Smart Networks and Services

Future research challenges on Software Networks (SDN&NFV) and Cloud Computing

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Smart Networks and Services Partnership - Stakeholders Workshop
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Trusted partner for your Digital Journey

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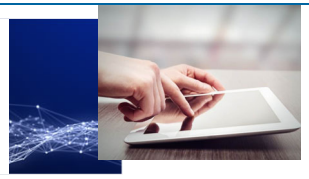
1 Atos vision on Smart Networks&Services

ATOS in a nutshell

- ***ICT*** *global consultant &* ***system integrator***
- *creating the firms of the future by* ***bringing together business & technology***
- *leader in* ***digital transformation***



Worldwide digital leader & **#1 leader** in Europe

€13 billion annual revenue

120,000 experts

73 countries

Worldwide IT Partner of the Olympic and Paralympic Games

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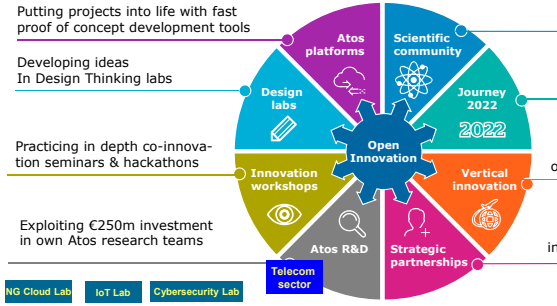
Atos end-to-end approach in digital transformation



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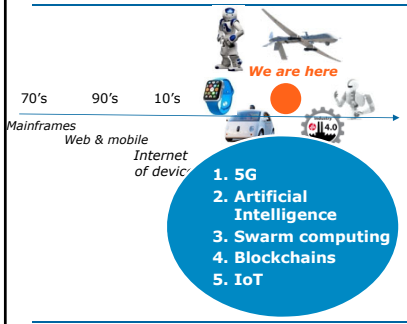
Atos current technological breakthroughs looking at Smart Networks and Services expectations



Where we go

Smart Networks and Services expectations

- Better performance (higher capacity, low latency, reliability)
- More intelligent/autonomous
- High automation
- More flexible /adaptive
- Available anytime and anywhere

Smart Networks research to meet expectations

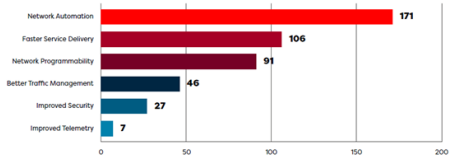
Beyond 5G communications need to prepare to enable **full automation** by means of **virtual network management architectures (NFV and SDN based)** in order to provide:

1. connectivity that can **dynamically adapt to changing requirements by means of big data and AI based network management** in order to support **highest reliability and flexibility in an autonomous way**
2. **enhanced integration with next generation edge computing**, cloud resources and **HPC** with adaptive topologies in order to achieve **zero latency, high performance and extended coverage everywhere**
3. **Advanced cybersecurity** mechanisms to achieve **fully trusted communications**
4. IoT → **IoEverything** – **hyper-connectivity**

2 Software Networks (beyond 5G)

NFV&SDN expectations: network automation

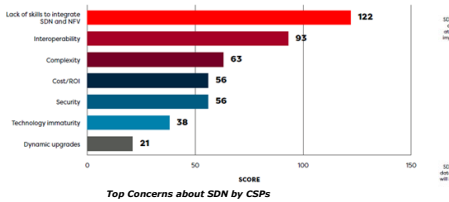
- Capex, opex reduction
- Reduce service creation time and time to market
- Network slicing enabler to cope in 5G with multitenancy over network resources for different stringent vertical requirements
- **Network automation**



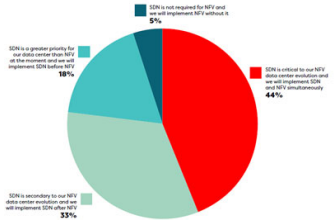
Expected benefits from SDN by CSPs. SDN and NFV: Automating Network Management. *Cisco, BluePlanet/Ciena* ***May'19***

Adoption barriers vs SDN/NFV promise: lack of network and virtual resources integration

More than 60% of CSPs has not yet started SDN deployment. They are at different PoCs/trials status. Only 5% shows no interest in SDN



Top Concerns about SDN by CSPs



Relevance of SDN to NFV

Source: SDN AND NETWORK VIRTUALIZATION: Automating Network Management. *Cisco, BluePlanet/Ciena* ***May'19***

SOTA SDN/NFV gaps and research challenges to move forward on smart networks

1. Unification of network and cloud resources management

- Full integration between network management and virtualization is not solved. → e.g. needs of advanced OAM mechanisms within SDN (gaps on fault management SFC) that should be driving cloud/NFV placement decisions

2. Cloud-native NFV orchestration

- VNFs are broken into microservices/CNFs
  - increasing self-management capabilities: auto-provisioning, auto-redundancy.
  - but, there are existing networking gaps as for example current integration of NFVO solutions into containers orchestration

SOTA SDN/NFV gaps and research challenges to move forward on smart networks

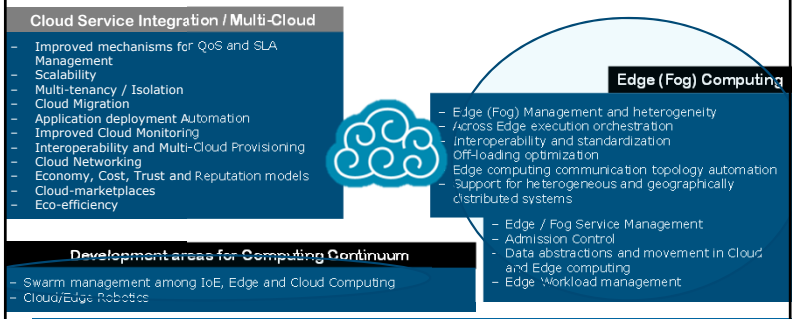
3. Intelligent network management: AI applied to NFV and SDN management

- AI decision modules realising an **adaptive control** over the resources (both network and cloud)
- **Elasticity to automatically react in real time** to changing network conditions, and consequently adapting to different network topologies
- AI-based control plane to enable **high number of connected devices**.
- Data-driven functions to implement **smart anomaly to predict negative effects** before they happen
- Key challenge: application of big data management – **data science to network management – data labelling**

4. Multi-access Edge Computing to store and process data locally at the edges of the network to provide faster reactions and providing higher capacity, contributing to Internet of Everything performance.

3 Next-generation Cloud Computing

Research Challenges for future work – Next Generation Cloud Computing



Edge (Fog) Computing Research Areas

- **Edge(Fog) Management and heterogeneity:**
  - **Management** of potentially **thousands/millions** of **small diverse devices** and sensors in an Edge computing set-ups **will require** of **new management styles**, potentially **decentralized** and **able** to **scale** to degrees that nowadays are unprecedented in existing cloud architectures.
- **Across Edge execution orchestration:**
  - Edge set-ups are envisaged to be spread covering wide geographic areas. For serving applications and services that make use of these **distributed** set-ups, **mechanisms** for **deployment**, **provisioning**, **placement** and **scaling service instances** across execution zones in the distributed Edge set-ups are necessary.
- **Interoperability and standardization:**
  - Current status of Edge computing developments very much relies on specific vendor solutions. In order for these to interoperate among them and with traditional clouds, new standards would have to appear to manage the expected scale of edge set-ups.

Edge (Fog) Computing Research Areas

- **Edge Workload management:**
  - Considering different types of workloads (monolithic or interactive) as well as the different processors types where these workloads can be computed, the final encapsulation solution may vary. System able to deal with **different encapsulation approaches** (VMs vs. Container) will be and mechanisms capable to **balance between high-performance processor and low power processor** according to the final objectives of the workload should be taken into consideration.
- **Data abstractions in Cloud and Edge computing:**
  - The need of developing data intensive applications able to manage more and more data coming from distributed and heterogeneous sources effectively, quickly, correctly, and securely is increasing. Tools that enable managing **data scattered on a heterogeneous and distributed environment** needs to deal with the intricacies of the underlying complex infrastructure composed by smart devices, sensors, as well as traditional computing nodes.

Development areas for Computing Continuum: Swarm management among IoE, Edge and Cloud Computing

- Dynamic eco-systems of clouds, each adding to the collective capability
- Allows operations and interactions to adapt according to context
- Improved efficiency and reliability of service provision through:
  - Enabling ad-hoc collaborations, which help built service networks
  - Optimizing delivery schemes and communication patterns, which enable information and services to be shared and exchanged
  - Creating reliability and dependability for edge resources
- Provides a significant step toward massively distributed computing models

4 Wrap-up

Wrap-up

- In order to meet future smart communication systems and networks expectations (automation, autonomy, high performance) they will need
  - 1) **enhanced AI-based virtual network architectures (SDN and NFV),** and
  - 2) further integrated management with cloud technologies, regarding:
    - **high distributed edge computing** research challenges: heterogeneity, interoperability, data abstraction, and swarm computing.
    - **NFV cloud-native** orchestration
    - **unified management of network and cloud resources** as part of the NFV/SDN paradigm
  - There will be other network specific research challenges which remain separate on telco and cloud,
    - e.g. challenges on network protocols, radio, spectrum, optical, satellite specifics research for networking
    - e.g. challenges regarding cloud services themselves, isolation, cloud monitoring, multi-cloud, cloud-marketplaces etc.
- New business models bringing closer telco and cloud stakeholders will arising involving network operators, vendors, cloud managers → increasing relevance of system integration

Thank you

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