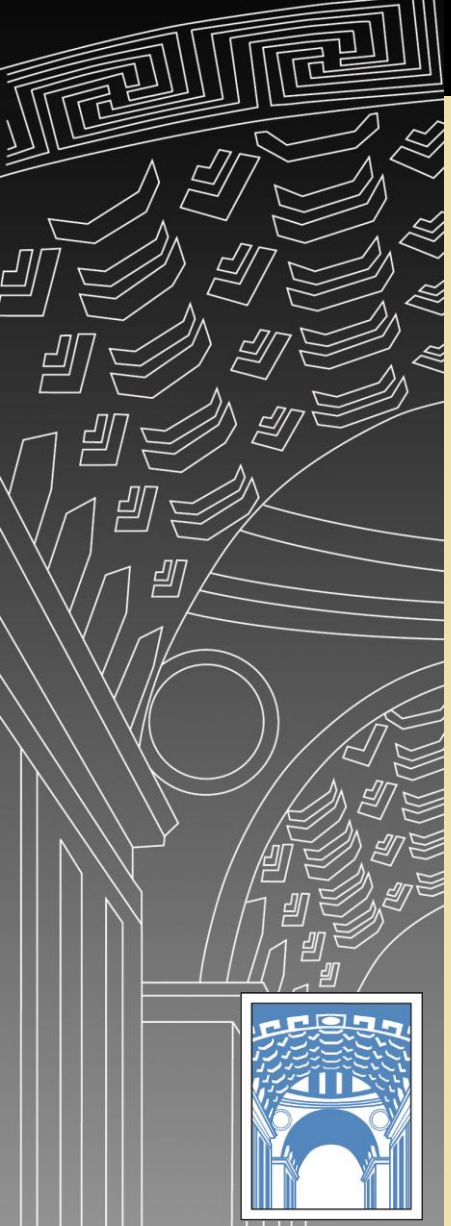

# IoT, SDN, NFV & AI
# Will networks be the same again?

**Kaustubha Parkhi**
**Principal Analyst – Insight Research**

**March 28, 2019**

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# About Insight Research

- Founded in 1990, Insight offers comparative market research and competitive analysis exclusively for the telecommunications industry
- Our research agenda includes NFV, SDN, vEPC, vRAN, Containers, LSO, IoT, 5G, AI OSS, BSS, BoD, CORD and Big Data

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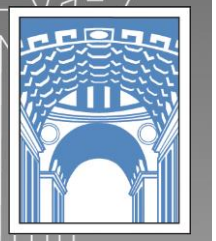
# What am I talking about?

- Overview of SDN and NFV
- IoT, SDN and NFV: The past, the present and the future
- AI and the future of IoT with SDN and NFV
- Conclusions



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# Overview of SDN and NFV

## Definitions

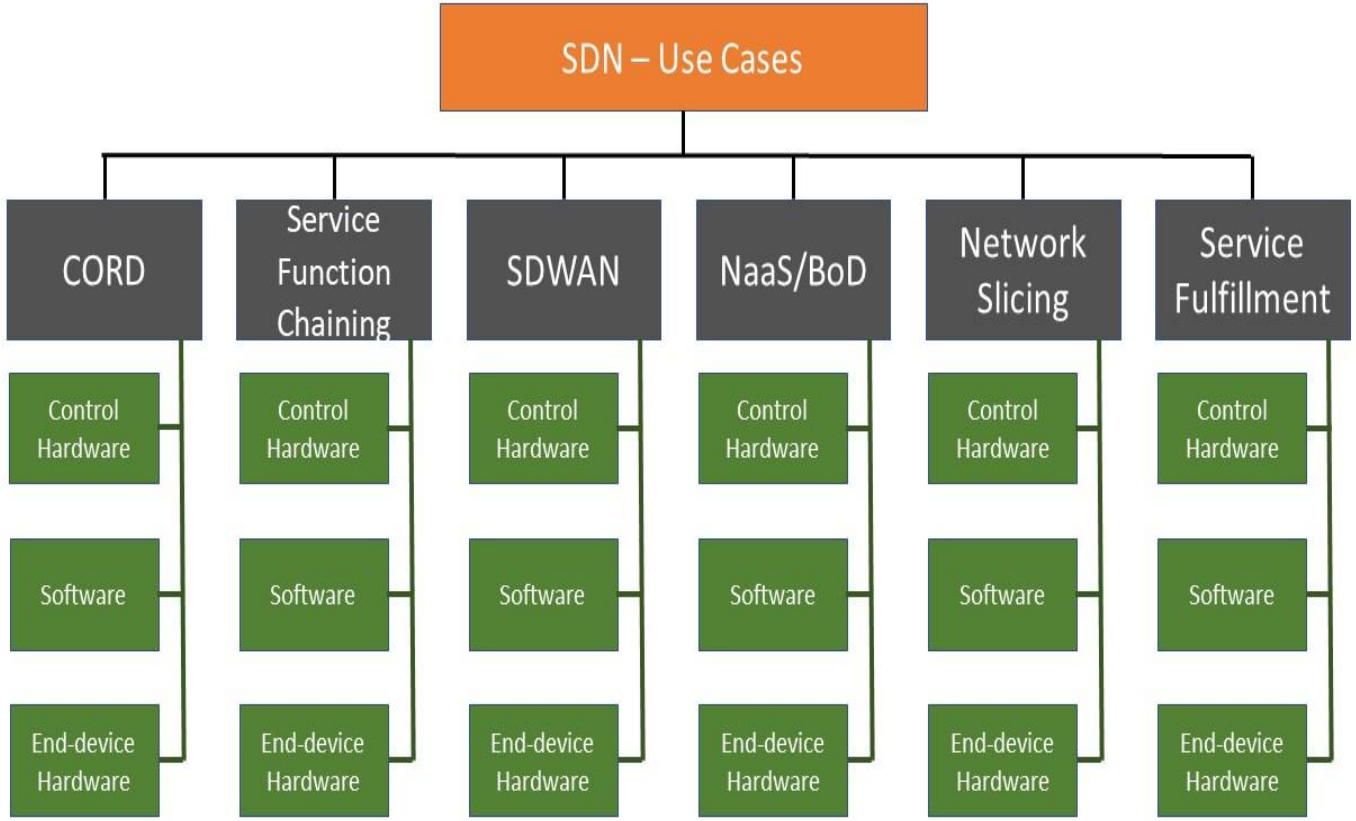
- SDN: An architecture that decouples the network control and forwarding functions enabling the network control to become directly programmable and the underlying infrastructure to be abstracted for applications and network services. - *The Open Networking Forum (ONF)*
- NFV: The migration from physical networking hardware to virtualized network functions.
- Network virtualization: The creation of multiple virtual logical networks on a single underlying physical network.

Thus NFV virtualizes ***specific functions performed by specific network elements***; while

Network virtualization creates a ***virtual topology*** by itself. These logical segments are often referred to as ***network slices***.

# Overview of SDN and NFV

## SDN use-cases

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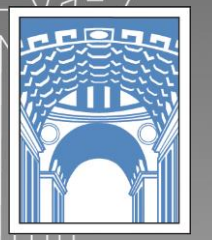
# Overview of SDN and NFV

## NFV use-cases

| VNF Category | VNF Type |
|---|---|
| Switching and Routing | Virtual Load Balancer (vLB), Virtual Application Delivery Controller (vADC), Virtual WAN Optimizer (vWOC) |
| | vRouter, Virtual Carrier-Grade Network Address Translation (vCGNAT) |
| | vSwitch |
| Core WAN Functions | Virtual IP Multimedia Subsystem (vIMS), Virtual Call Session Control (vCSC), Virtual Policy and Charging Rules Function (vPCRF) |
| | Virtual Baseband Unit (vBBU), Virtual Radio Access Network (vRAN), extensible Radio Access Network (xRAN) |
| | Virtual Evolved Packet Core (vEPC), Virtual Voice over Long Term Evolution (vVoLTE) |
| Interfaces and Gateways | Virtual Advanced Media Software (vAMS), Virtual Session Border Controller (vSBC), Virtual Web Real-Time Communication (vWebRTC) Gateway (GW) |
| | Virtual Customer Premise Equipment (vCPE), Virtual Service Gateway (vSG) |
| | Virtual Wireless Access Gateway (vWAG) |
| Standard Device | Virtual Domain Name Server (vDNS) |
| | vFirewall |
| | Virtual Internet Protocol Security (IPSec), Virtual VPN (vVPN) Controller |
| IP Applications | Virtual Intelligent Messaging (vIM) |
| | Virtual Voice over Internet Protocol (vVoIP) |
| Testing | vProbe, Virtual Test Agent (vTA) |



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# IoT, SDN and NFV
## IoT and telcos

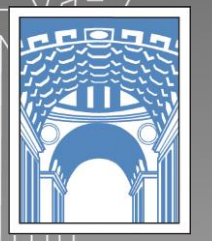
For telcos, IoT is

- A **network design challenge** of the **past**
- A **virtualization staging ground** of the **present**
- A **fact of life** of the **future**

# IoT, SDN and NFV
## The past

For telcos, IoT is

- M2M was a precursor to IoT
- IoT has surpassed M2M in application diversity and in service level demands
- IoT has made networks heterogenous



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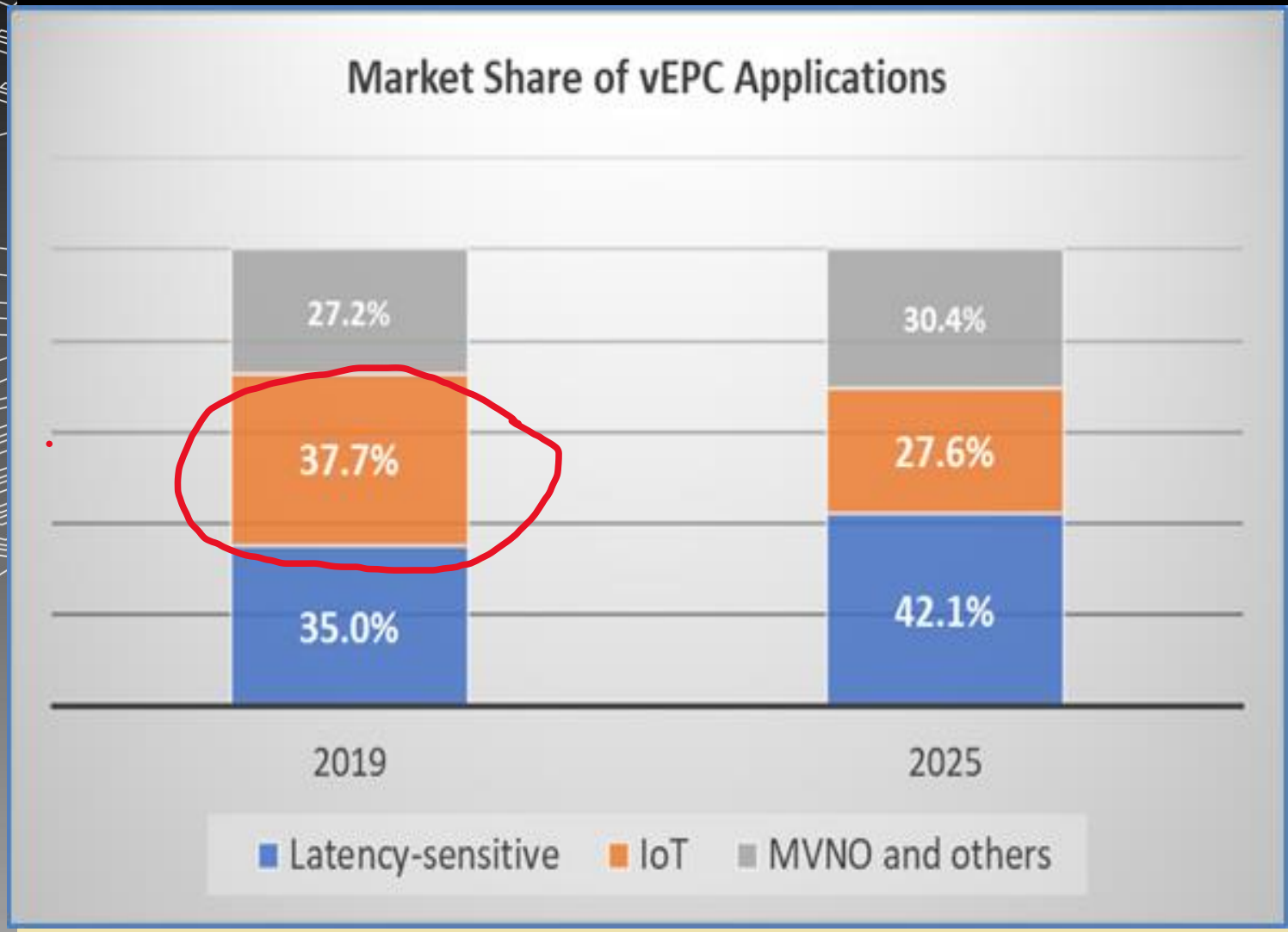
# IoT, SDN and NFV

## The present – SDN and IoT

- **SD-WAN** provides visibility and predictability in network performance – a key for IoT management
- **CORD** offers best practices in scalability and reliability of data centers to telco central offices
- **BoD** can channelize network resources to manage the ebb and flow of traffic patterns – generated to a large extent by IoT-enabled devices
- **Network slicing** carves out network segments to cater to specific applications and customer segments – IoT is a generator of network diversity
- **Service function chaining** customizes network function sequences in response to diverse traffic flow patterns – IoT is a generator of traffic flow diversity

# IoT, SDN and NFV

## The present – vEPC and IoT

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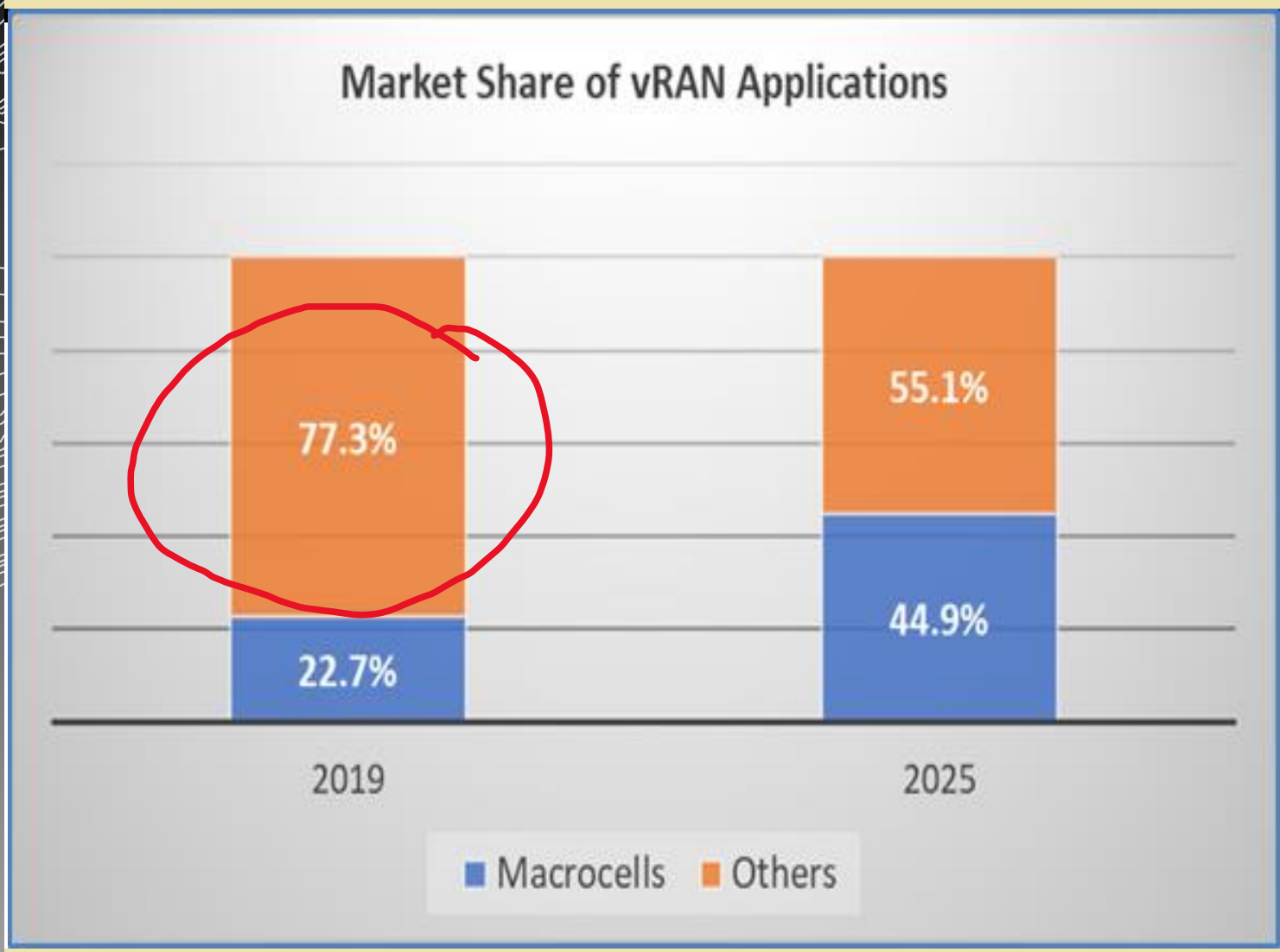
# IoT, SDN and NFV

## The present – vRAN and IoT

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# IoT, SDN and NFV

## The present: Key vendor and telco initiatives

- Ericsson's Cloud Packet Core can support up to fifty million devices in a single deployment
- Nokia's Cloud Packet Core focuses only on IoT and M2M applications
- Amarisoft eNodeB supports Release 14 compliant narrowband IoT (NB-IoT) and LTE for machines (LTE-M) networks
- In 2016, AT&T launched its vEPC-based IoT implementation involving General Motor's OnStar service in some European markets
- In April 2016, China Mobile announced that it will leverage NFV technologies for large scale development of VoLTE network, virtualization of IoT network platform and development of fixed network
- In January 2018 , China Mobile used its test system to complete a performance verification test for core networks from four vendors to verify that the NFV-based networks can individually support 5 million narrowband IoT (NB-IoT) devices
- Samsung and SK Telecom deployed NFV technology to support the development of IoT in February 2015
- In February 2018, SoftBank selected the Affirmed Network's MCC to deliver IoT services and mobile connectivity to enterprise customers

# IoT, SDN and NFV

## The present: Learnings from vEPC and vRAN

- vEPC is ideal for slicing the network into such segments governed by specific and largely independent objectives
- Most initial vEPC deployments are in the area of M2M and IoT setups
- APN methodology has been instrumental in cellular operators opening their IoT and M2M setups to vEPC
- Inserting specific gateway nodes and offering in conjunction with service capability exposure function and service capability server
- NB-IoT capabilities such as extended discontinuous reception (eDRX), power saving mode (PSM) and utilization of control and user plane are also added to vEPCs
- Distributed antenna systems (DAS) vendors are showing considerable interest in the vRAN market
- DAS installations are used to provide enterprise or industry-specific coverage, including IoT installations

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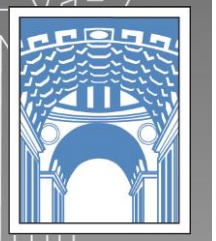
# IoT, SDN and NFV
## The present: Summary

IoT, in many ways, is the ***principal raison d'être*** of SDN and NFV



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# IoT, SDN and NFV

## The future: IoT-driven revenue streams

- Wideband wide area connectivity
- Local area connectivity
- Narrow-band wide area connectivity
- Equipment sales
- Management platforms
- Hosting
- Information security
- Operations and monitoring
- Analytics

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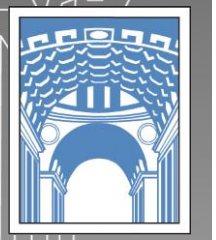
# Telecom operators

## The future: SDN/NFV opportunities and threats

- Service agility
- Centralized control
- Software-driven approach
- Cost savings
- Vendor neutral hardware
- Flexibility in network design
- Ownership of feature-rich services

- Unlearning and relearning
- Hardware to software transition
- Coping with open source
- Managing data explosion
- Interoperability between disparate SDN, NFV components
- Concerns about reliability and SLAs



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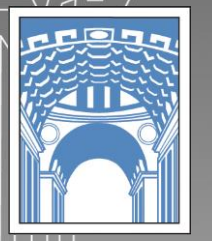
# AI and the future of IoT with NFV/SDN

## The path ahead

- IoT opens numerous revenue streams for telcos
- NFV and SDN facilitate telco embrace of IoT
- Telcos continue to have apprehensions about several aspects of NFV and SDN including reliance on open source, DevOps methodologies and reliance on software-based product development
- IoT powered by NFV and SDN will lead to an explosion of data points in todays telco networks

**AI can help in making sense of this new look network and maximize revenue opportunities.**



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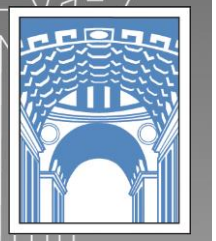
# AI and the future of IoT with NFV/SDN

## Information security

- AI automates threat detection by adapting to changes in threat patterns
- AI is capable of processing and analyzing large volumes of data
- AI offers superior response time to attacks
- AI is capable of withstanding strings of attacks
- AI is ideal for authentication of biometric logins



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# AI and the future of IoT with NFV/SDN

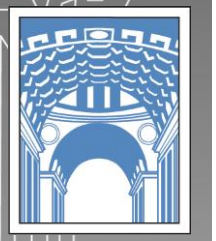
## Operations and maintenance

- AI facilitates network policy settings when confronted with large amount of data points to analyse
- Cisco offers a tetration analytics platform that can generate access lists automatically
- AI facilitates predictive maintenance – employed by China Mobile

# AI and the future of IoT with NFV/SDN

## Analytics

- AI enables intuitive network planning
- AI helps in predicting usage trends
- Analytics, combined with SDN, can help the network become self-learning – Ciena Blue Planet Orchestrator combines SDN/NFV constructs along with Analytics



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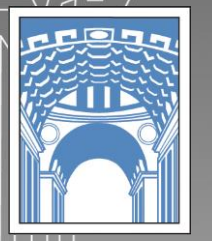
# Conclusion

- IoT is acquiring an evergrowing presence in today's new look telco networks
- SDN/NFV and IoT have a synergistic relationship
- AI can help assuage concerns about network stability and revenue maximization of the new look networks



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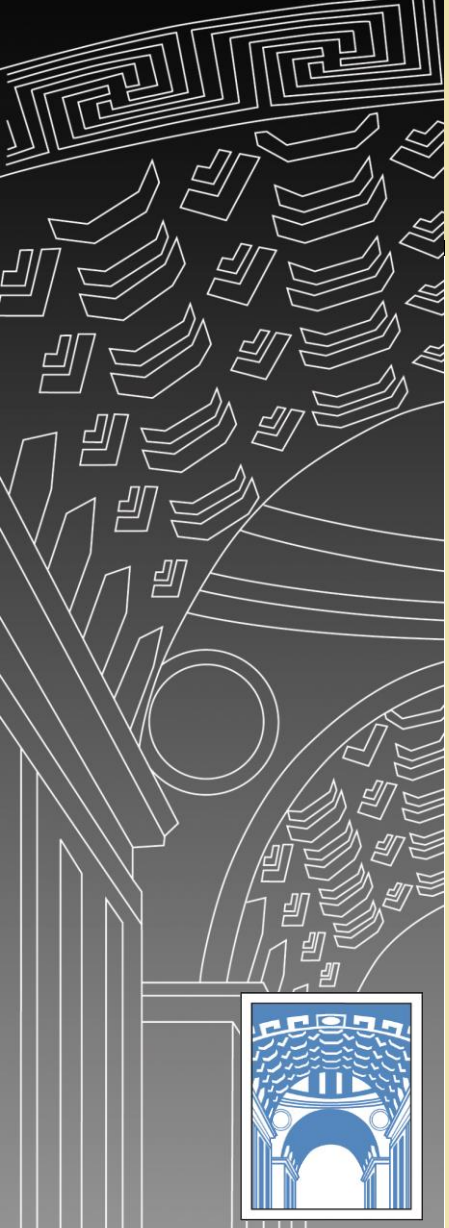

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# Thank You

**Kaustubha Parkhi**
**Principal Analyst – Insight Research**
**kaustubha@insight-corp.com**