



# The Way to 5G

Dipl.-Ing. Herbert Koblmiller  
*Court certified Expert*



technology  
humanity

new  
radio

multi  
dimension

the network  
is evolving

the age of  
wireless

**A1**

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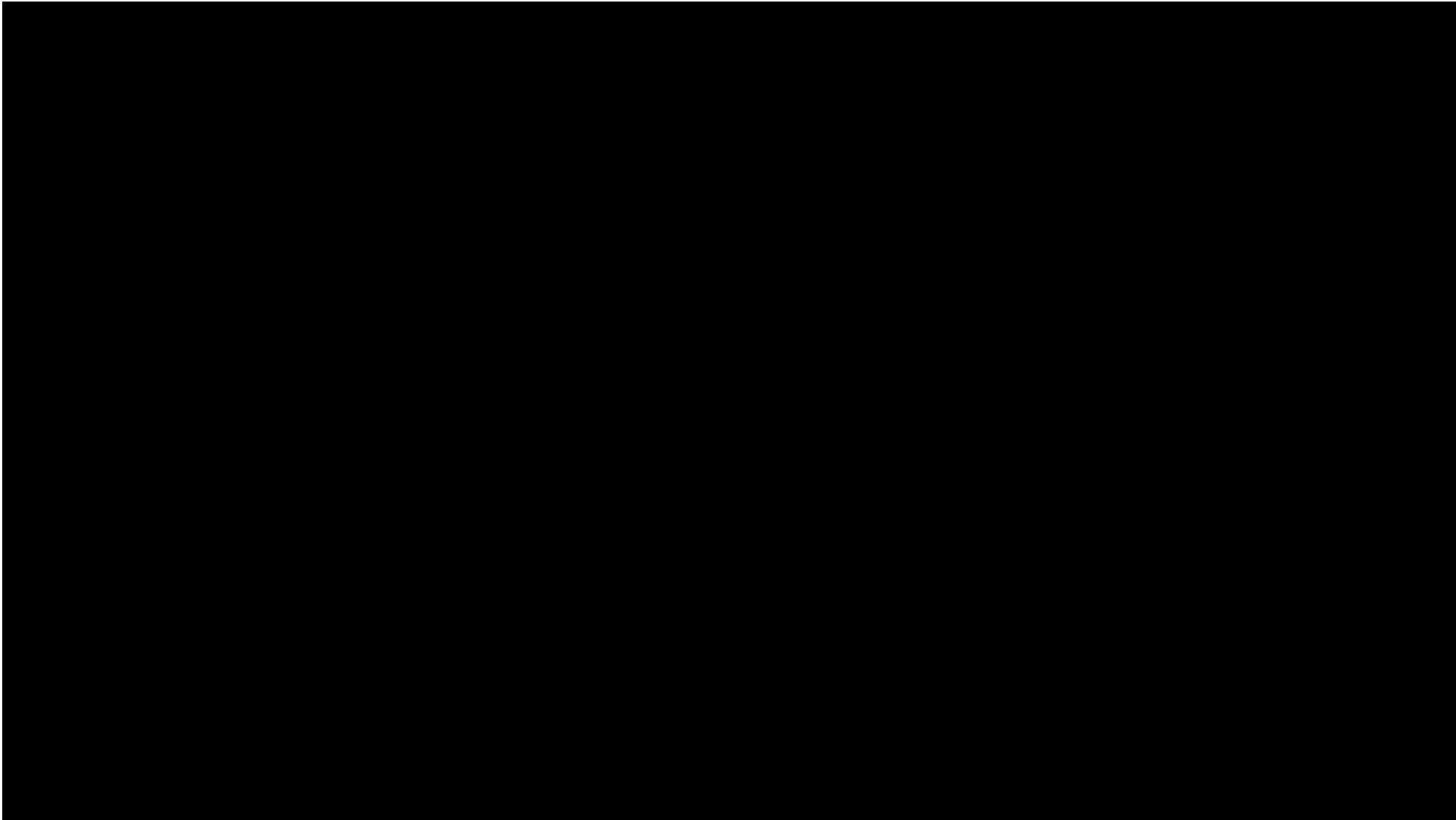


# The Age of Wireless



**statements**

**timeline**





# The Age of Wireless



**statements**

**timeline**

**... phones were places  
not people ...**



**... we did not have to sell the vision,  
our job was to make it work ...**



**... the network is  
the fabric of the future...**





# ... the network of you



# timeline

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# the network is evolving



increased  
mobile  
data

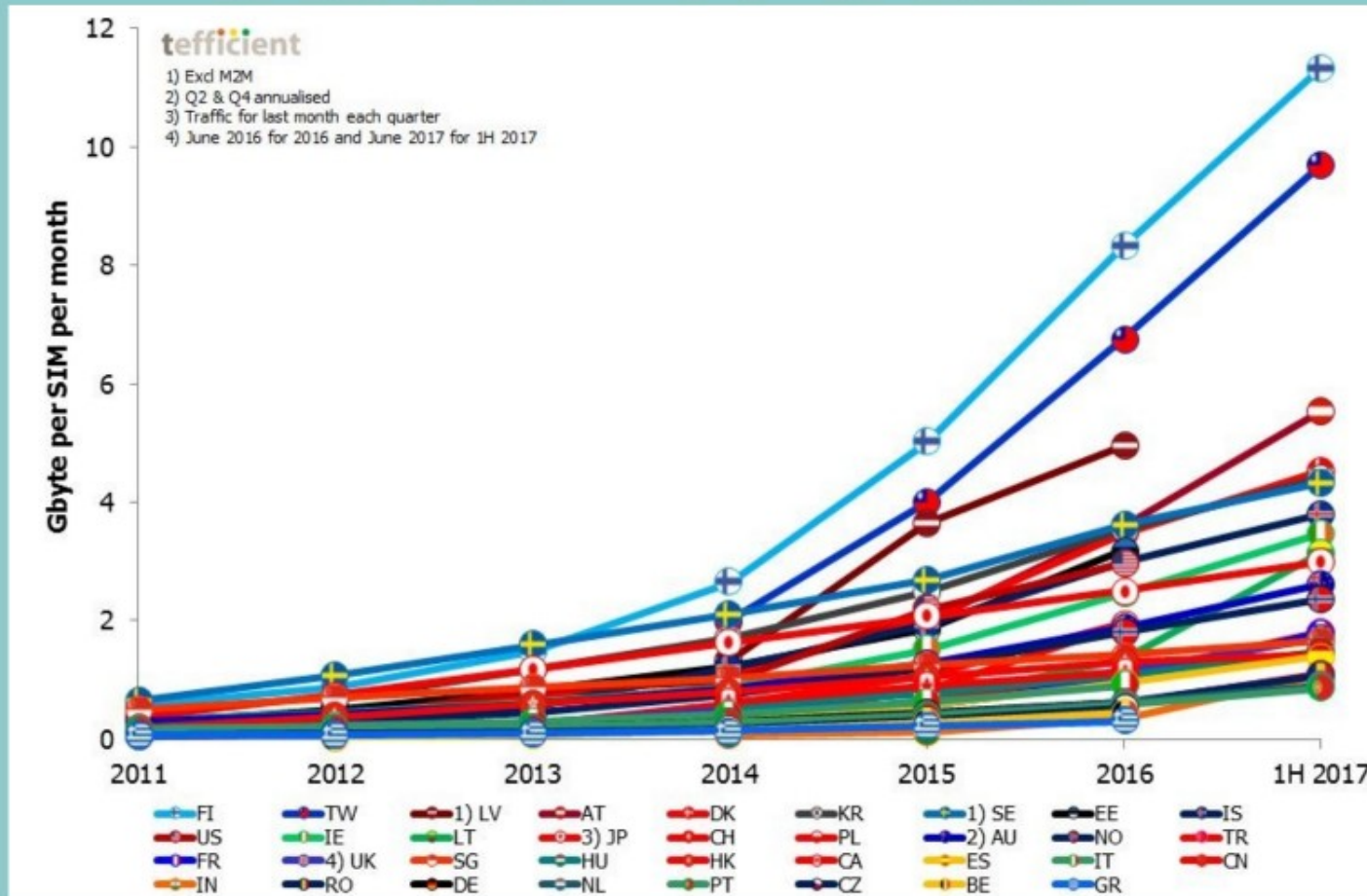


new  
demands



specification  
timeline

# increased mobile data



*Austria is within strongest growth in Data*

**new demands**

# new demands

*Connected Devices*



# new demands

*Connected Devices* --> *Internet of Things*

# new demands

*Connected Devices --> Internet of Things*

*Machine Learning*

# new demands

*Connected Devices* --> *Internet of Things*

*Machine Learning* --> *Artificial Intelligence*

# new demands

*Connected Devices* --> *Internet of Things*

*Machine Learning* --> *Artificial Intelligence*

*increased Productivity*

# new demands

*Connected Devices --> Internet of Things*

*Machine Learning --> Artificial Intelligence*

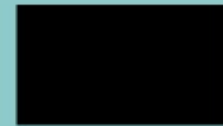
*increased Productivity --> Industry 4.0*

# new demands

*Connected Devices --> Internet of Things*

*Machine Learning --> Artificial Intelligence*

*increased Productivity --> Industry 4.0*



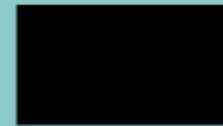


# new demands

*Connected Devices --> Internet of Things*

*Machine Learning --> Artificial Intelligence*

*increased Productivity --> Industry 4.0*



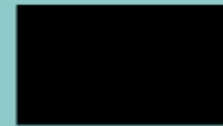


# new demands

*Connected Devices* --> *Internet of Things*

*Machine Learning* --> *Artificial Intelligence*

*increased Productivity* --> *Industry 4.0*



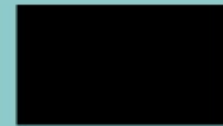
*Virtual Reality*

# new demands

*Connected Devices* --> *Internet of Things*

*Machine Learning* --> *Artificial Intelligence*

*increased Productivity* --> *Industry 4.0*



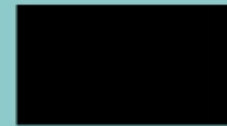
*Virtual Reality* --> *mixed Reality*

# new demands

*Connected Devices* --> *Internet of Things*

*Machine Learning* --> *Artificial Intelligence*

*increased Productivity* --> *Industry 4.0*



*Virtual Reality* --> *mixed Reality*





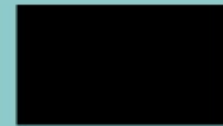
A TimeWarner Company

# new demands

*Connected Devices* --> *Internet of Things*

*Machine Learning* --> *Artificial Intelligence*

*increased Productivity* --> *Industry 4.0*

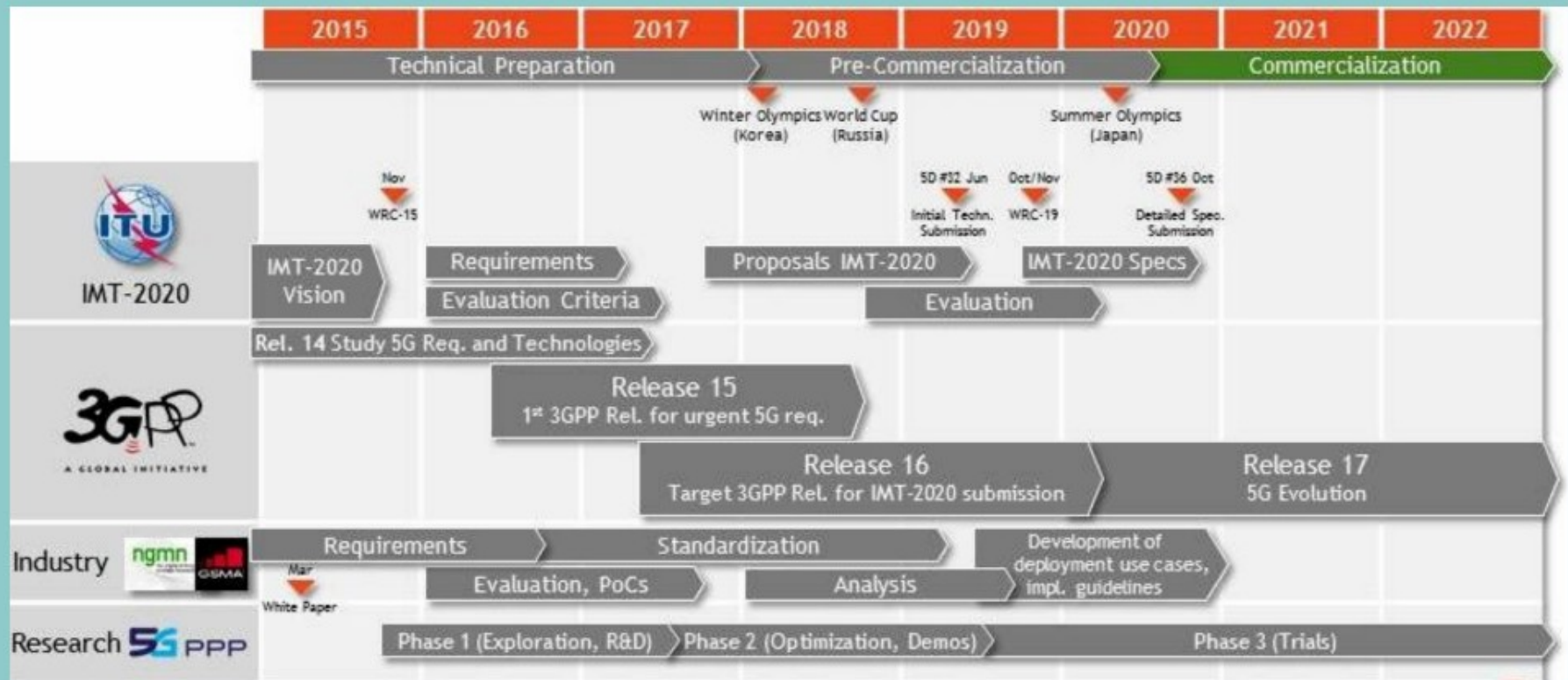


*Virtual Reality* --> *mixed Reality*



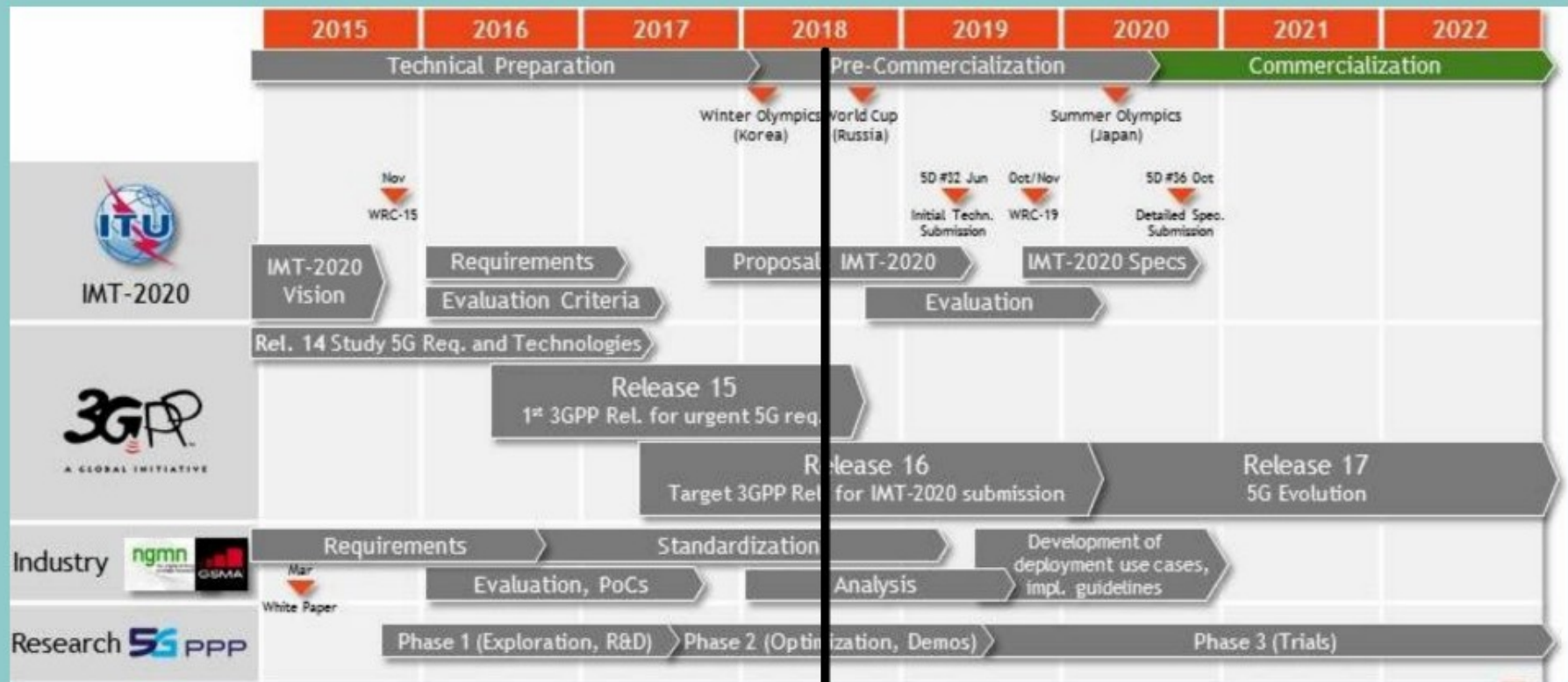
**it is no fiction ... we are already in it!**

# it is no fiction ... we are already in it!



Source: 3gpp, Qualcomm

# it is no fiction ... we are already in it!



Source: 3gpp, Qualcomm





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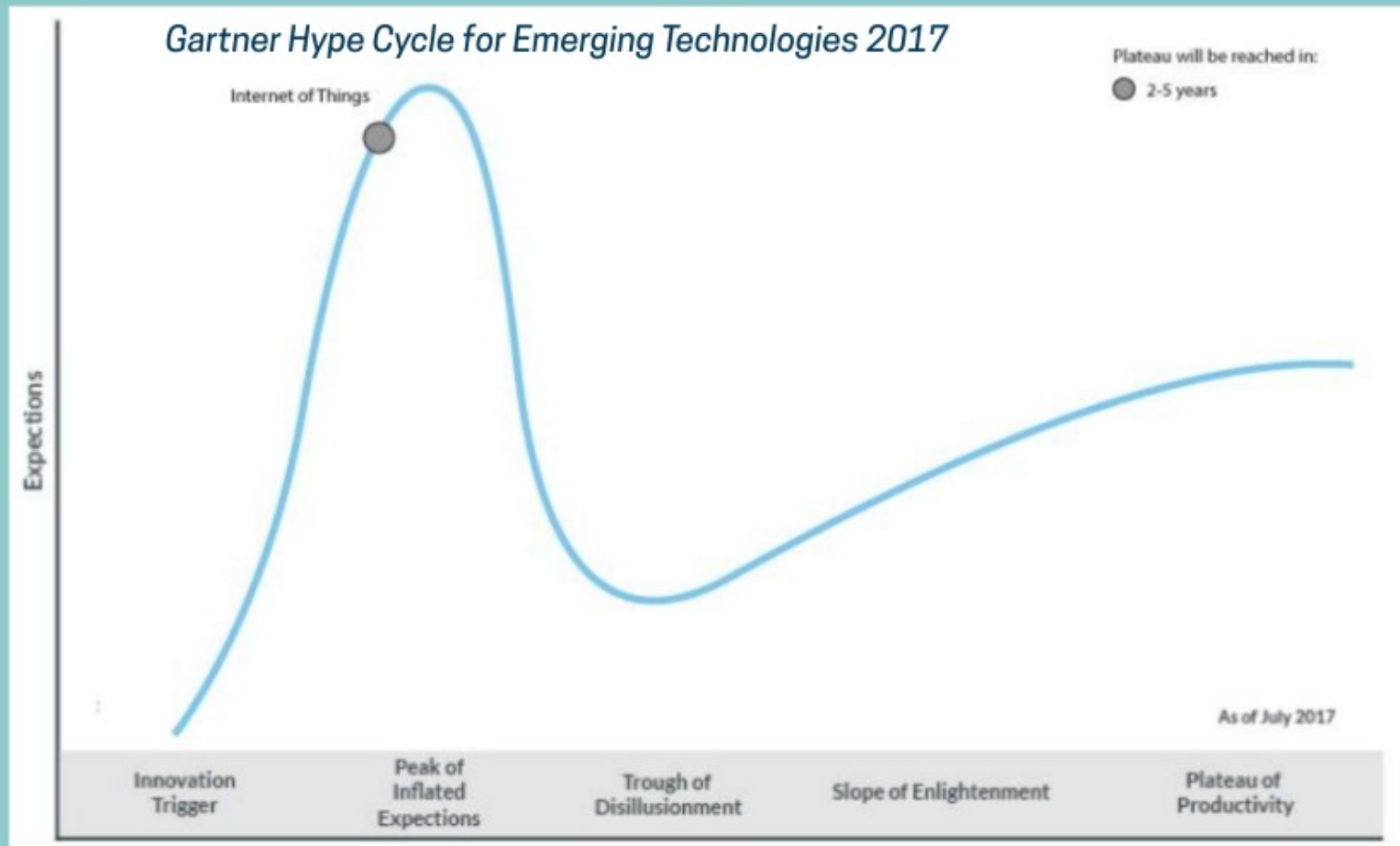
# multi dimension

enhanced  
mobile  
broadband

massive  
machine Type  
communication

ultra reliable and  
low latency  
communication

# Internet of Things IoT

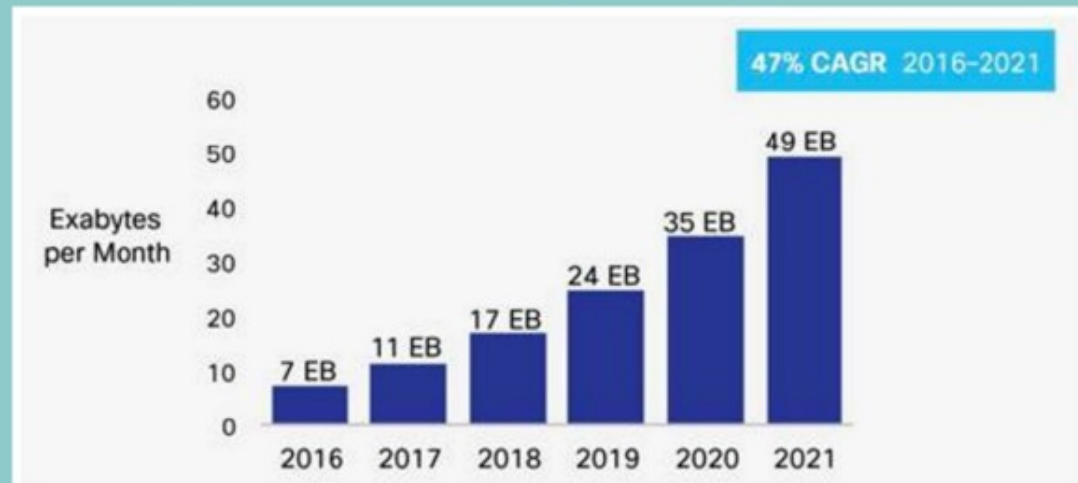


# enhanced mobile broadband

Today's wireless networks do not have enough spectrum bandwidth and network capacity to serve and meet growing consumer demands.

By 2021, wireless networks will increase in usage by 47% CAGR annually to reach 49 Exabytes per month.

Speeds will reach peaks of 10Gbps and deliver 1Gbps at 500km/ hour.



CAGR= Compound Annual Growth Rate

Source: Cisco VNI Mobile, 2017

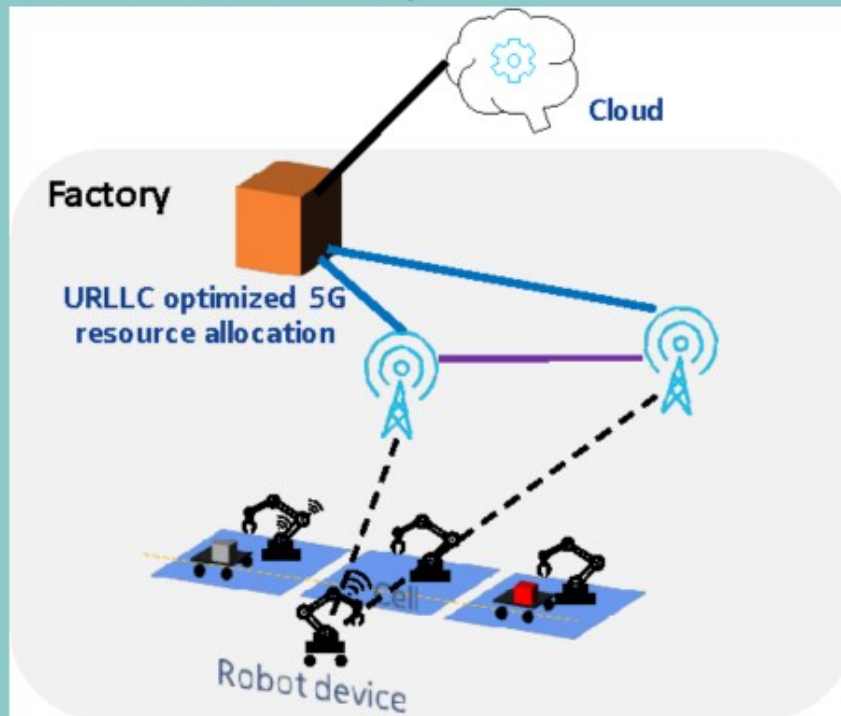
# ultra reliable and low latency communication (URLLC)

*is a new service category that will be supported in 5G New Radio (NR)*

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*is a new service category that will be supported in 5G New Radio (NR)*

Robots in the factory

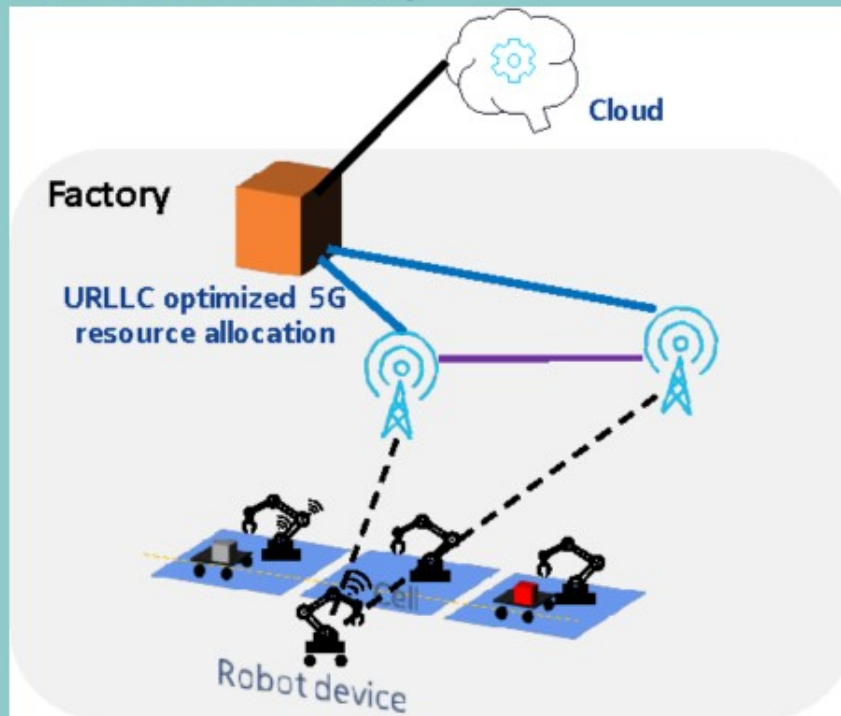


Picture: Hyoungju Ji, Sunho Park

# ultra reliable and low latency communication (URLLC)

is a new service category that will be supported in 5G New Radio (NR)

## Robots in the factory



Picture: Hyoungju Ji, Sunho Park

## Autonomous Transport



Picture: Ericsson



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# new radio

*Distribute Wherever You Can,  
Centralize Only When You Must  
and Compute Everywhere*

*by Balamurali Thekkedath*

new  
frequencies

network  
virtualiza  
tion

massive  
MIMO

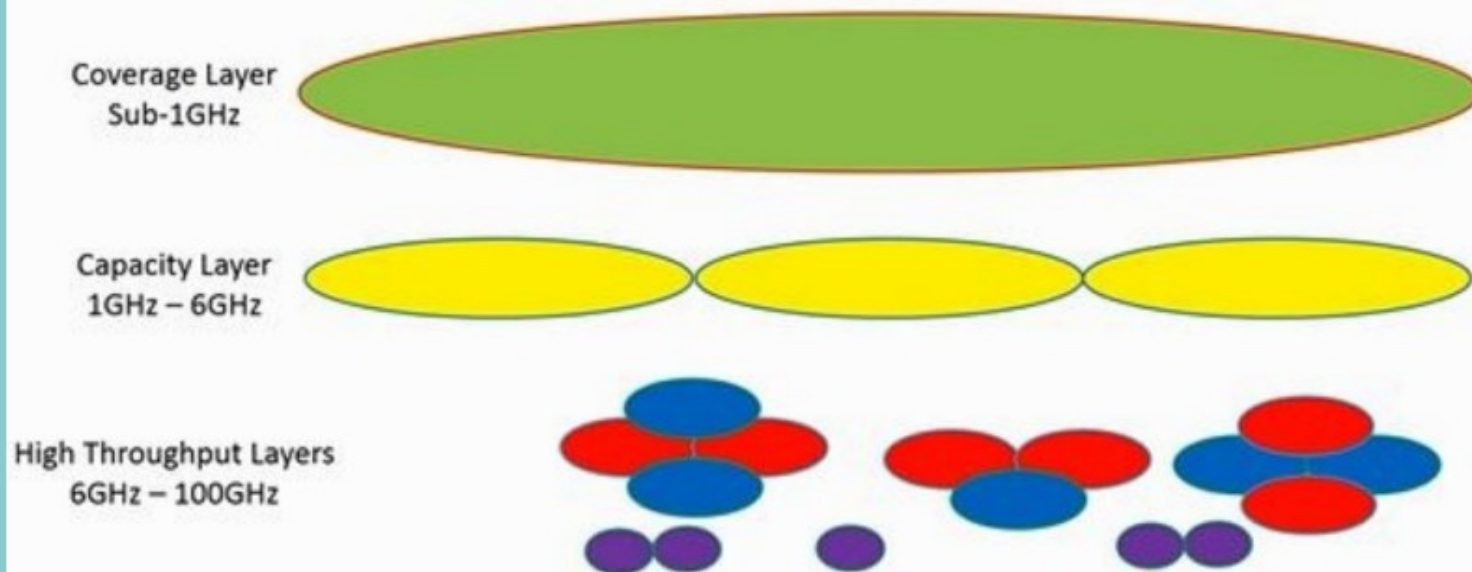
mobile  
edge  
computing

network  
slicing

# new frequencies

*additional layers*

## 5G: Multiple Layers for multiple needs



# massive MIMO

# massive MIMO

*gain for increase spectral efficiency*

# massive MIMO

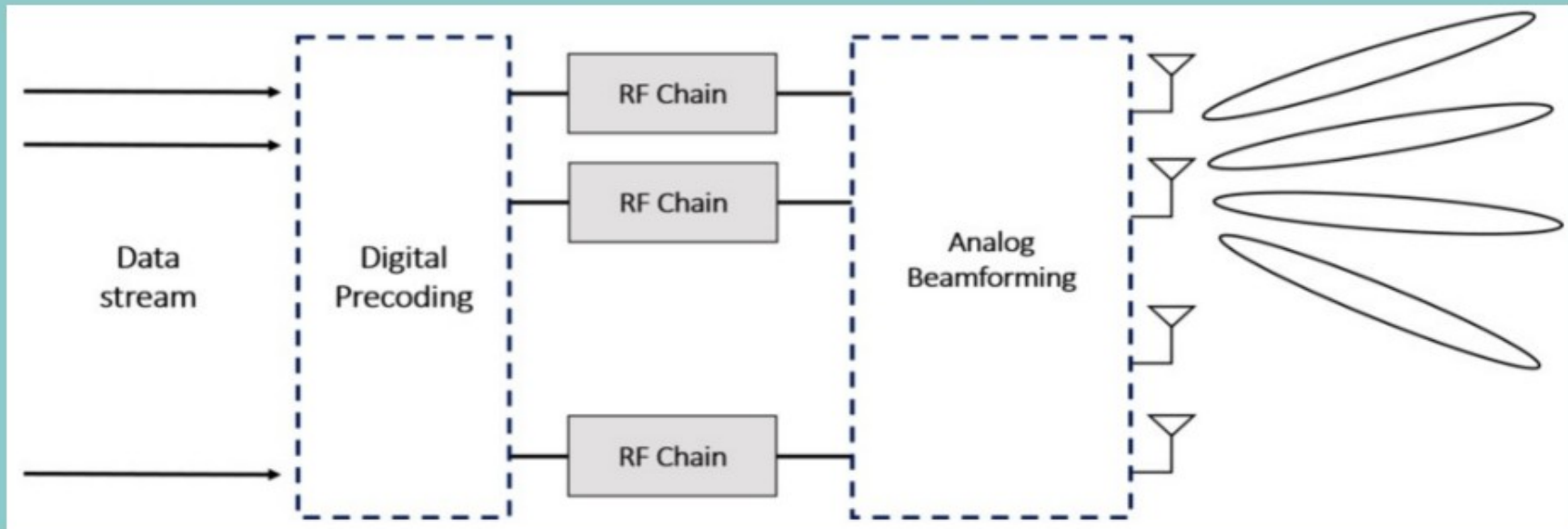
*gain for increase spectral efficiency*

*analog beamforming - hybrid beamforming - digital beamforming*

# massive MIMO

gain for increase spectral efficiency

analog beamforming - hybrid beamforming - digital beamforming



hybrid beamforming structure (Sakaguchi lab)

# mobile edge computing

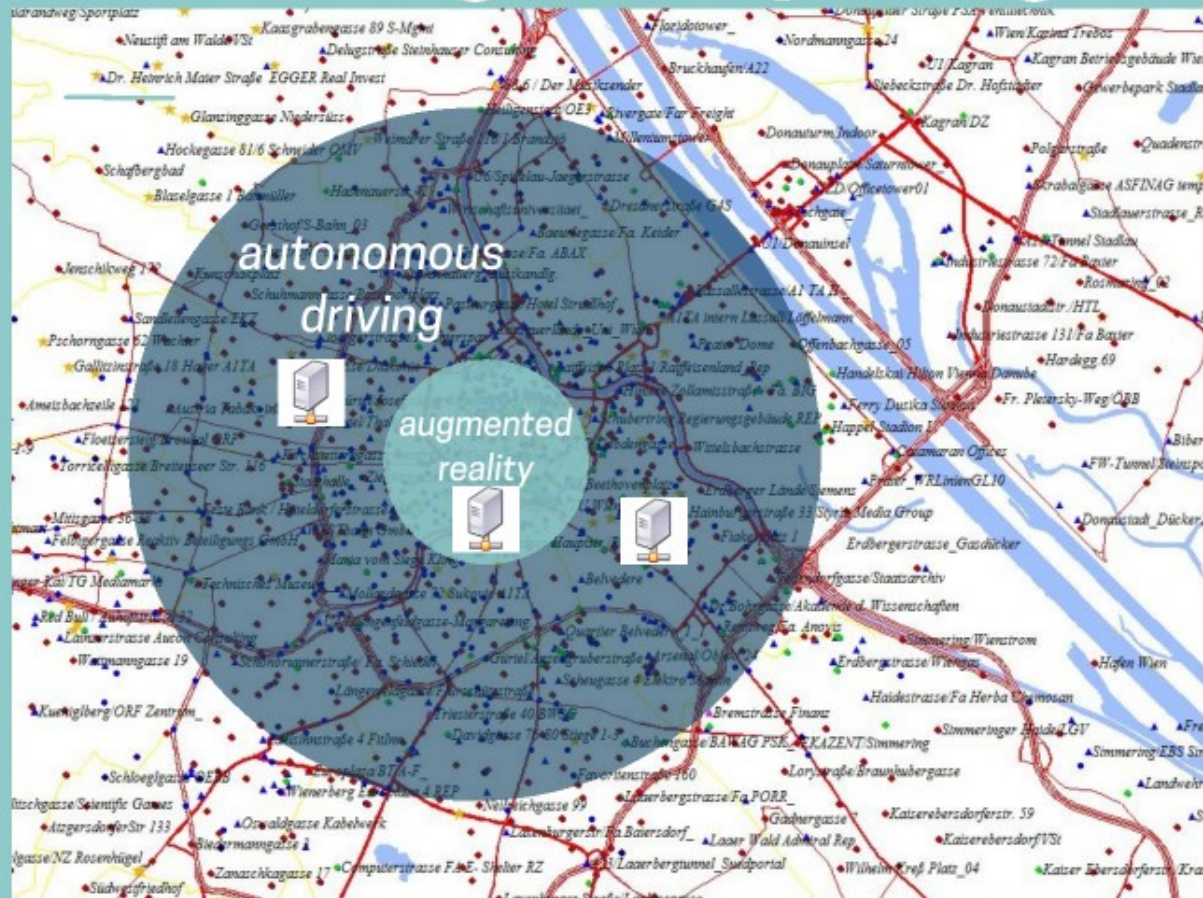


# mobile edge computing





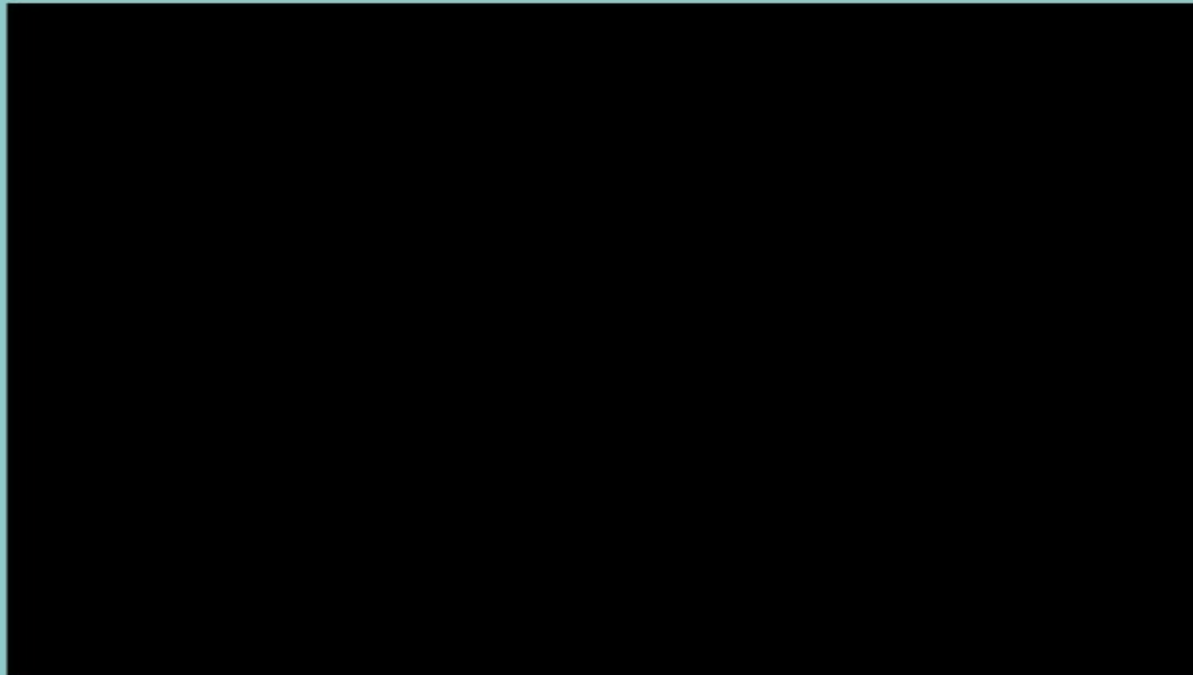
# mobile edge computing



# network slicing



*Service based Architecture*

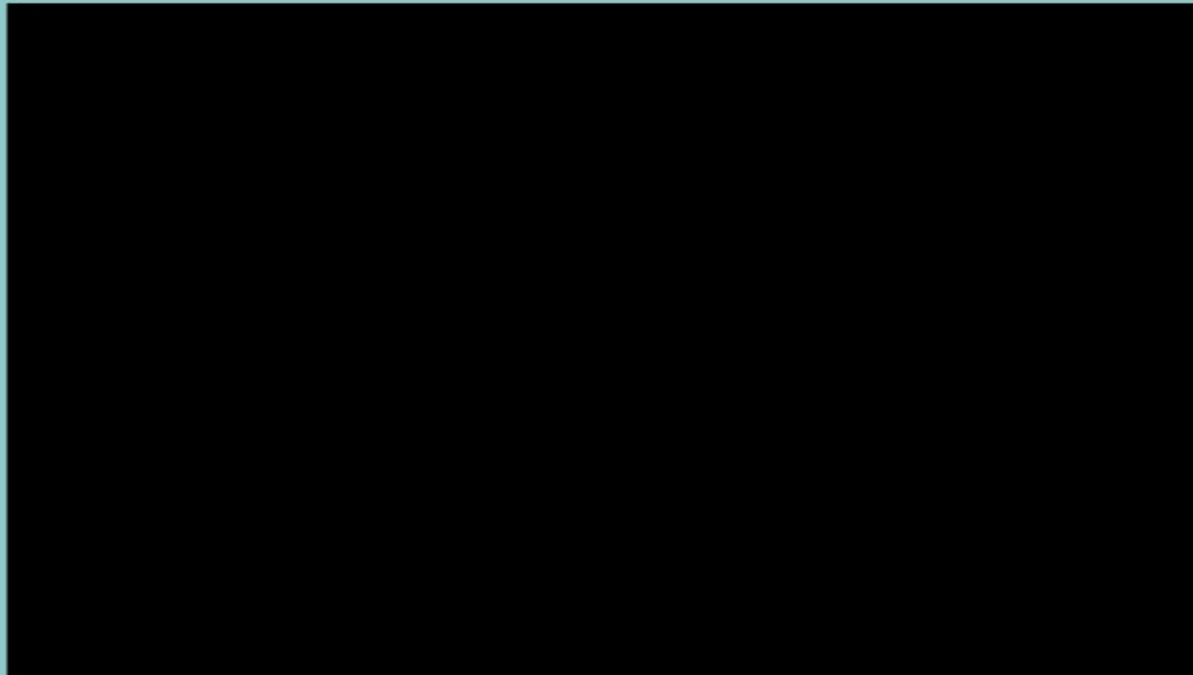




# network slicing



*Service based Architecture*



# network virtualization

*Scalability*







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# future of technology and humanity









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