

Evolution of the Edge



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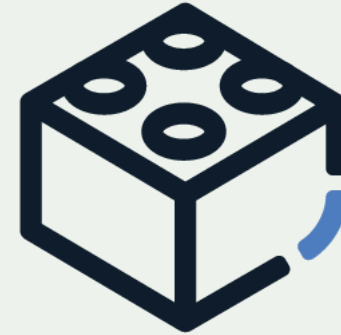
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Will the Internet's evolution inhibit the Internet?

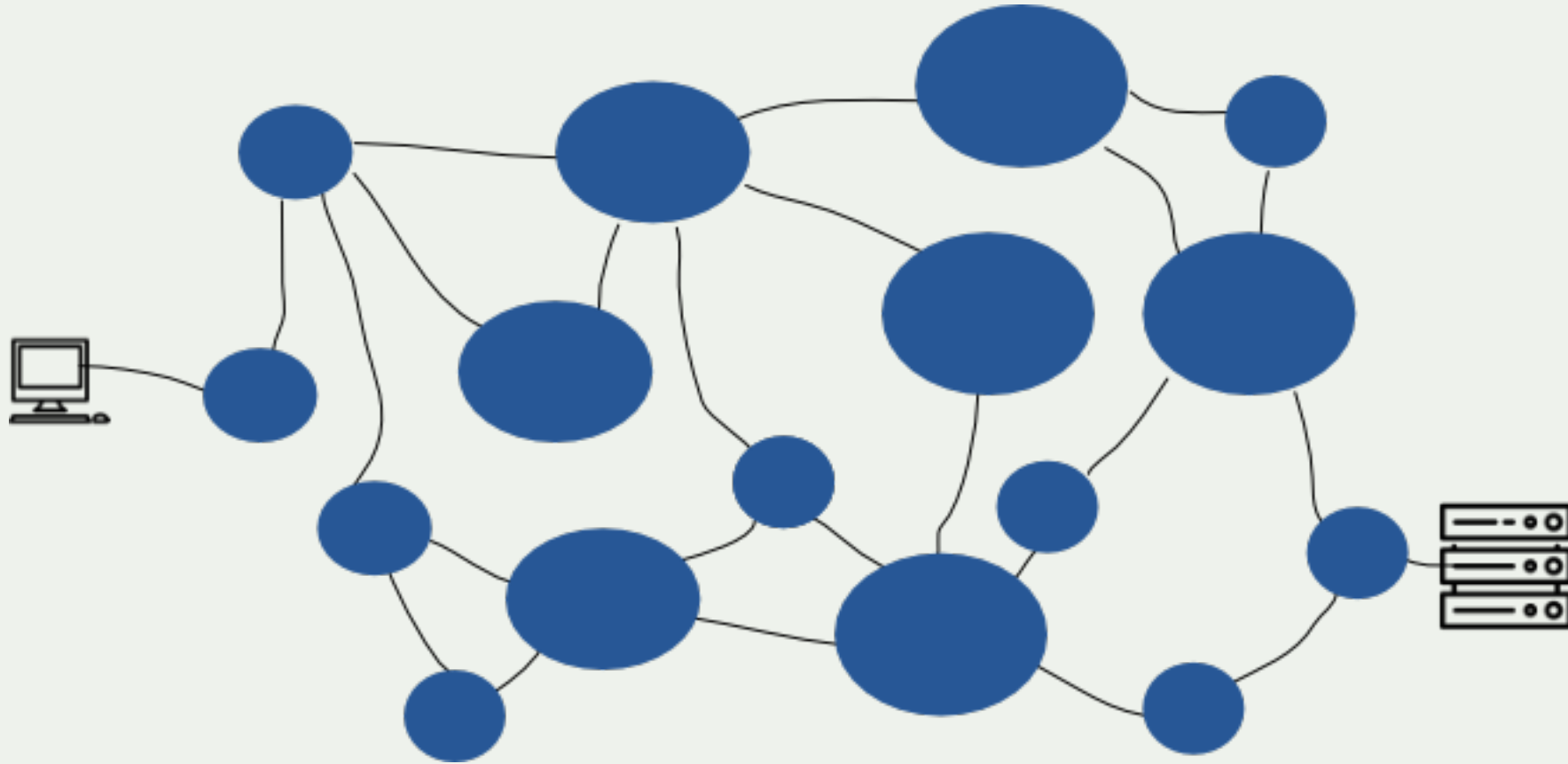


The Internet Way of Networking



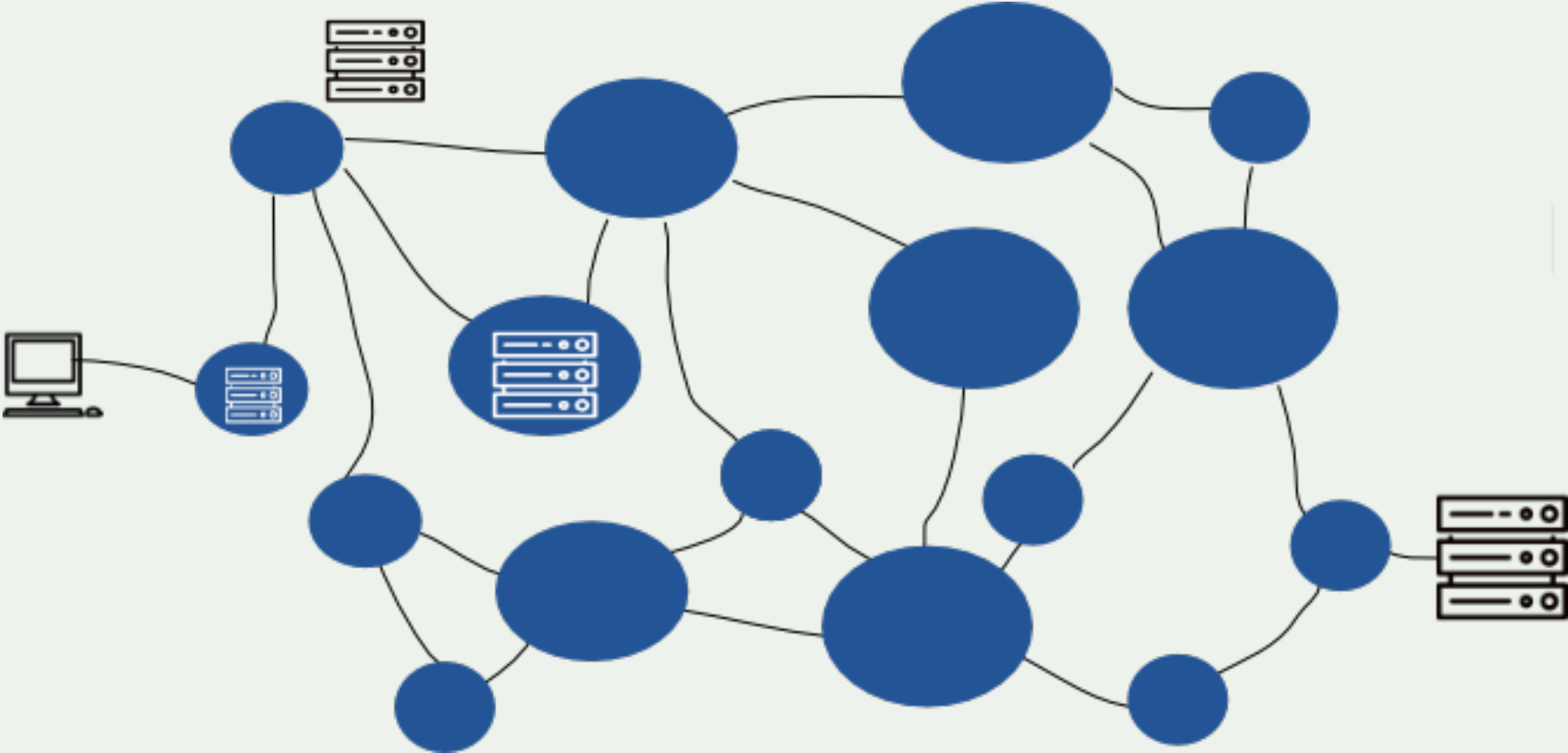
What is the Edge of the Internet anyway?

Classical Internet: No intelligence in the Network



Evolved Edge

More and more services from 'inside of the network'



We'll describe/define variations of this during the presentation



Why are we here?

Wikipedia definition: Edge computing is a distributed computing paradigm that brings computation and data storage closer to the sources of data

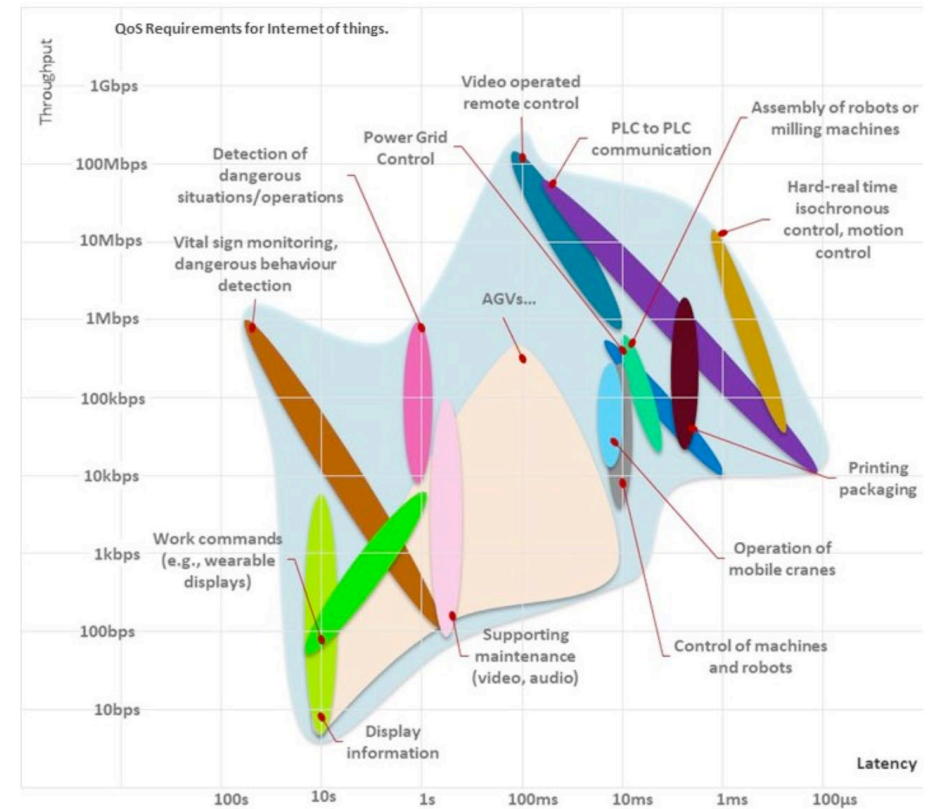
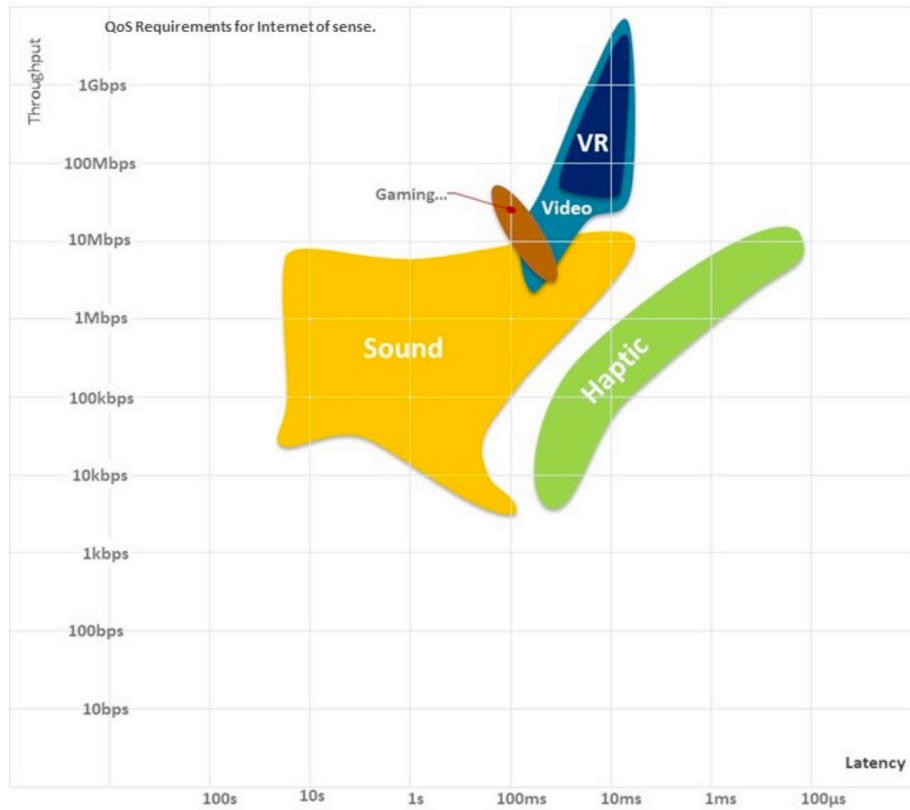
The technical fabric of the Internet today isn't a simple client-server model anylonger.

- Computing and storage closer to the users.
- Commenters like Geoff Huston predict changes to the Internet's routing
- The 5G design has local computing as a key element of its architecture (slicing)
- The Future 2030 vision by the ITU-T is full of references to edge computing



Driving applications in the latency-bandwidth plane

Figure 11: Indicative quality of service requirements for future applications (IoS and IoT). Source: Ofcom.

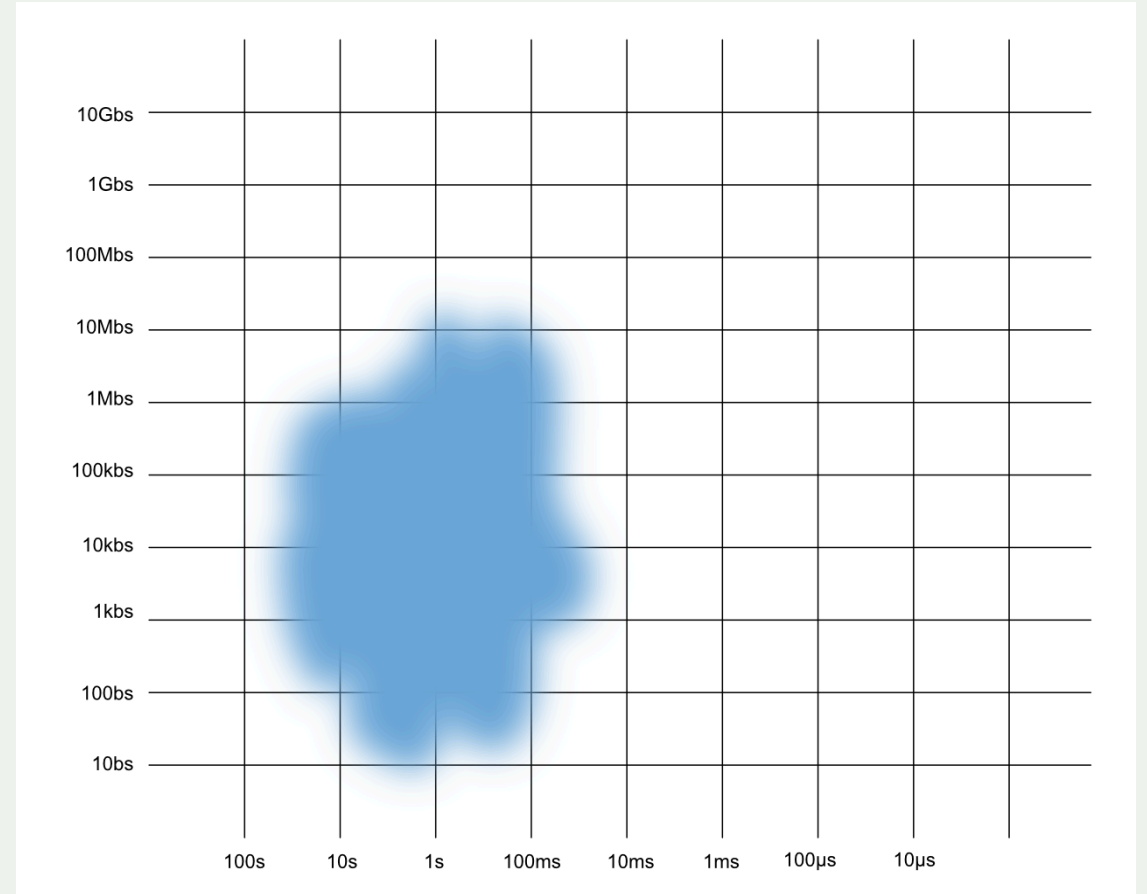


Evolution (90s: the classic era)

Mostly the network of networks with servers at one end and clients at another

Traffic would travel the globe and use tier-1 transit routes

Classic Internet



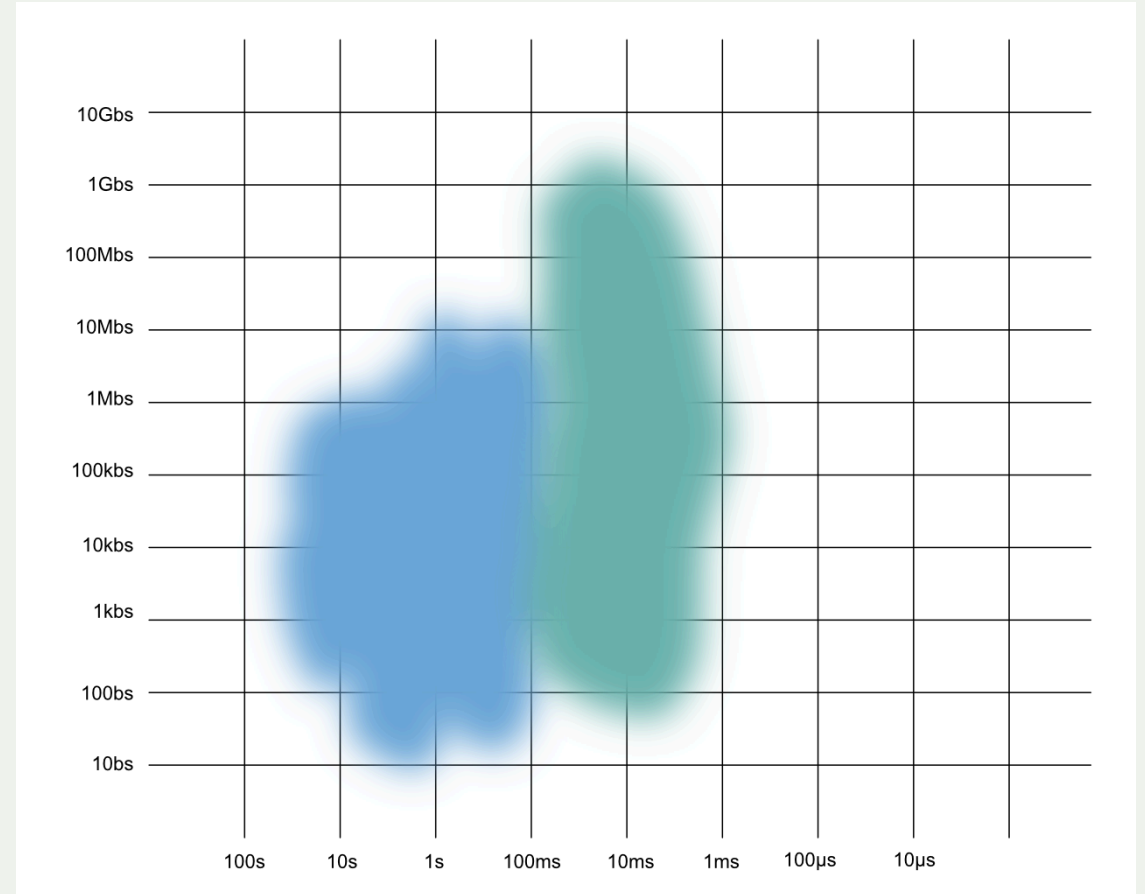
The casual history in the next few slides needs validation

Evolution (00s the rise of the cache)

The rise of the cache.

- Akamai and the likes moved servers to data centers at the major IXes.
 - In the early days disk per fedex
- DNS starts to get a role in dynamic service discovery
 - DNSAnycast
 - Dynamic DNS

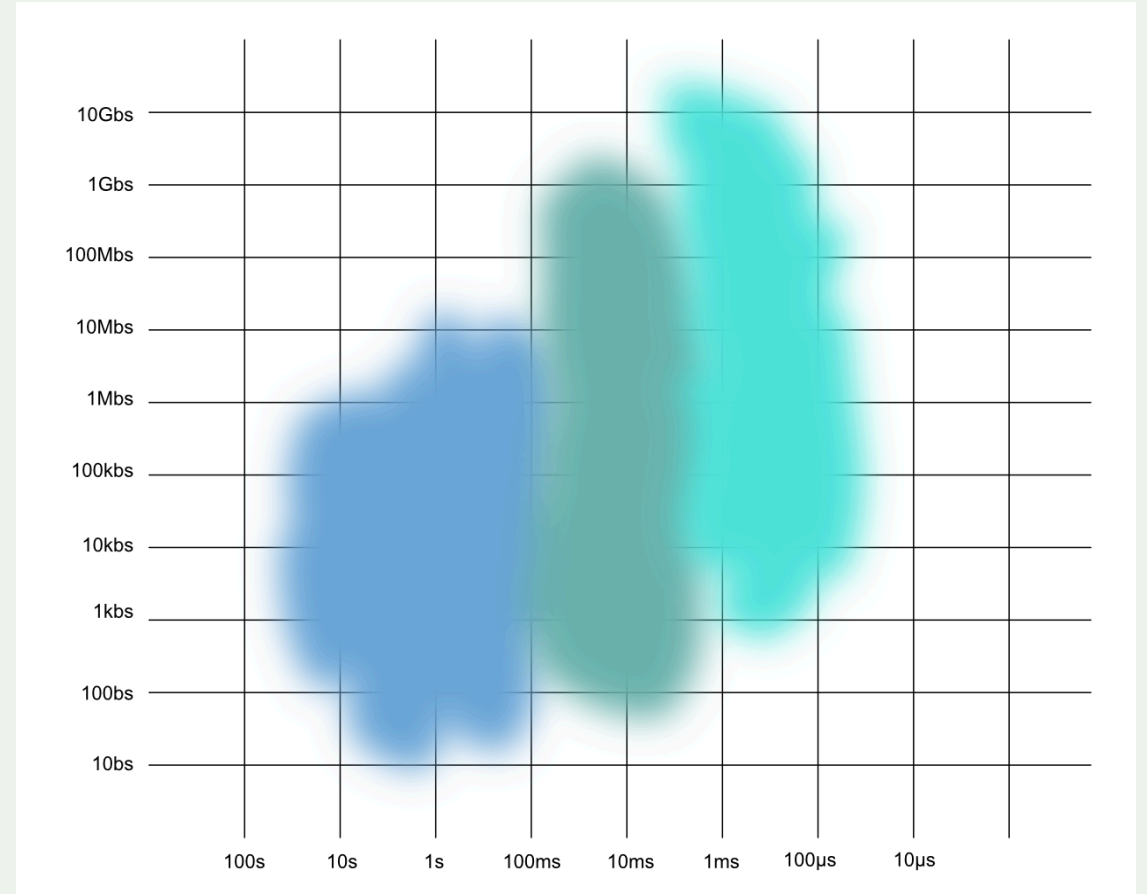
Hybrid Internet (typically distant edge)



Evolution (10s the hyperscalers)

- Data center orchestration
 - DevOps
 - Virtual Machines and Containers
- Private backhaul
- Denser interconnect
 - IXP explosion
 - Private interconnect

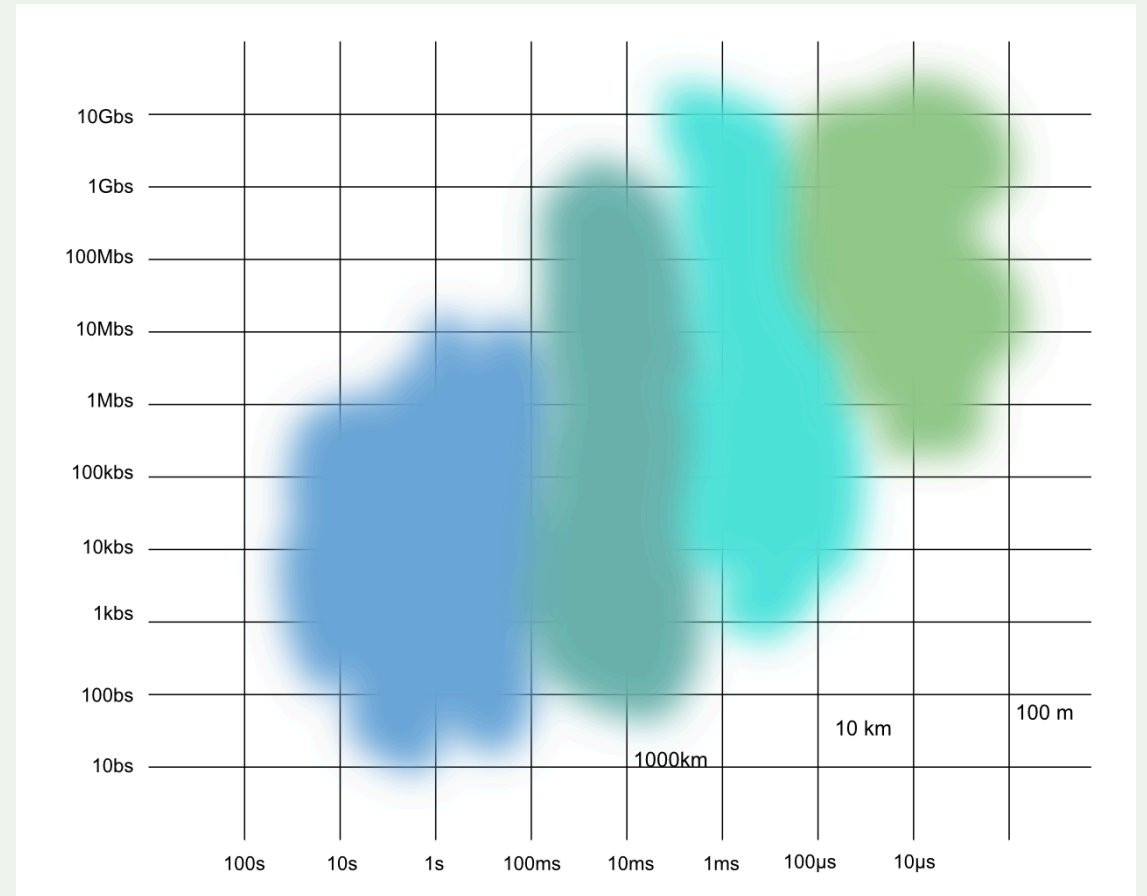
Hybrid Internet (evolving to close edge)



Evolution (20s the rise of slice)

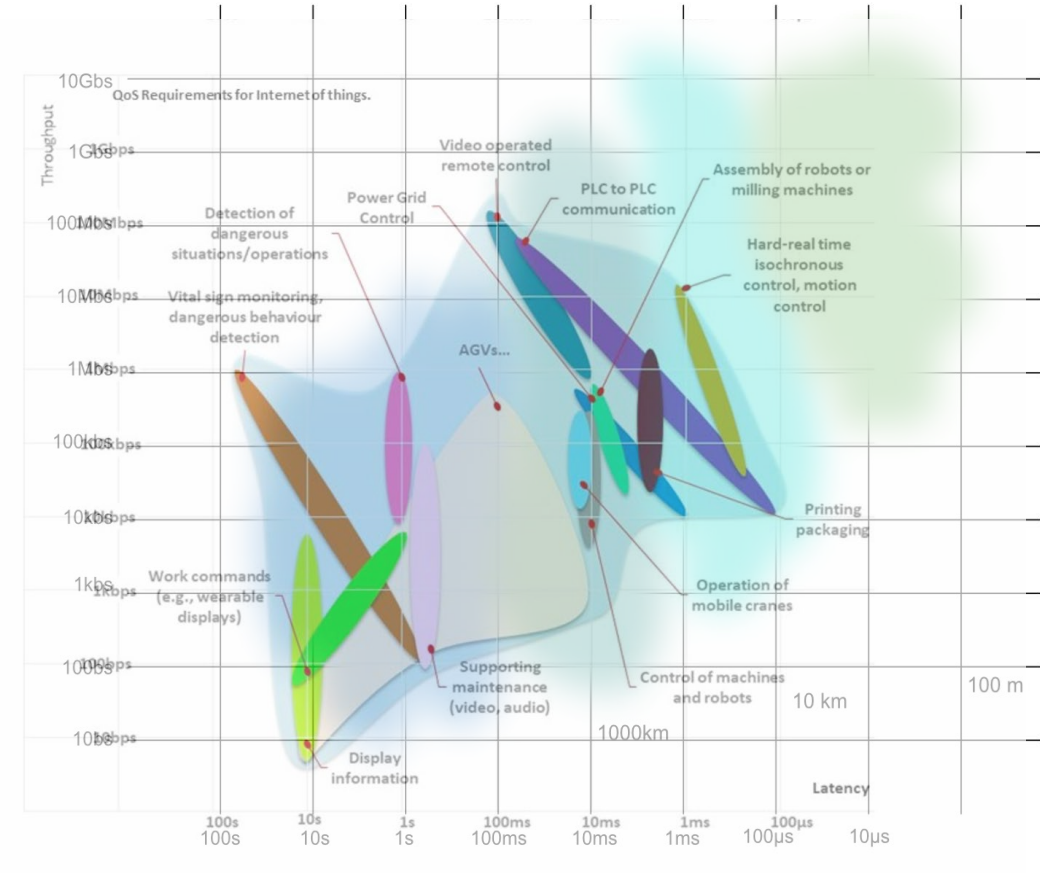
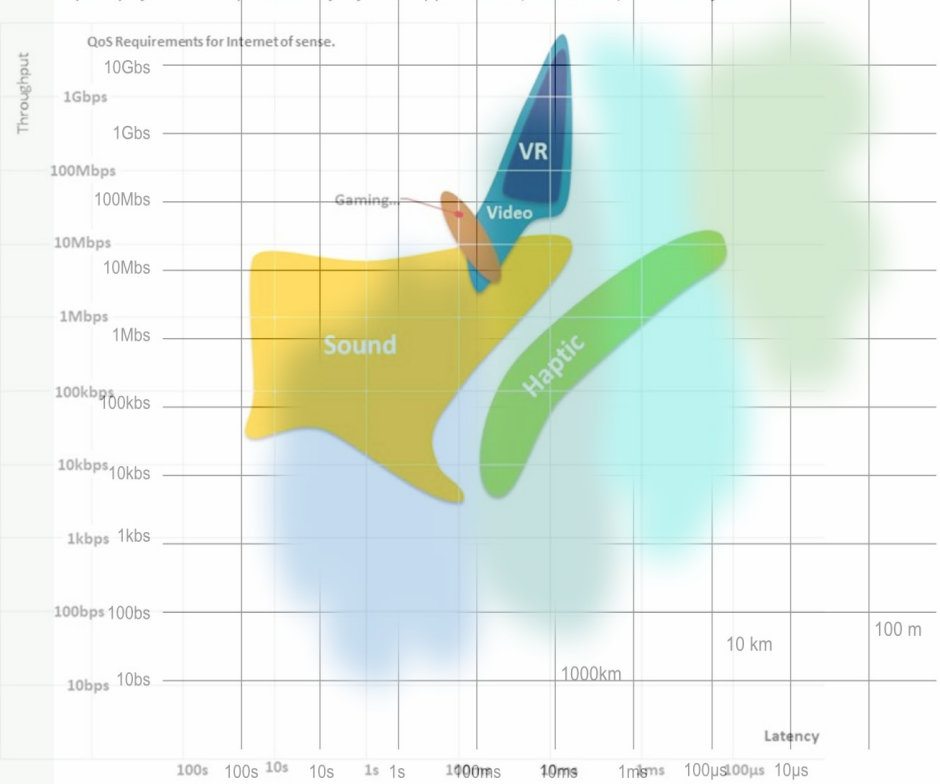
- Gaming and video are pervasive
- Covid pandemic
 - Majority of video calls 'local'
- 5G promises sliced service architecture
 - Container sized data centers near mast
- FG2030 discusses applications that cannot work without edge computing

Hybrid (even more close edge) and introduction of Telco like services.



Another view on the relation to applications

Figure 11: Indicative quality of service requirements for future applications (IoS and IoT). Source: Ofcom.

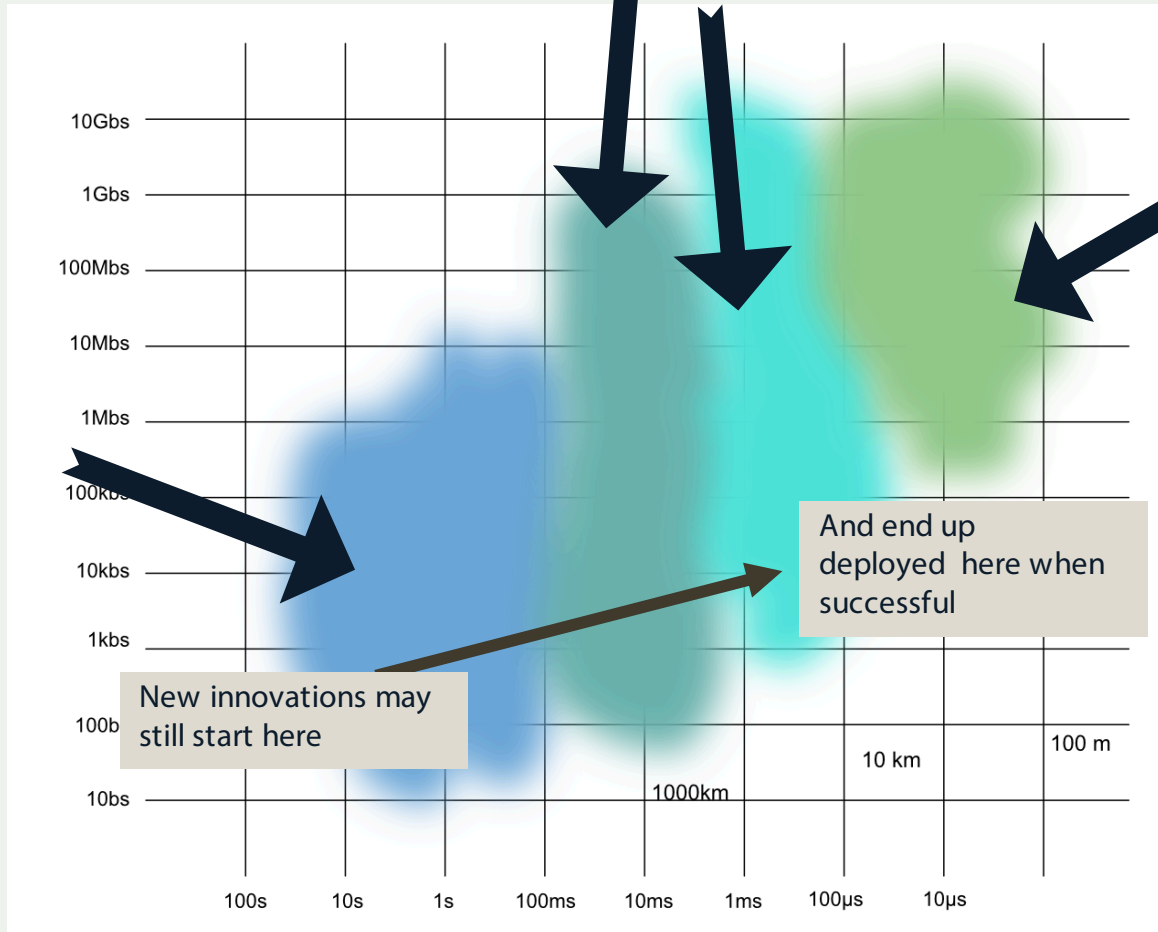


Questions, Questions



Classic

Hybrid
Distant
Close



Telco

Policy requirements.

Can players in each blob reach a global markets?

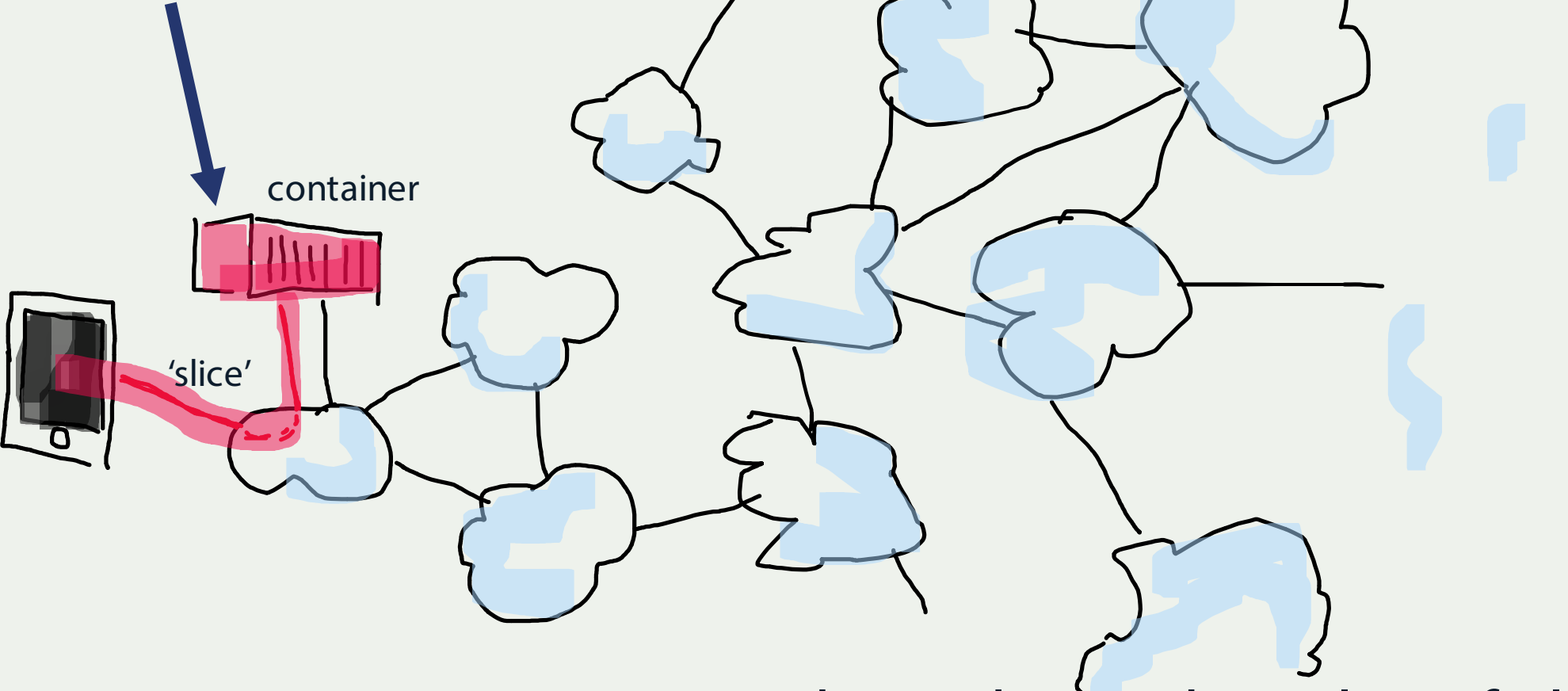
Are all these areas 'open'? Is there interoperability

Will innovation move the other way?

What makes innovations move around?



Suppose this is prevalent



Then what is the value of all of this and how do we sustain it?



Thank you.

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Some definitions

- **Classic Internet** – global - Server and client are separated by a few AS-es and all application traffic traverses all the ASes when service is delivered.
- **Hybrid** - Servers are located close to the client, potentially in the same AS, but where Internet technology is used for communication and intermediation.
 - Distant edge - regional - the server is located tens of milliseconds away from the client. Potentially one or two AS-es away. Datacenter is regional, less than a few thousands of kilometres away (typically about 50 ms)
 - Close edge – provincial - the server is located less than ten milliseconds away from the client. Potentially in the same AS or directly (privately) peering with the network where the client resides. Datacenter is typically less than a few 100km away (provincial, typical low 10s of milliseconds)
- **Telco** – municipal - servers and clients are located in the same network and specialized networking setups are used to achieve QoE.
 - Typical distance 10 milliseconds.

