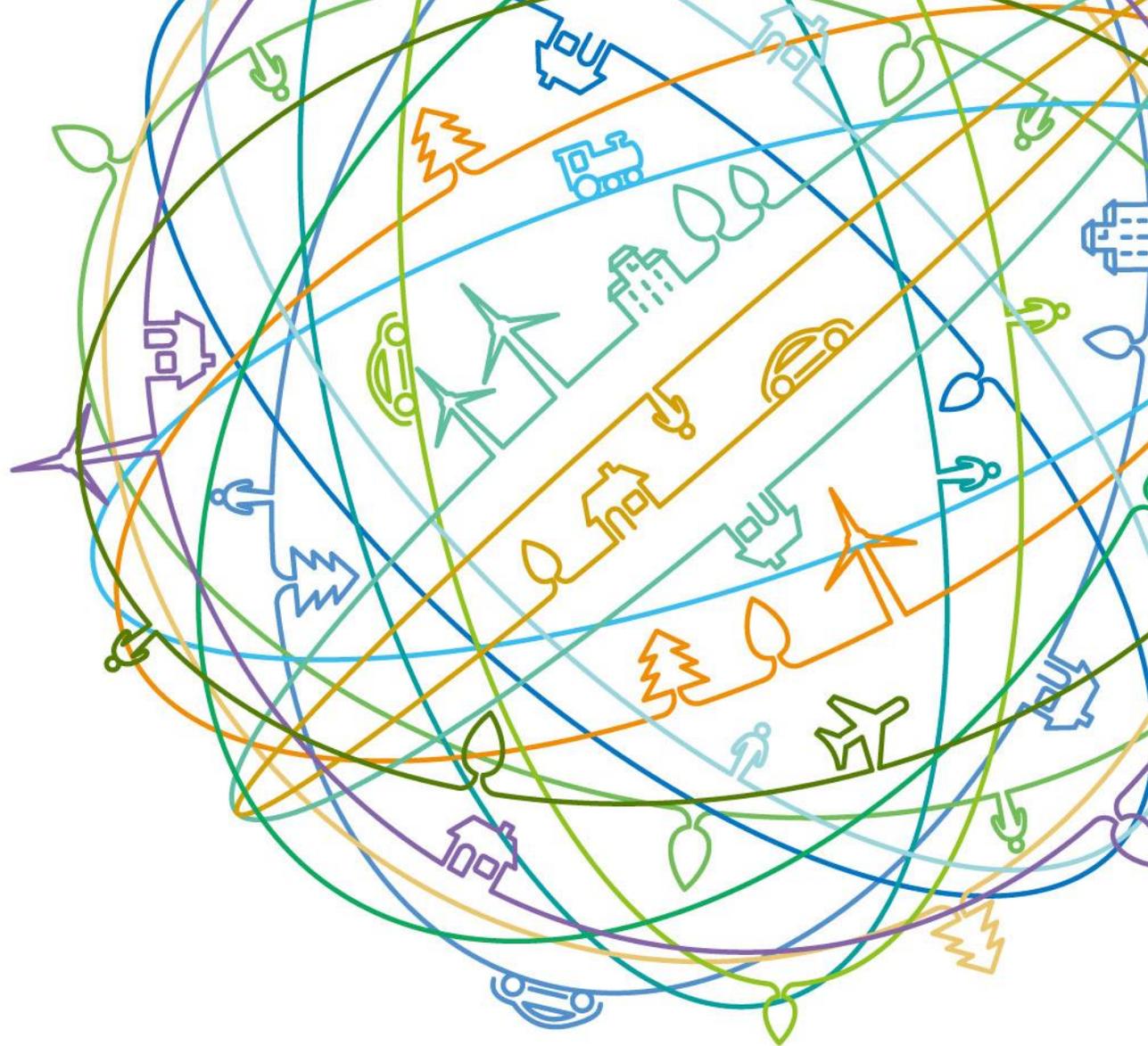
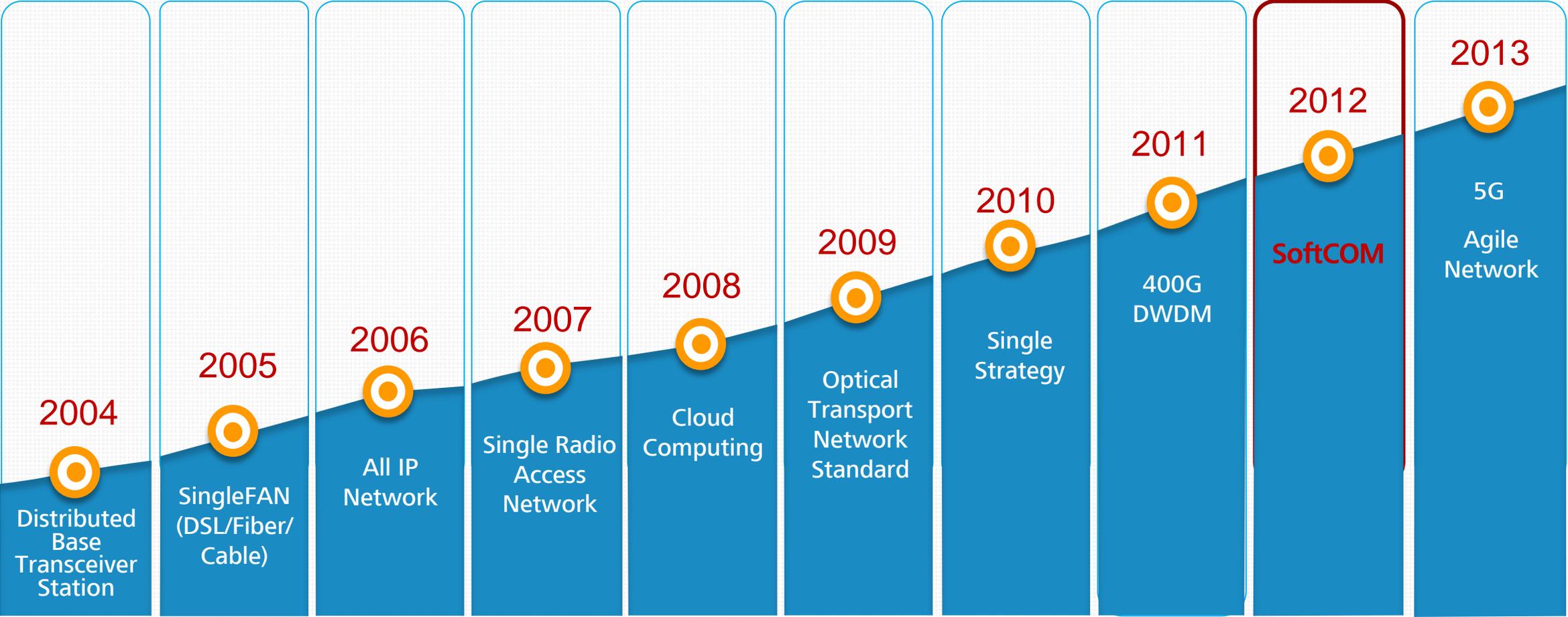


The RAS challenges of NFV



Become a Leader by Continuously Investing in Innovation



In the last 20 years, the communication industry has undergone 3 profound changes.....



What's Next?

1. From Analog to Digital
2. From Fixed to mobile communication.
3. From TDM to IP/Internet

The New Change—— Introduce Internet changes to Telecom.....

Cloud Computing, Big Data, OpenFlow, NFV (Network Functions Virtualization), SDN(Software Defined Networks),.....

Network

- Close
- complexity
- Time consuming for rolling out

Operation

- low efficient
- High Cost

Current Network

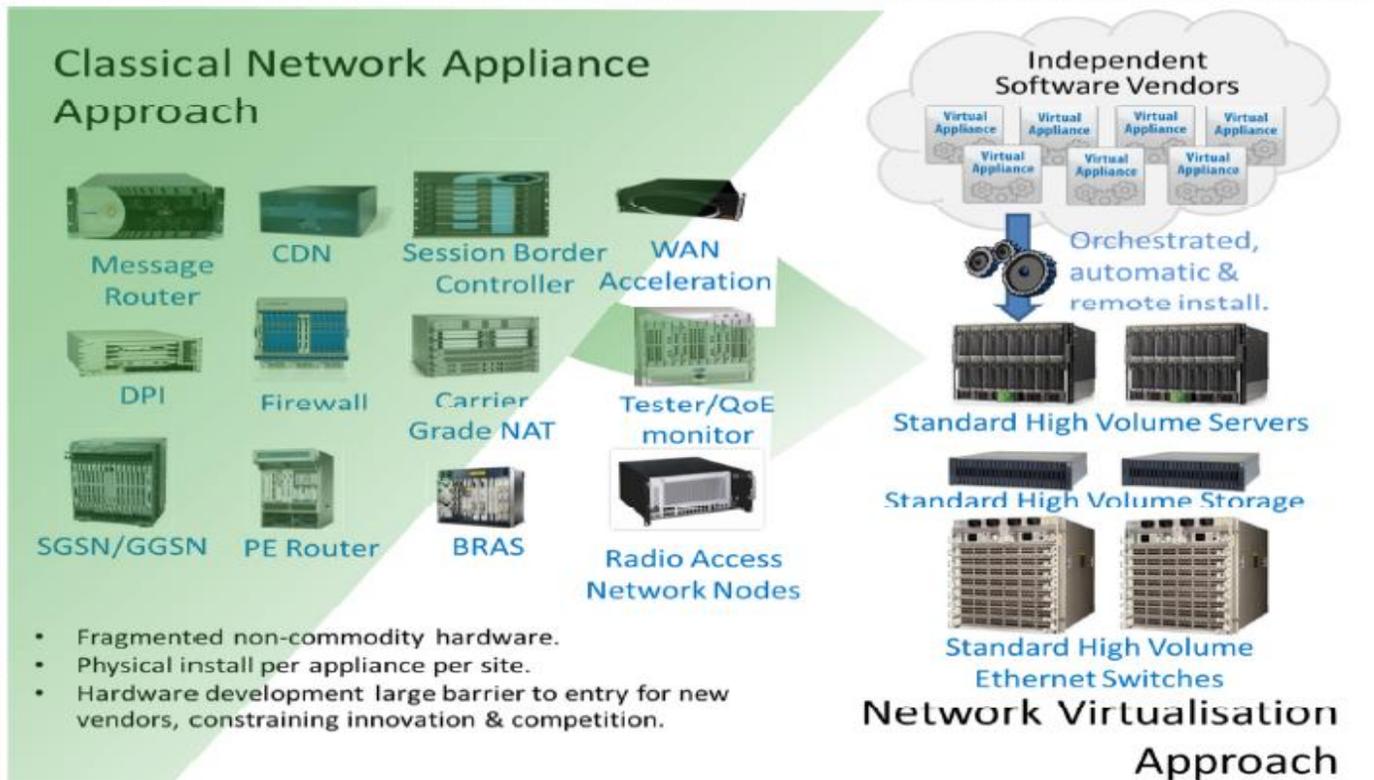
1. Embrace Internet technology evolution, introduce cloud computing ideology and SDN to telecom
2. Enabling telecom operators to win cloud opportunities driven by IT industry
3. Transform the telecom network to simple, efficient, programmable network, structurally reduce TCO.
4. Create new Operator-Vendor business partnership

**SoftCOM
(NFV+SDN)**

- Software-Defined
- Virtualization
- Cloud-Formation

- Intelligence
- Automation
- Openness

NFV now is the mainstream in Telecom



Members from CT and IT are working together:

■ **Carriers:**

AT&T, Verizon, BT, FT, DT, Vodafone, Telefonica, TI, Century Link

■ **CT Vendors:**

Huawei, Ericsson, Alcatel-Lucent, NSN, NEC.....

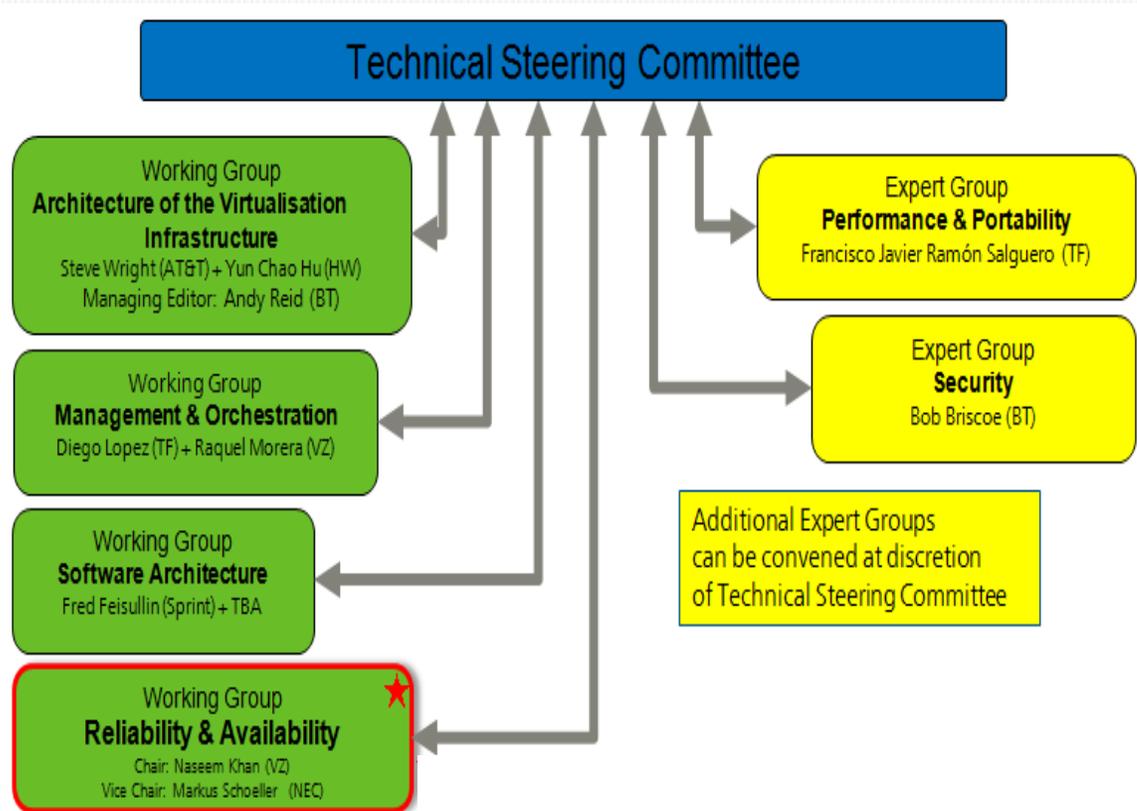
■ **IT Vendors:**

HP, intel, IBM, CISCO, Juniper.....



Huawei is Working together with Industry to enable NFV

- Reliability & Availability working group is one of the four NFV working group for its importance.
- Huawei actively engaged in and make key contributions.



ETSI NFV RELAV WG Specification outline:

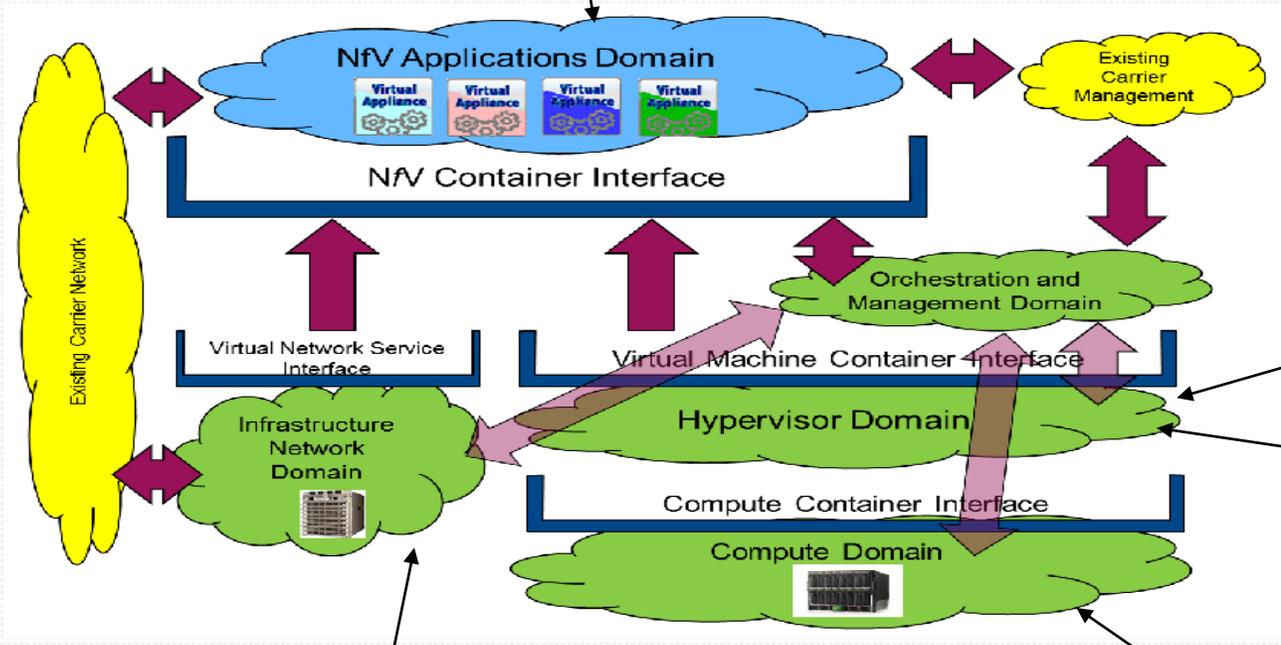
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NFV Challenges for example.....Far more about Function

5. Some HA mechanisms might need to be re-architected because of the virtualization.

RAS challenges caused by

- ✓ **New architecture:** Decoupled HW&SW, COTS, more layers,.....
- ✓ **New Characteristics:** Scalable, Dynamic/Elastic ,.....
- ✓ **New system:** Normally more SW bugs for a completed new system



3. New fault modes for the new virtualization layer.

2. The virtualization has separated HA and the HW fault detection system.

4. HW/SW Components from different providers make fault localization more challengeable.

1. Less reliable COTS hardware

Challenges are real——IT Grade vs. Carrier Grade

- ✓ “14 cloud outages in 7 months, who is next?” CIOL, , 8/7/2012
- ✓ “Is The Cloud Really Ready For Business?” Forbes, 7/30/2012
- ✓ “Amazon Cloud Outage Causes Customer To Leave” InformationWeek , 7/6/2012

.....

- ✓ Research of 13 selected leading cloud service providers shows the Availability is **99.9%** and downtime cost them **70M USD** since 2007, which based on the cost benchmark of 2000. IWGCR, 6/17/2012
- ✓ Data center outage: overall average cost of **\$505,502 per incident**, more than **\$5,000 per minute**, 2/1/2011, Ponemon Institute
- ✓ Top ten cloud outages of 2013 accounted for a whopping revenue loss more than **\$31Million**
- ✓ The number of Cloud **outages rise quickly** with the growth of cloud services, CSA,2013

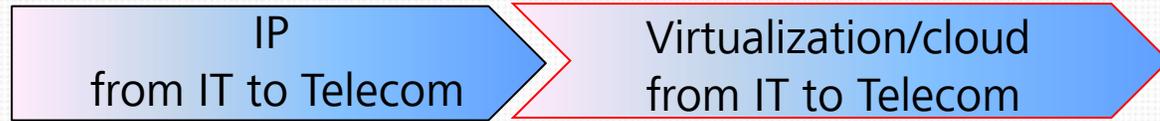


99.9%?

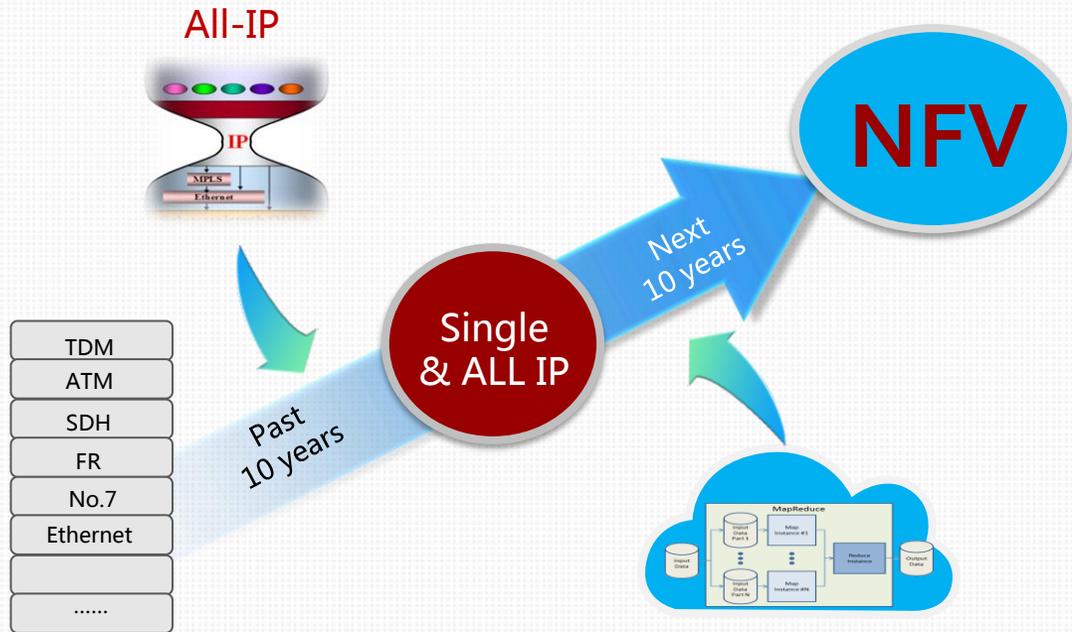
99.999%?

Challenges are real——The way to Carrier Grade

Will high availability (five 9s) and customer experience could be kept as before when virtualization/cloud technologies are introduced?



All-IP drives the telecom industry In past 10 years and take years for IP's from IT to Telecom.



To meet with carrier grade, fault detection and Failover technologies should be improved for Telecom application:

- BFD、 enhance OAM, etc. : **faster fault detecting** ,less than 50ms (Vs. seconds before)
- E-VRRP , IGP FC, MPLS FRR etc.: **faster failover**, in hundreds microseconds (Vs. seconds before)

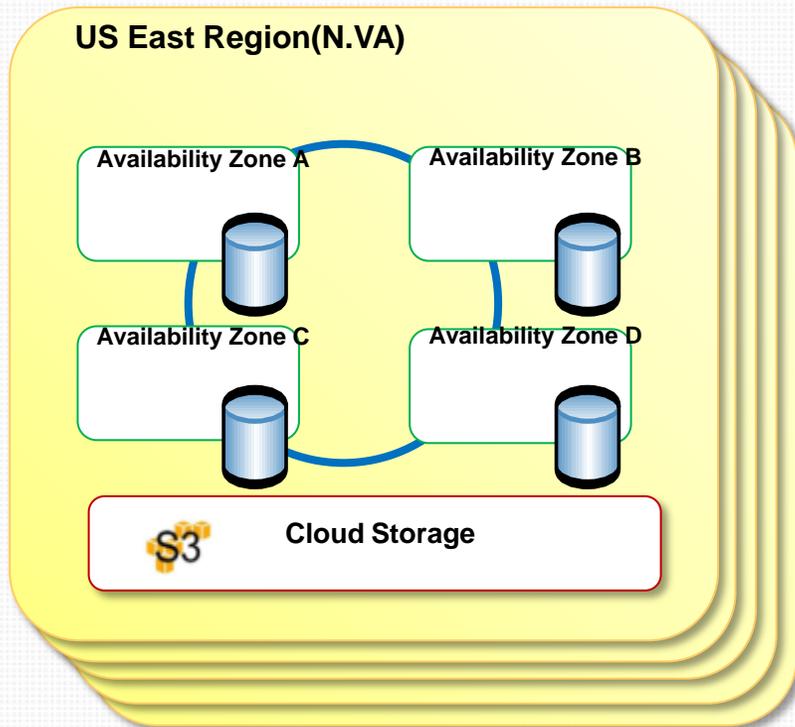
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New ideas & technologies along with Cloud

History sometimes seems to repeat itself!

Challenges are real—New Change , New RAS risks (1)

- No SPOF enough? Redundancy enough?
- Elastic/distributed architecture seems beautiful but.....



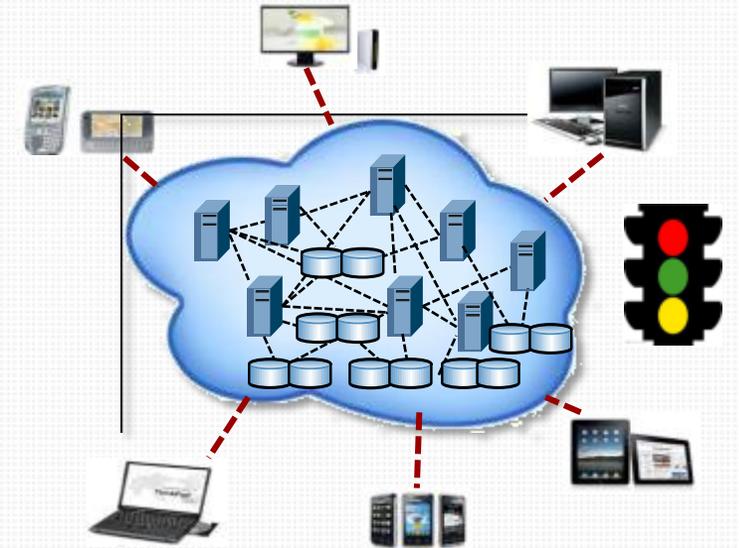
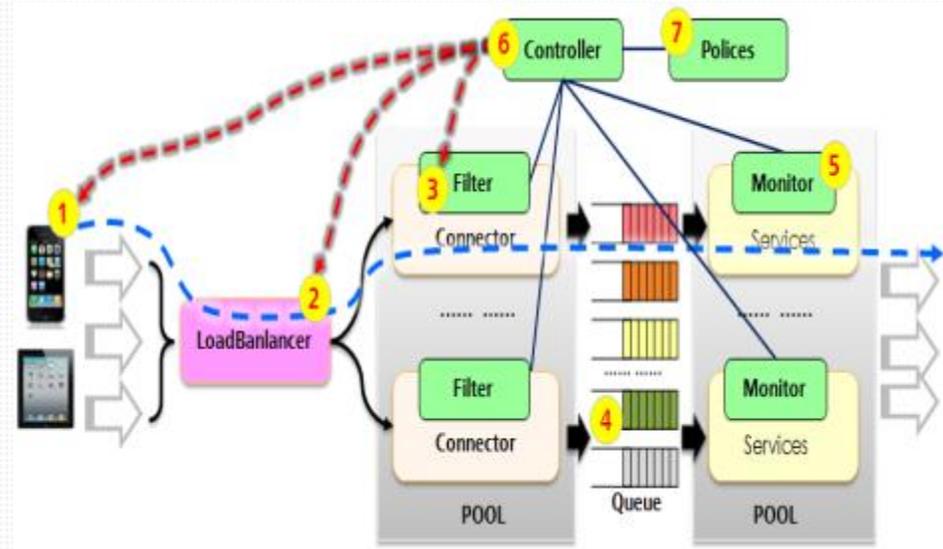
Lessons from Telecom:

- Orange (France Telecom) outage, 2012.7
- O2 UK outage, 2012.7
- Verizon LTE outages, 2011~2012
- NTT DOCOMO outages, 2011~2012

.....

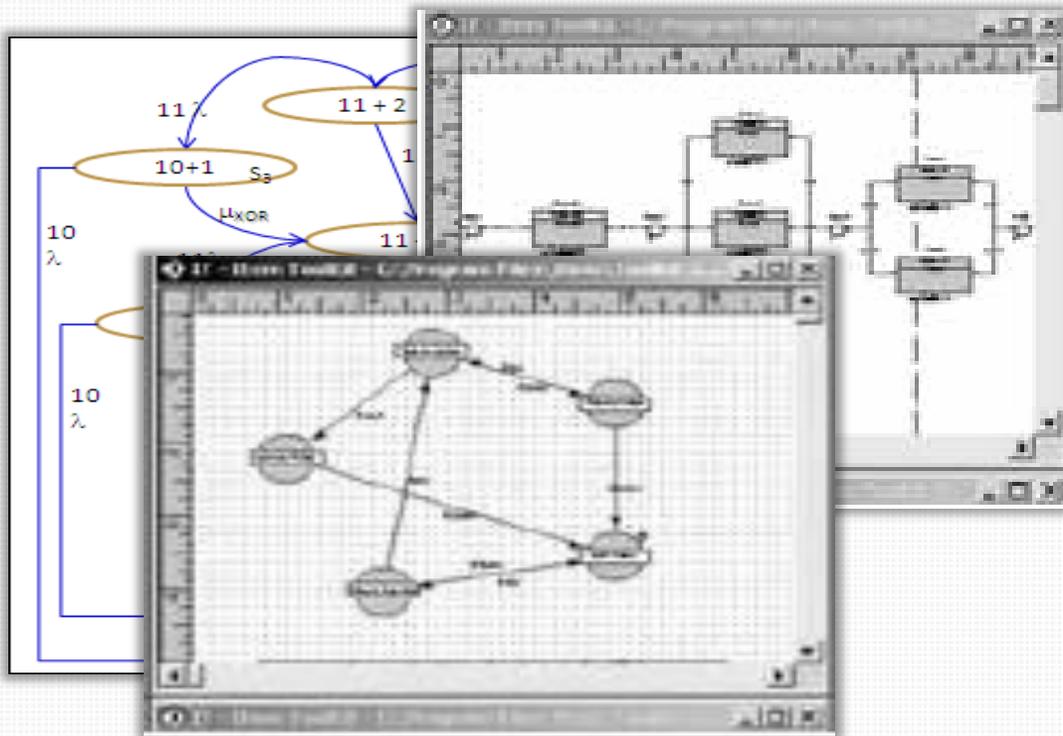
Challenges are real——New Change , New RAS risks (2)

- Load balancer
- Overload Control
- Behaviors of different Users, New Applications, New Smart Dives
- Traffic Models



Challenges are real—New Technologies , New RAS risks (3)

- Data Loss could be a more serious issue -----Data Durability!
- 0.07% of the volumes lost permanently during one Amazon outage last year.



99.9999999999% ?

Expressing P_3 as a sum of partial fractions

$$P_3(s) = \frac{A}{s} + \frac{B}{(s-r_1)} + \frac{C}{(s-r_2)} + \frac{D}{(s-r_3)} \quad (4)$$

We obtain

$$A = 1$$

$$B = \frac{6 \lambda^3}{r_1 (r_1 - r_2)(r_1 - r_3)}$$

$$C = \frac{6 \lambda^3}{r_2 (r_2 - r_1)(r_2 - r_3)}$$

$$D = \frac{6 \lambda^3}{r_3 (r_3 - r_1)(r_3 - r_2)} \quad (5)$$

Using Inverse Laplace transform

$$P_3(t) = A + Be^{r_1 t} + Ce^{r_2 t} + De^{r_3 t} \quad (6)$$

Durability (data of 1 chunk) = $1 - P_3(T \text{ is 1 year}) = -Be^{r_1 T} - Ce^{r_2 T} - De^{r_3 T}$

Durability (data of Volume) =

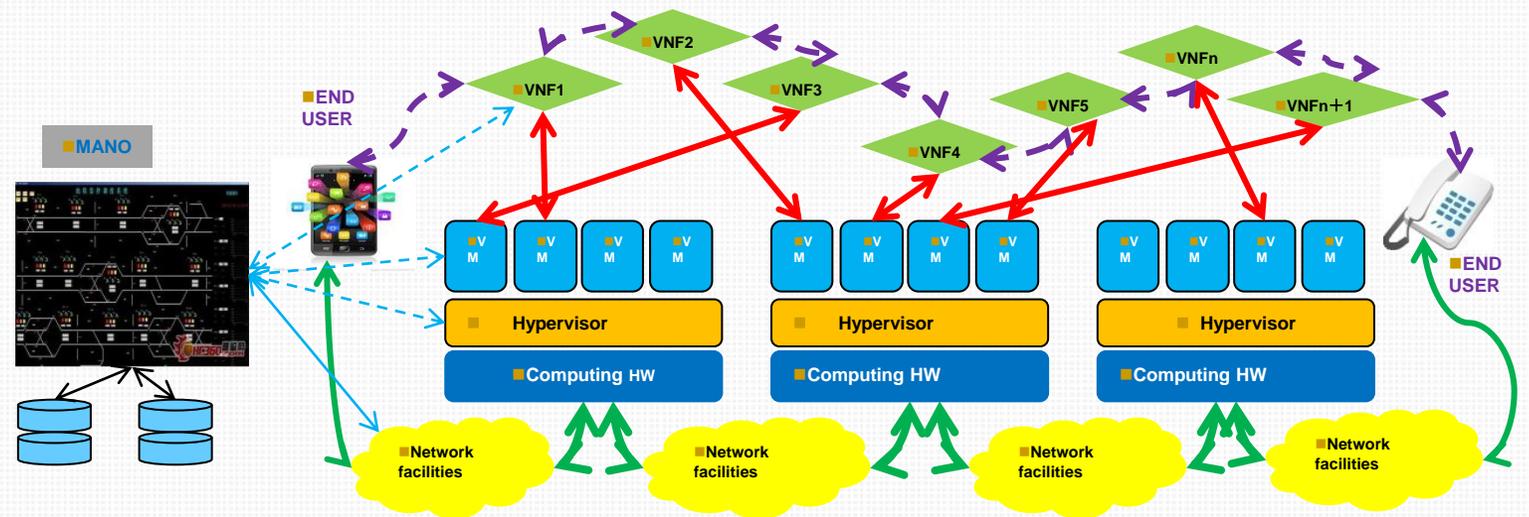
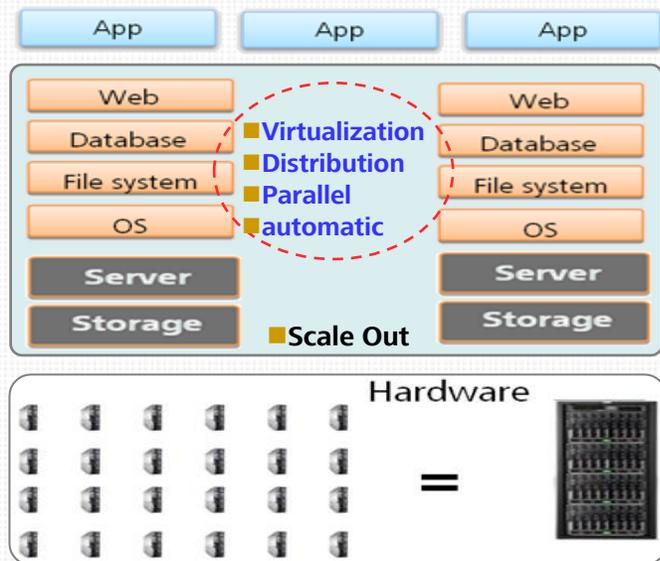
Model 1 : $1 - NT * \Pr(F_i)$

NT = total number of physical nodes Model 2 : $1 - \text{Min}(C_{NT}^3, \text{Partition_Number}) * \Pr(F_i) \quad (7)$

Our Design Philosophy for new RAS challenges

Some RAS Design Philosophy for the new trends:

- **FCA**-----Feature Centered Availability
- **SDA**-----Software Defined Availability
- **SAA**-----Soft-failure Awared Availability



Thank you

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