



ITU-T Focus Group, Lisbon, Jan 2020

On the network of control

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 Instituto de Telecomunicações

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- Universidade de Aveiro
- Universidade de Coimbra
- Universidade de Lisboa
- Altice Labs
- Nokia
- Universidade de Porto
- Universidade da Beira Interior
- Instituto Ciências e Tecnologias Empresariais

Main partnerships

- Instituto Politécnico de Leiria (IPL-STG)
- Instituto Politécnico de Coimbra (ISEC)
- Instituto Politécnico de Lisboa (ISEL)
- Instituto Politécnico de Setúbal (EST)
- Instituto Politécnico de Tomar (ESTT)
- Universidade do Algarve (UALg)
- Universidade de Évora (UEv)
- Universidade da Madeira (UMad)

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Instituto de Telecomunicações - Aveiro

PhD researchers	~80
PhD students	~94





Optical communications
Radio communications
Networking, mobile networks, future internet
Electronic design for telecommunications

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ATNOG – Advanced Telecommunications and Networking group

- 12 PhD, ~50 members
- **IEEE Distinguished Lecturer – Communications**
- Multiple lines of work
 - Research
 - Industry cooperation
 - Standardization
- High practical component
 - Testbeds, implementations, tools...
- Open Source contributions
 - <https://github.com/ATNoG>
 - Test infrastructures

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We are hiring researchers!
Contact me (ruilaa@ua.pt)

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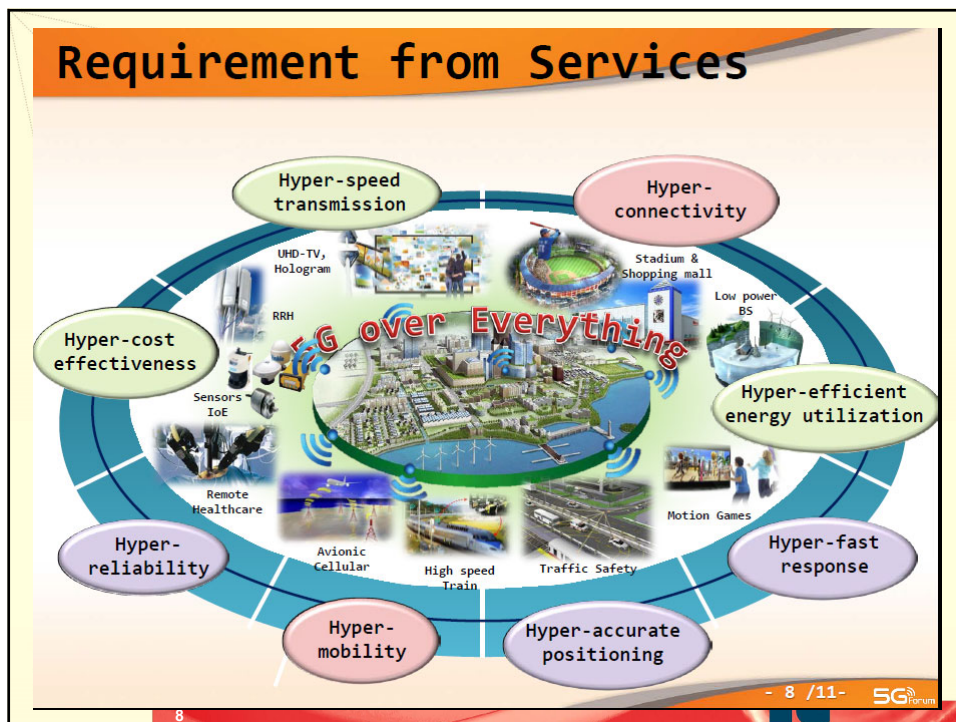
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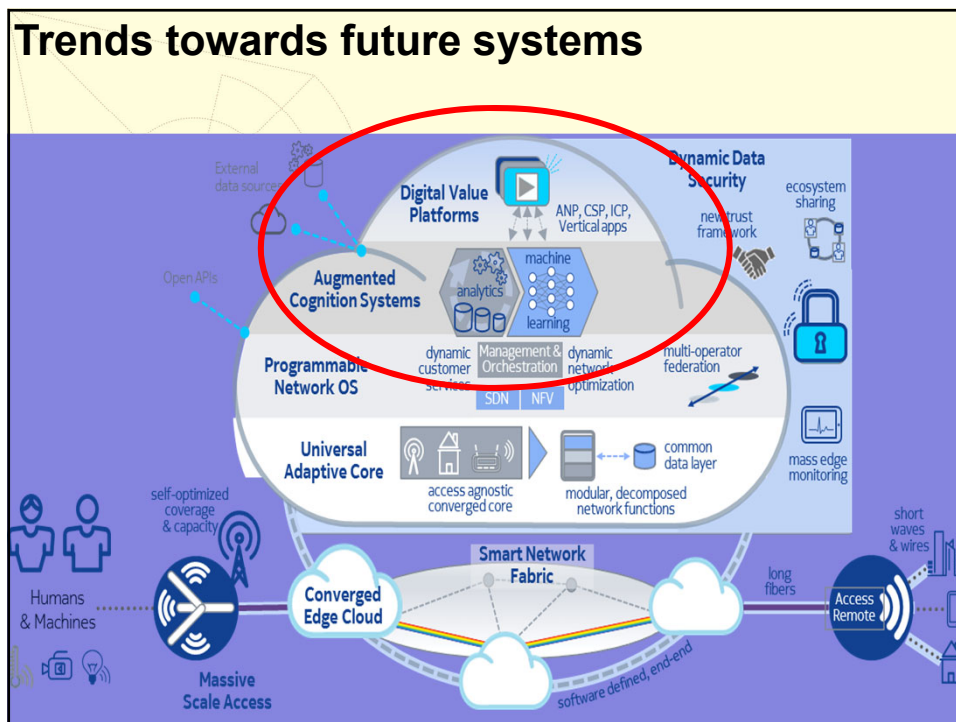
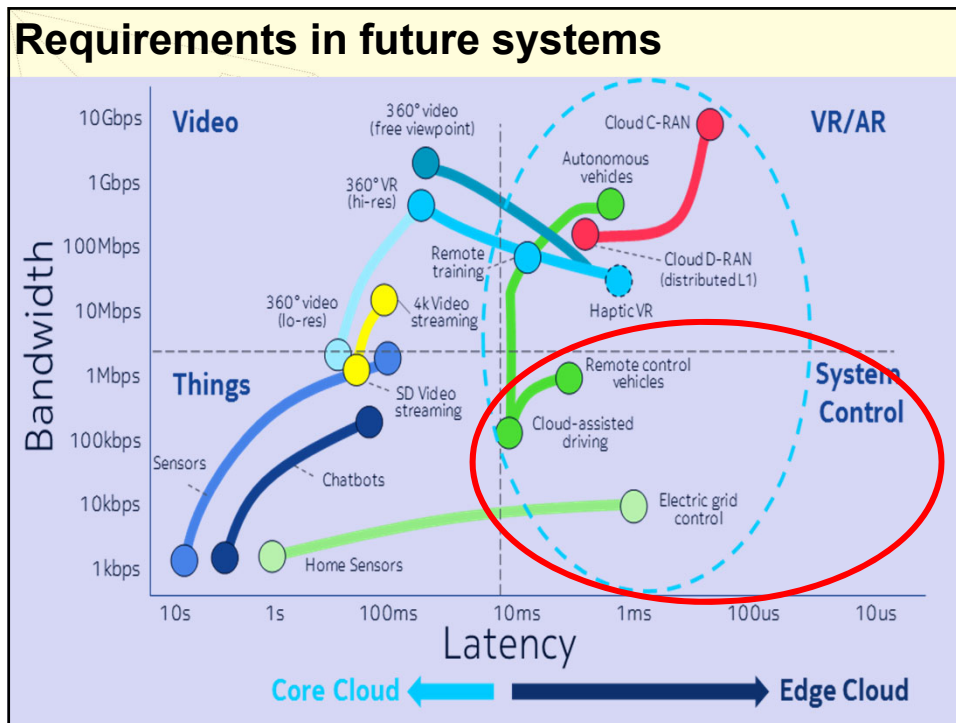
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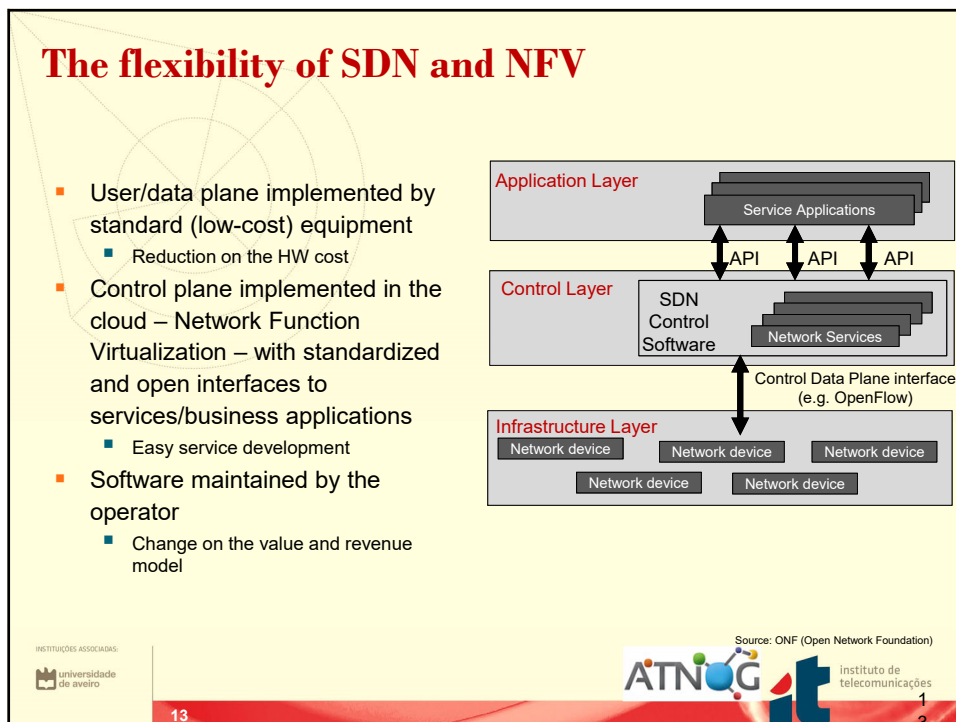
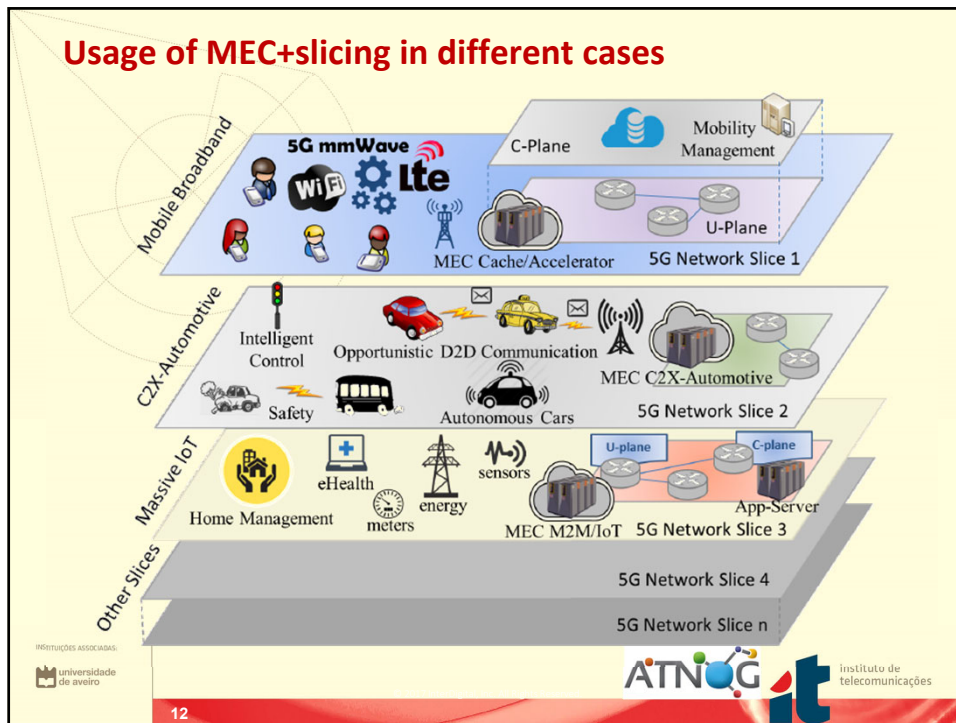
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Example: 5GinFIRE Reference Model Architecture

Based on existing Open Source projects

e.g. Openstack, Opendaylight

Based on ETSI reference architecture of MANO functionality

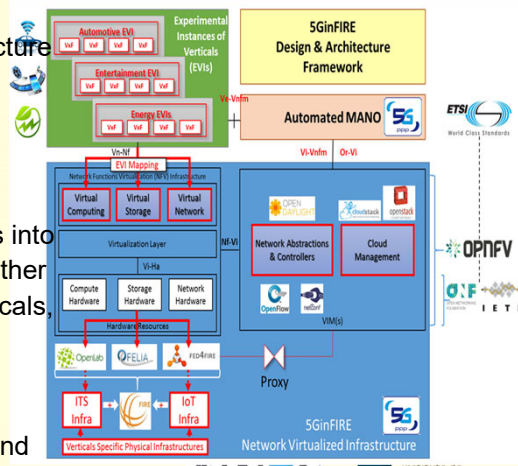
Open Source MANO

Introducing and integrating infrastructures from verticals

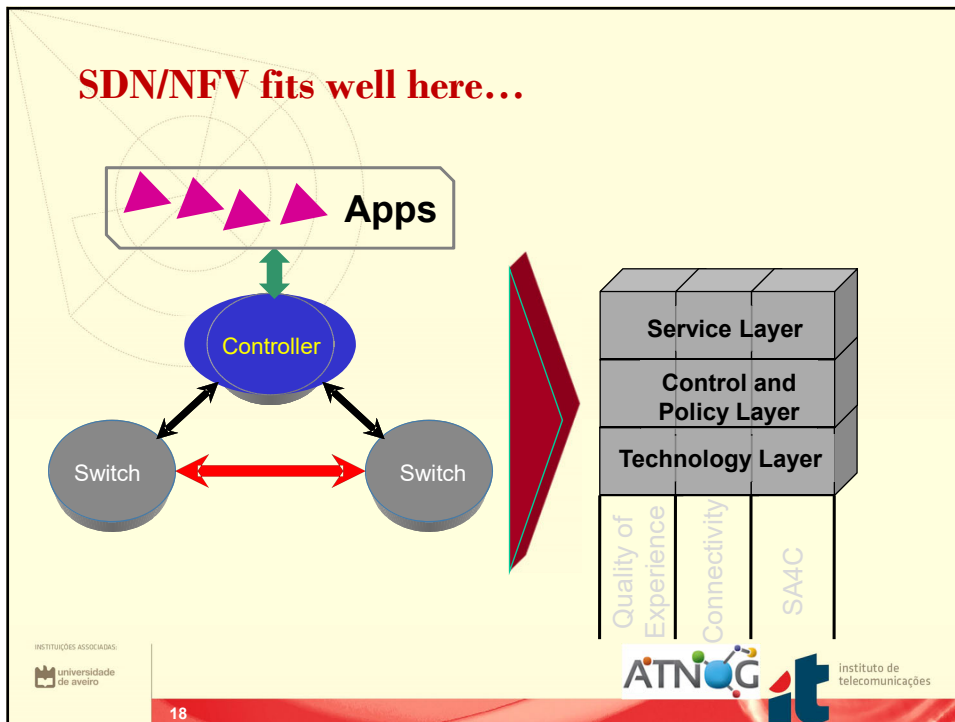
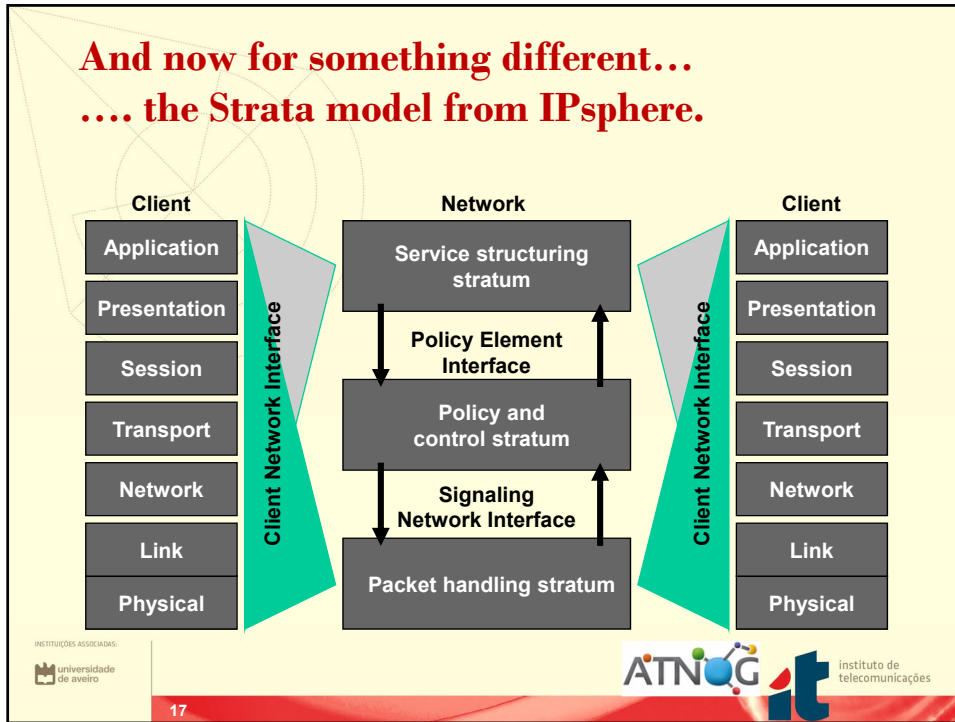
Generalizing the concept of VNFs into accounting for functionalities other than network, namely, for verticals, aka VxFs

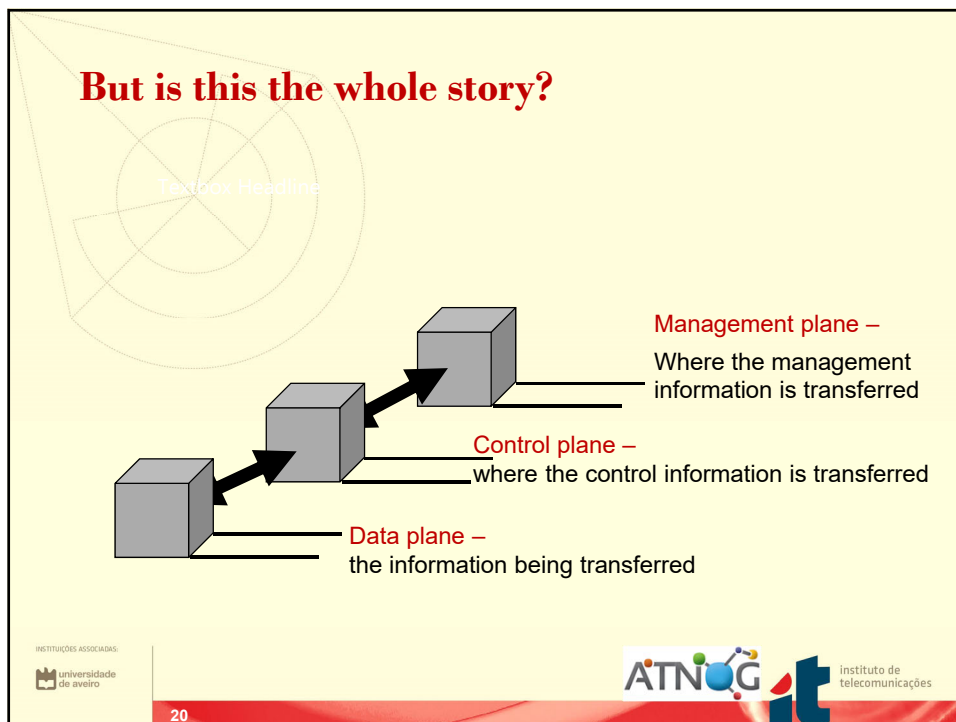
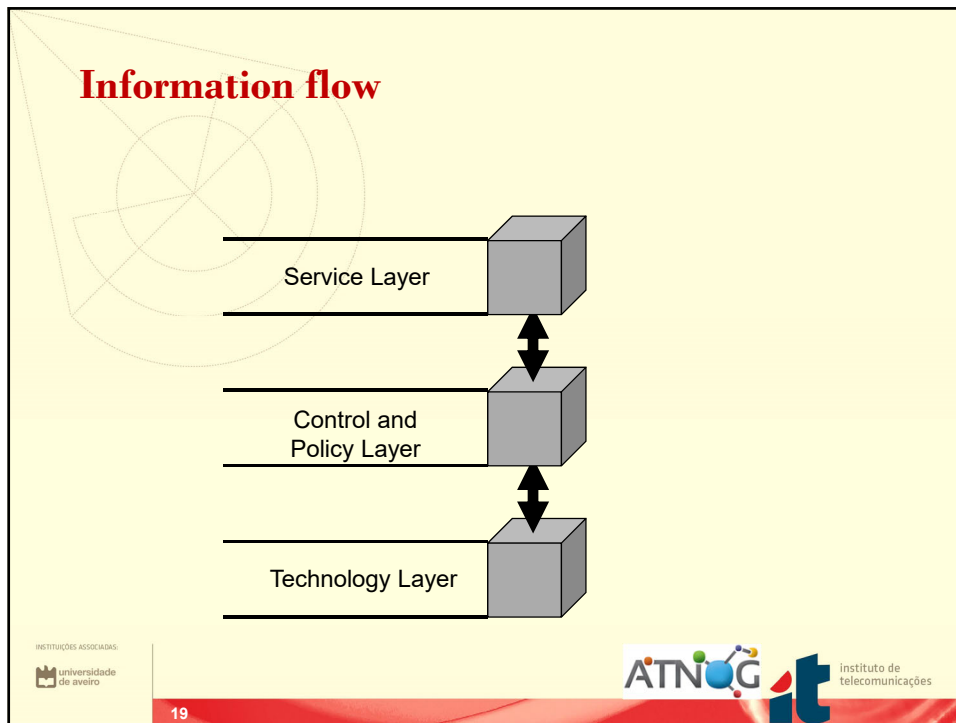
universal management of virtual functions

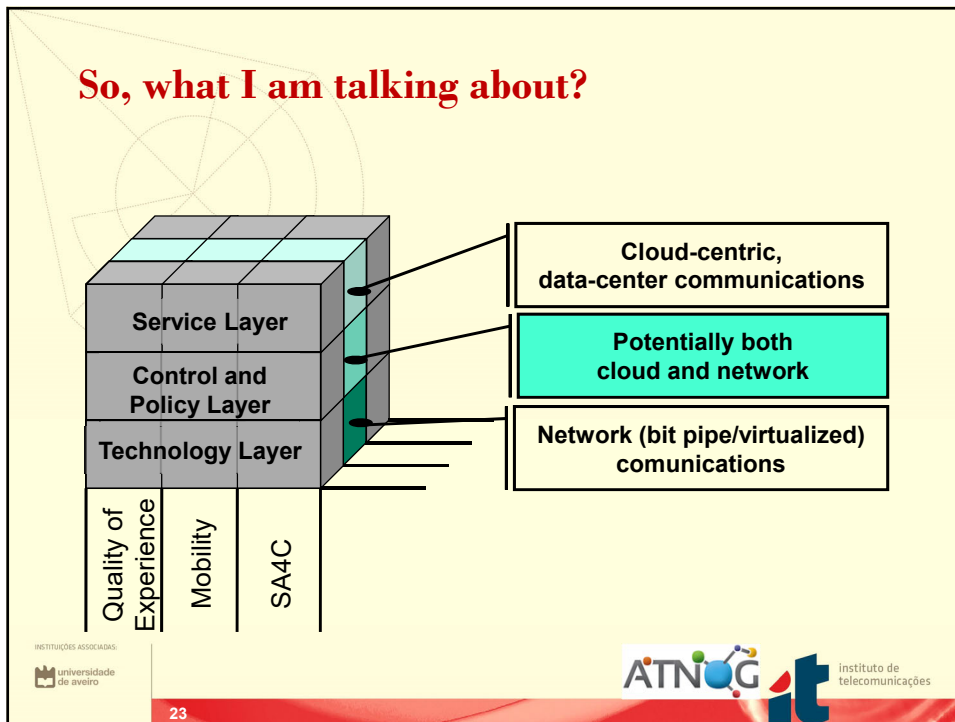
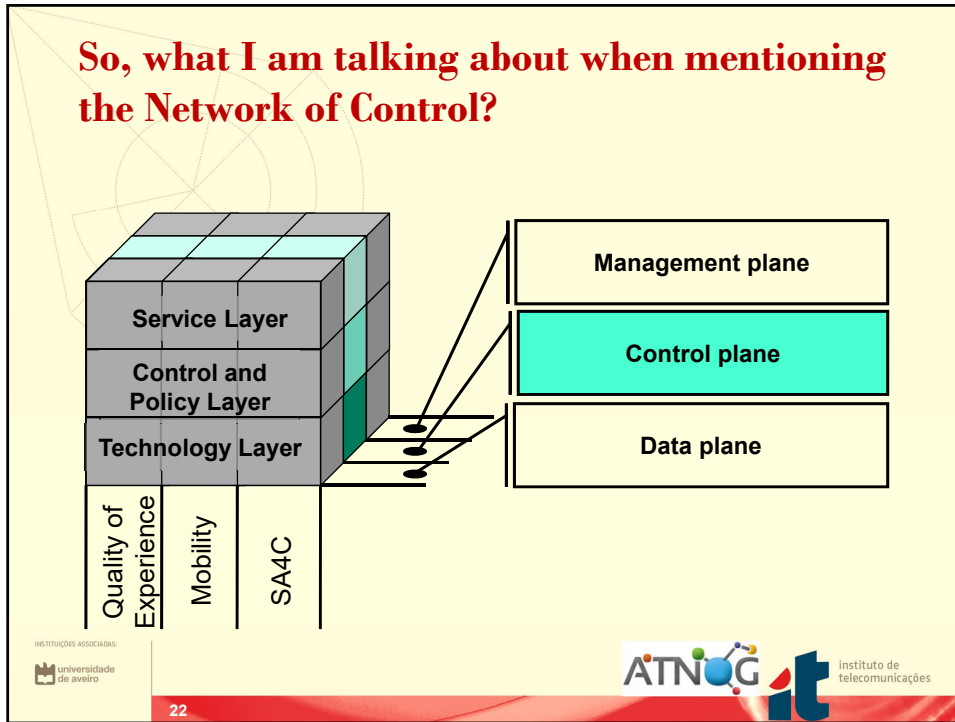
Automated deployment of VxFs and creation of VxF stores



So,
are we on the same page ?
(until now)








What are the properties of this Control Network?


Without this control network, the network does not exist!

- **Bootable!**
- **Resilient!**
- **Flexible!**
- **Self-adaptable!**

- **Needs to be efficient...**
- **Needs to be multi-technology**
- **Crosses network and cloud**
 - **Multiple types of requirements**
 - **Both protocol and API oriented**

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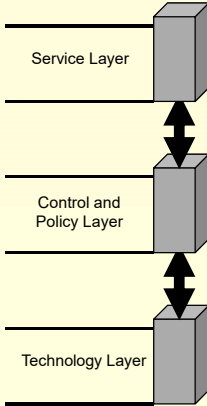
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What will change in the upcoming networks?


- More diverse technologies will be used.
- More diverse business models, including virtualization at multiple layers
- Higher "intelligence" at central entities
- Much higher requirements for monitoring: the network needs to know everything
- Optimal vertical support (dynamic slices):
 - more information going into the service layer
 - or, more detailed requirements going into the CP

The vertical flow of information is increasing for the **simple task of controlling the network**



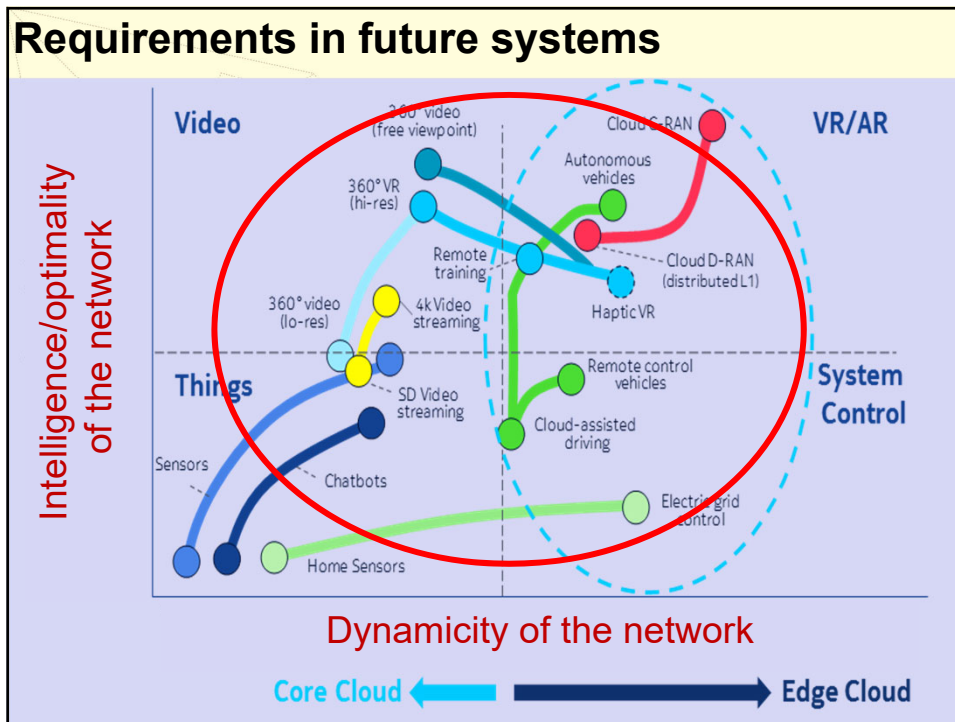
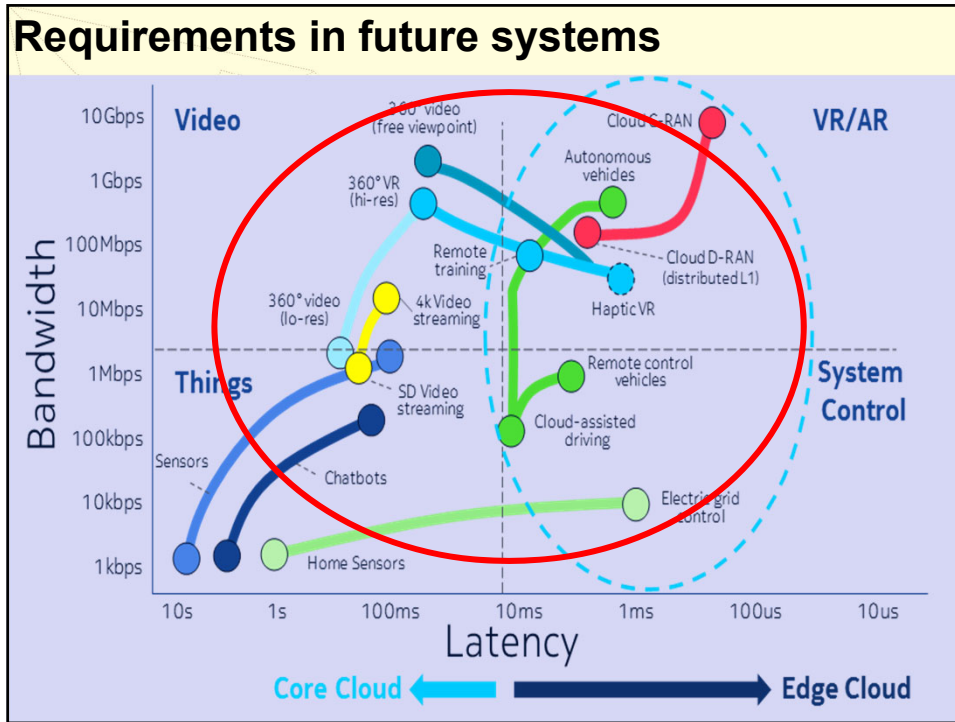
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Is this worth it?

Does it make sense?

- Intelligence requires information flow and processing
- Dynamicity implies better updates (higher update rates)
- Multiple operators/stakeholders imply complex trust configurations and associated overheads
- Increased complexity of the business environment implies more information exchanged, with more “scoping”
- Everything requires increased monitoring
- (and not discussed)


How much overhead (=comm+proc) does it require to achieve what benefit (=for the network....or the customer)?

Where will the value be?

Conclusions – what is missing

- 5G technology is coming – to every country, every business
- Our DATA PLANE many aspects and use cases will be handled in the next years
- For 2030, the big change will be in the CONTROL PLANE
 - At the time, the ecosystem should be mature for our “wonderful” use cases to explode out of silos
 - But the network would have been developed for optimizing the data aspects, in a near-silo approach

The network of control is a challenge that must be addressed in the next years.








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Questions?

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