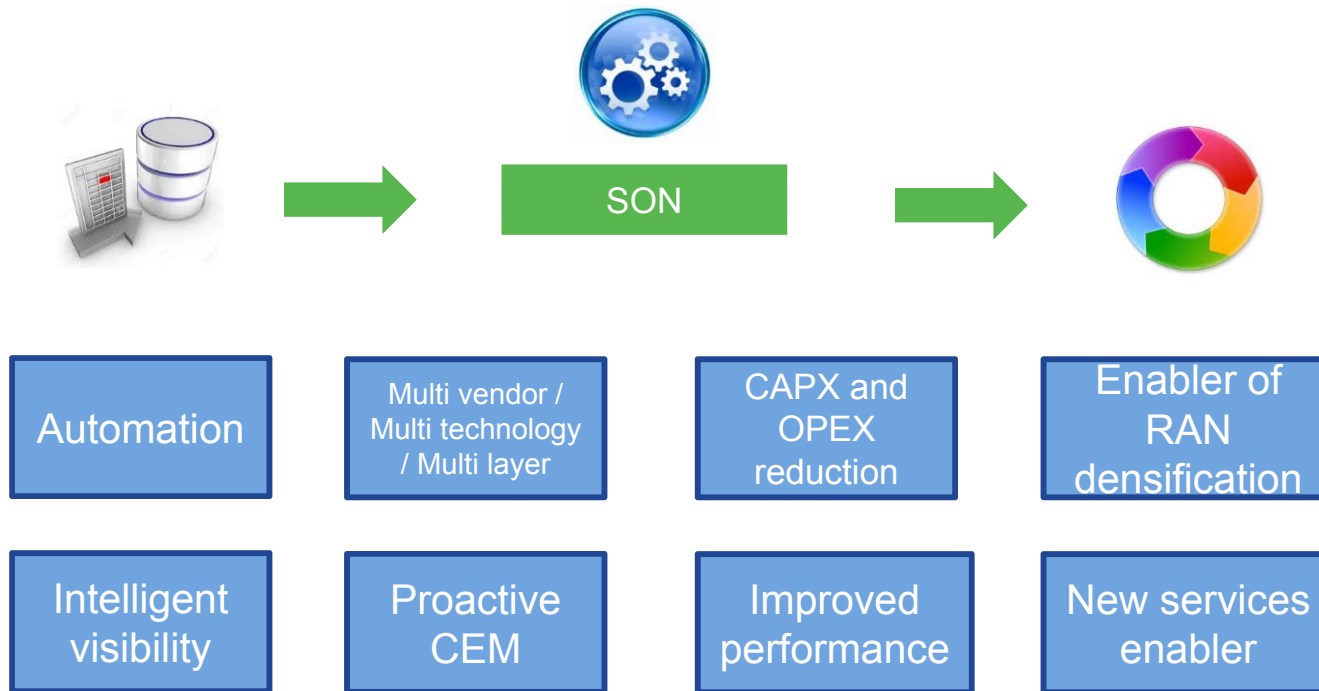
Self  
Healing



# Advances in breadth, agility and precision



# SON evolution and vision



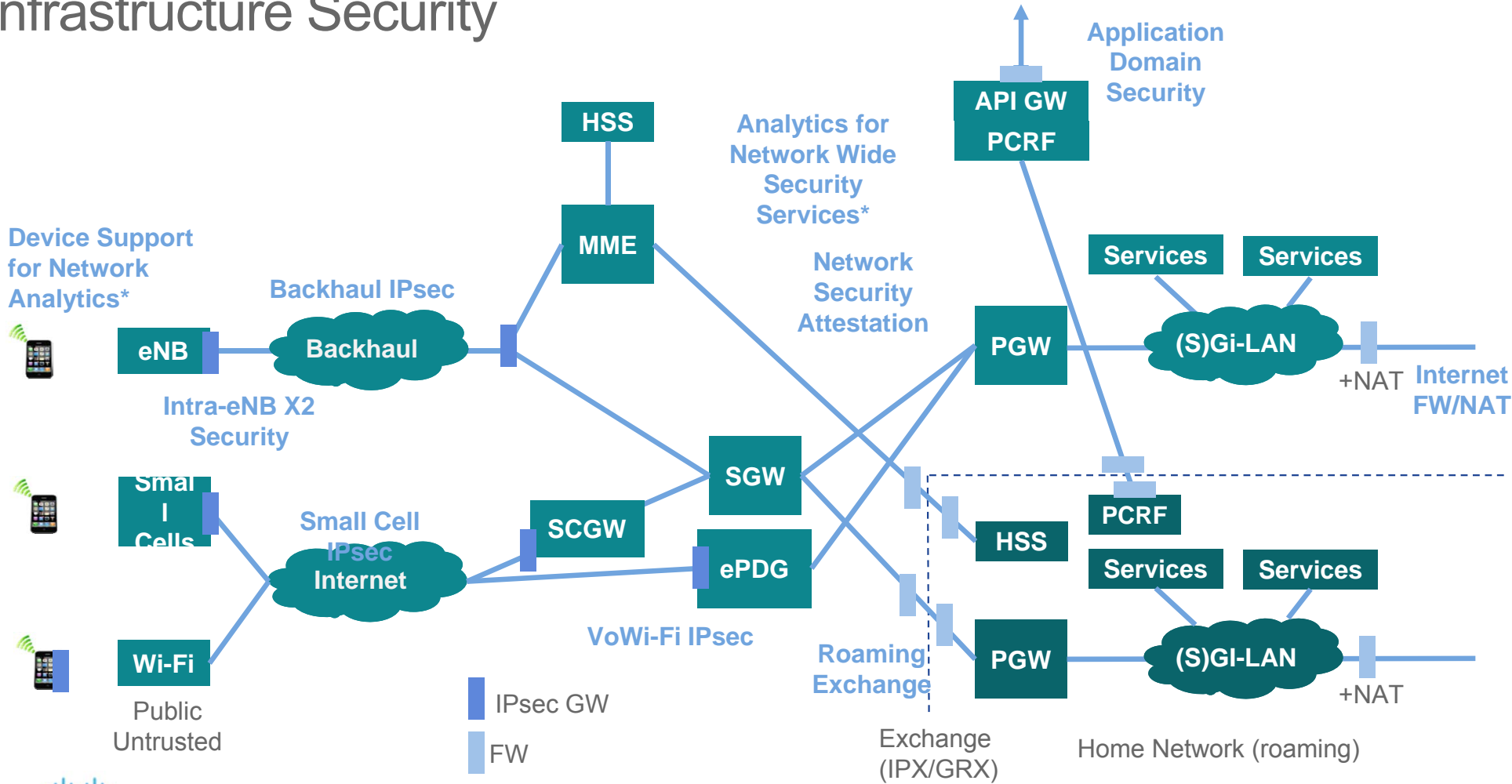
SON is a fundamental element in evolving network architecture (5G)

# CRAN Decompositions

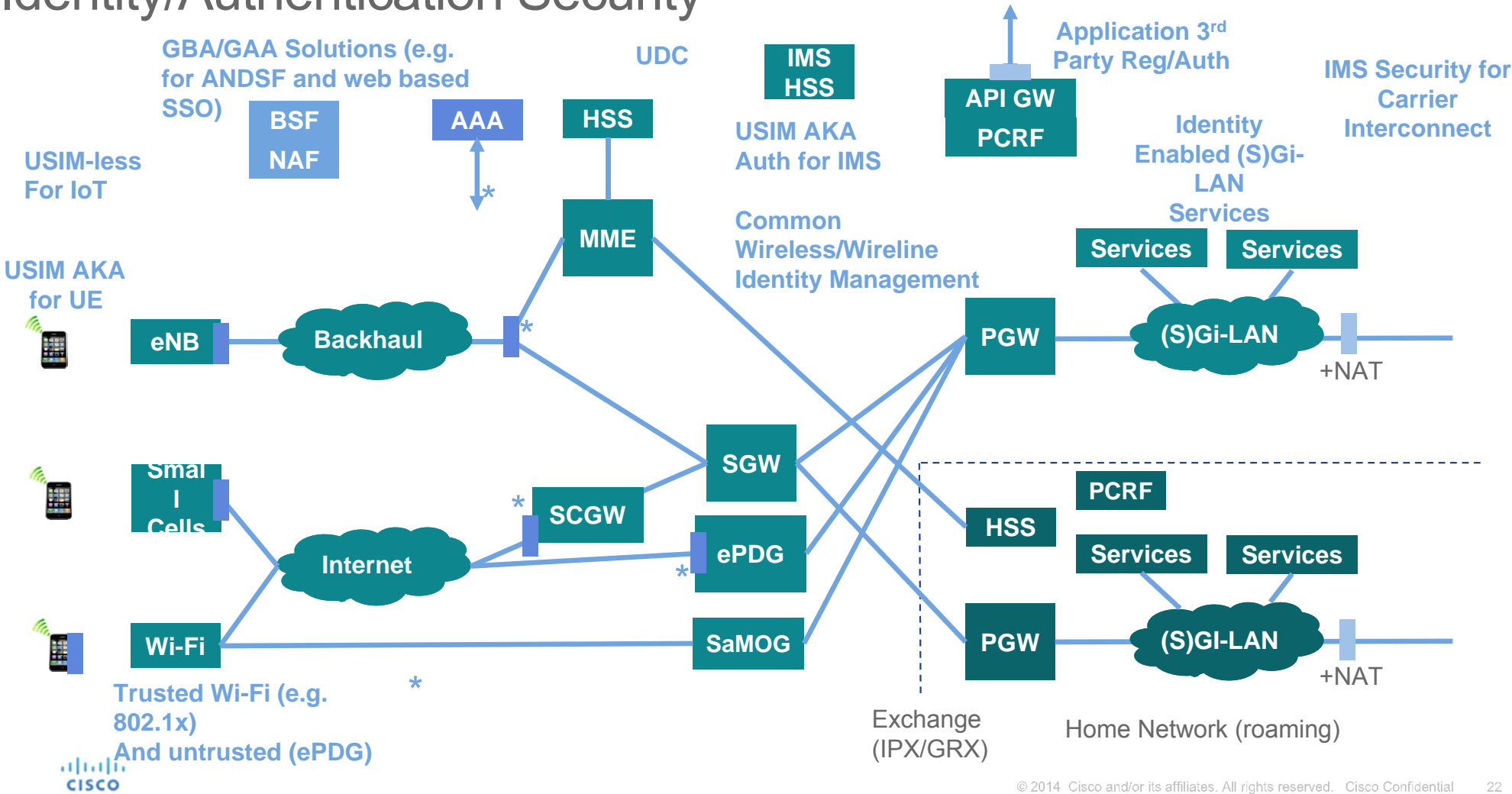


Can all this be protected ...

# Infrastructure Security



# Identity/Authentication Security

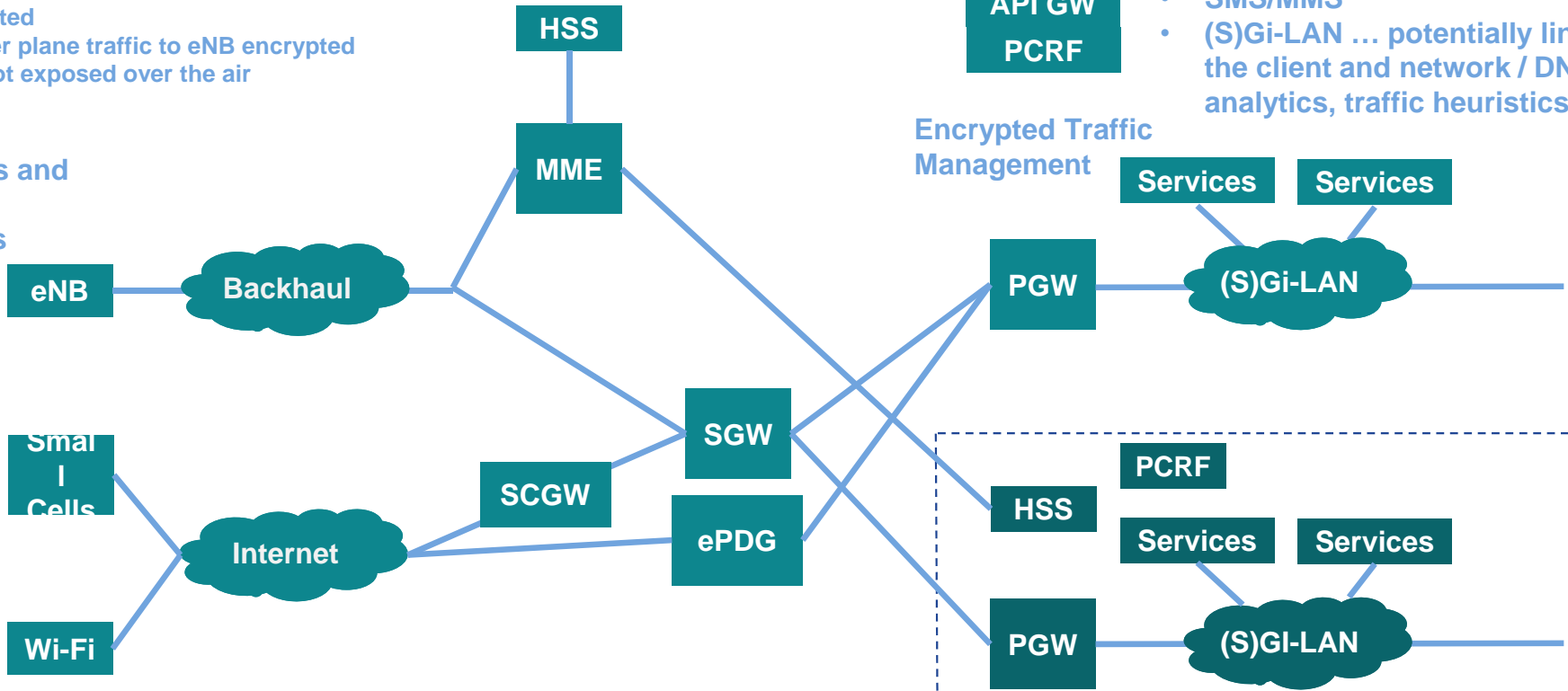


# User Based Security Services

## NOTES:

- IMS SIP Signaling encrypted per IR.92 to P-CSCF
- UE NAS/RRC traffic between UE and MME encrypted
- UE user plane traffic to eNB encrypted
- IMSI not exposed over the air

## Malware Scanners and Device Analytics



# Platform Security

- MANO related:
  - How do we secure IPR of scripts and Yang models included in the product/function?
  - Attestation of a virtual environment (particularly in tenant situations) ... including NFVI/VIM/VNF, for both boot and run-time applications
  - Resource credential management
  - Role based access capabilities
- NVFI/VIM related:
  - Securing VNFs and associated data/control in a multi-tenant environment
  - Container/VM and network isolation in multi-tenant environments
  - Meeting security requirements for regulatory features (e.g. Legal Intercept)
- Compromised Platforms
  - Detection and mitigation of platform (SW, FW) malware
  - DDOS attack mitigation ... both source and sink
  - Timing/sync attack mitigation



# The Many Dimensions of Mobile Security

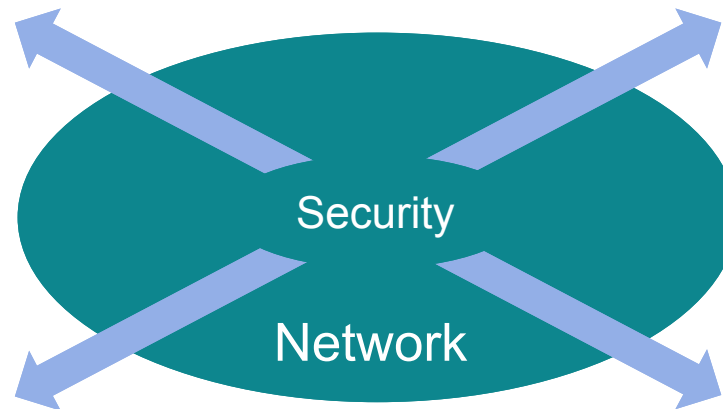
## Creating a Unified Security Approach

### INFRASTRUCTURE

- Link security (IPsec)
- Firewalls (and NAT)
- Analytics to support security services
- Network DDOS attack mitigation

### IDENTITY MANAGEMENT

- Device identity and authentication
- Service/application authentication
- User identity and authentication
- Single Sign-on options



### PLATFORM

- Securing IPR of scripts & models
- Attestation (boot and runtime) both VNF and PNF
- Resource credential management
- Role based access capabilities
- Container/VM & network isolation
- Detection & mitigation of platform (SW, FW) malware

### USER BASED SECURITY

- Device clients for malware detection and analytics
- Network based security intrusion detection/prevention appliances
- Encrypted traffic and reasonable network management

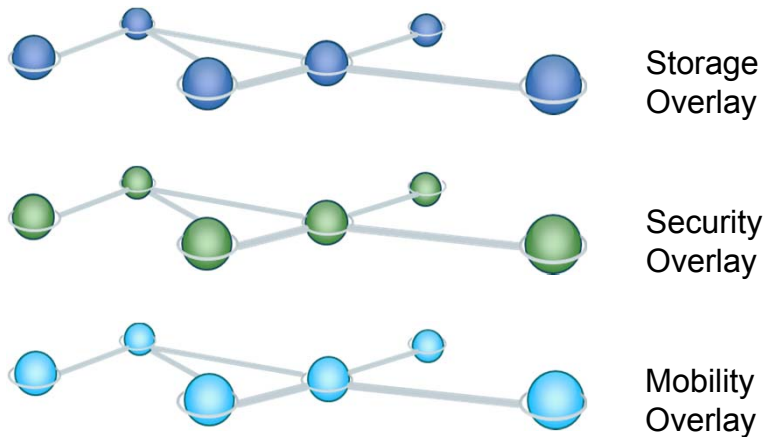
# Summary

## Summary

- Mobile data is still growing
- Provides new opportunities
  - Cell Densification
  - Elastic expansion of networks (NFV and Virtualisation in general)
  - Elastic recovery of networks
- Feedback loops
  - A lateral view on E2E Service Assurance
- SON
  - Extend its capabilities (help address the complexity)
- Security
  - A unified approach required

# Providing a New Foundation for 5G

## Information Centric Networking



Mobile, Secured, Storage Network



A new model for modern Internet usage  
Builds on the latest “*Future-Internet*”  
architecture research

### New networking paradigm:

- **Mobility** – eliminate need for special mobility overlays
- **Security** – guarantee the integrity of every data object
- **Storage** – dynamic placement of information anywhere in the network



**CISCO**

*TOMORROW starts here.*