# Computing-aware Networking Use case of ALTO

draft-liu-alto-can-usecase-00

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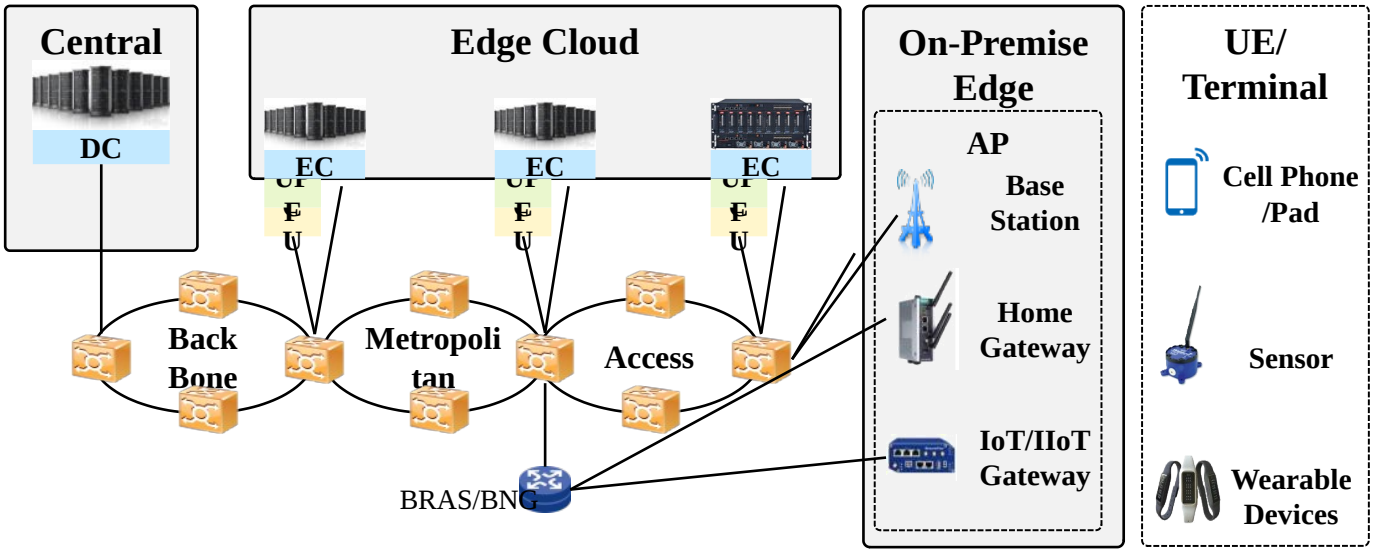
# **Background-**ICT Infrastructure Redefinition

**Service providers are offering the integrated computing and networking infrastructure (edge computing) to**

- **Provide the best user experience such as low latency and high reliability**
  - New applications such as AR/VR and remote control require higher SLA
- **Optimize utilization of network and computing resources**
  - Highly concurrent requests especially during the COVID



# Challenges of edge computing

- Geographically Scattered Large Number of Edge Sites
  - Highly distributed
  - May or may not have proximate distances to user
- Resource Limitation
  - *fewer servers – 10s of server per node.*
- Heterogeneous Hardware
  - *CPU, GPU, Memory, ASICs*
- Dynamic Load
  - *Available resources change quickly*
- Edge-cloud Coordination
  - *Edge does not solve all*
- High Cost
  - *On-site maintenance is expensive*
- Mission Critical
  - *Users are counting on you (i.e. 100% reliability of industry automation)!*

**Many of these challenges are NOT solvable solely in "Computing Domain" NOR the "Network Domain" alone.**

**Can we have a collaborative approach?**

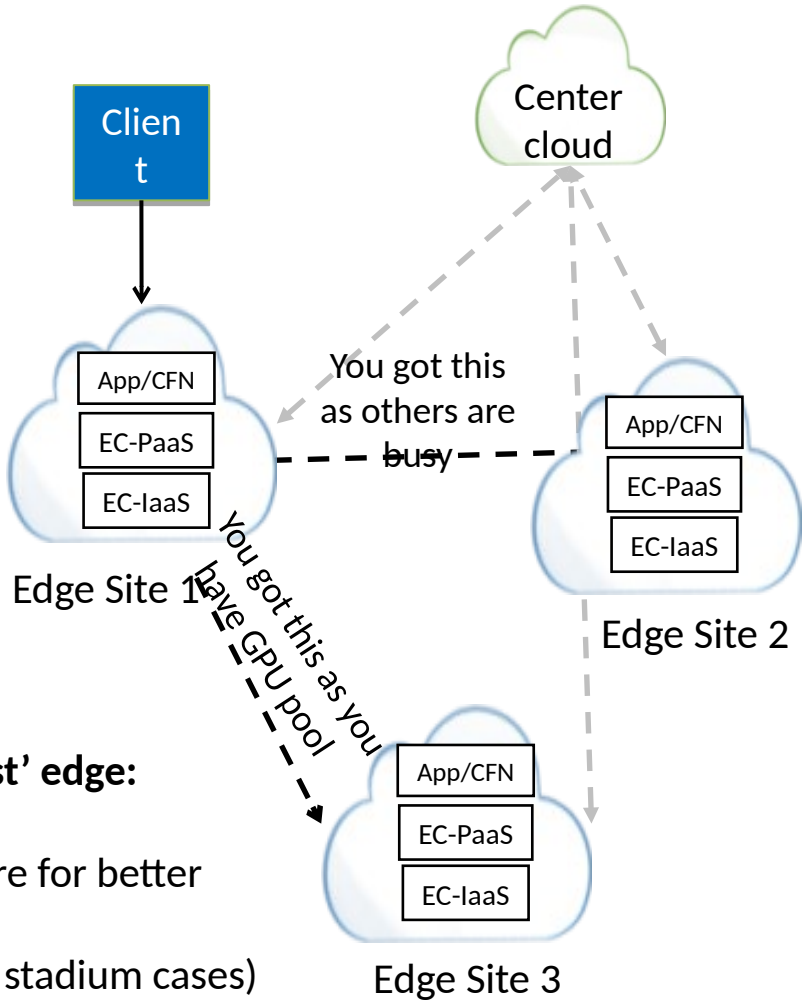
# Use case that needs the joint scheduling – AR/VR

Upper bound latency for motion-to-photon (VR): to less than **15-20 ms** to **avoid the motion sickness**

a) sensor sampling delay: <1.5ms
b) display refresh delay: ≈5 ms
c) frame rendering computing delay with GPU≈ **5.5ms**
d) network delay =20-1.5-5.5-7.9 = **5.1ms**

**The budgets for computing delay and network delay are almost equivalent!!**

**Computing resources have a big difference in different edges**



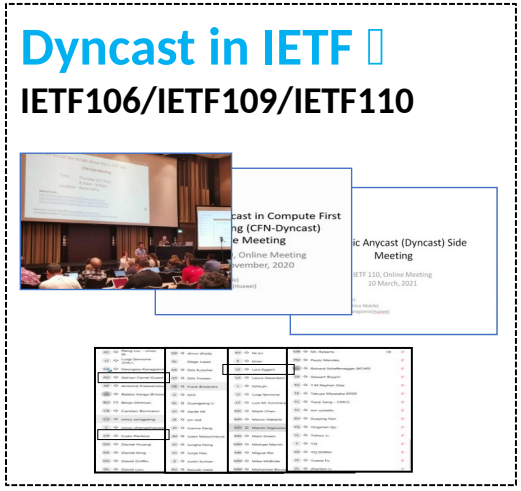

**Examples for need to dynamically steer traffic to the 'best' edge:**

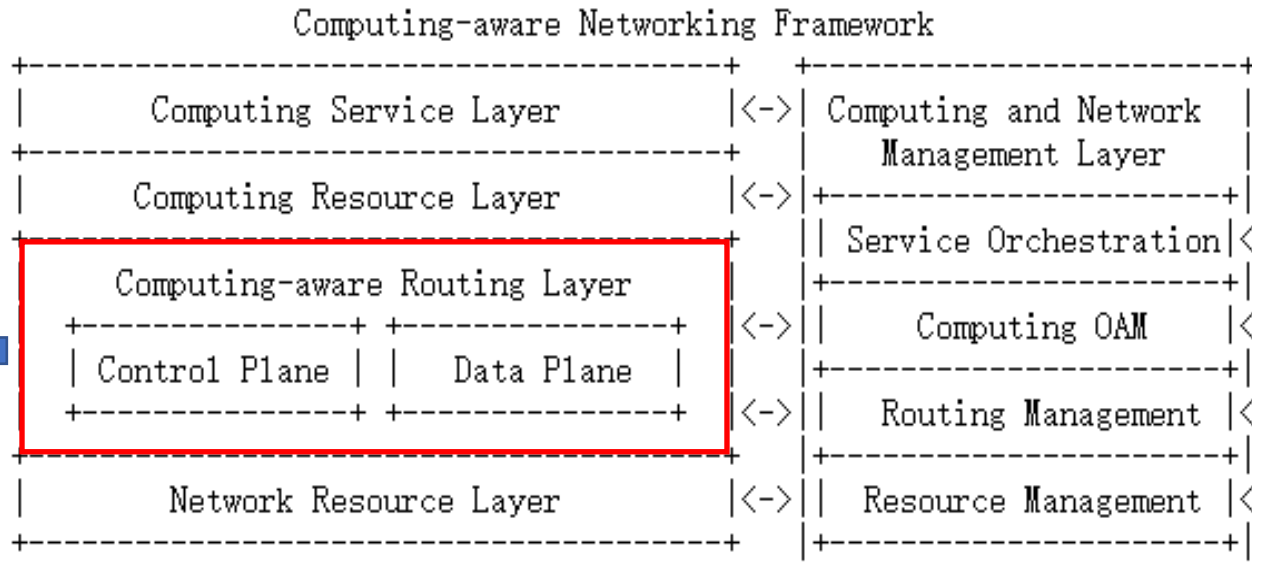
- Training in center cloud, whilst detection in edge DC
- Rendering tasks need to be diverted to GPU infrastructure for better quality
- Traffic/compute offloading for tide effect (Theatre/Sport stadium cases)

# Computing-aware Networking

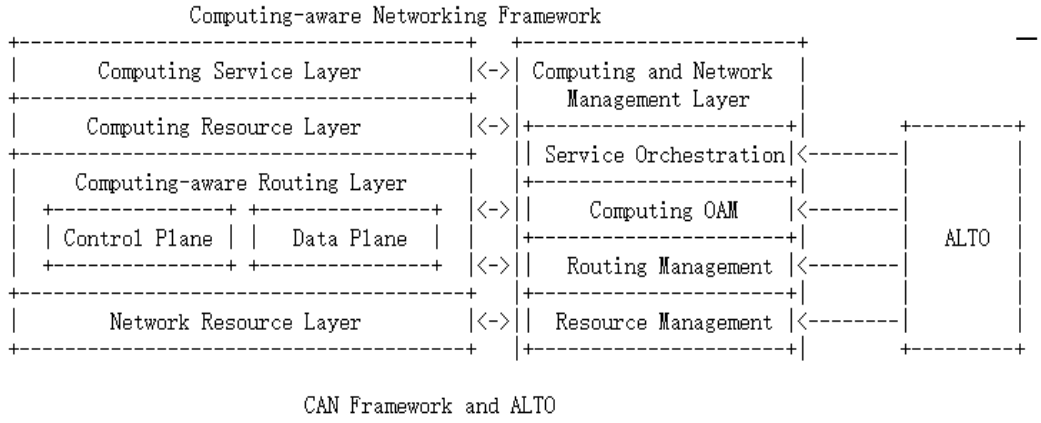
computing-aware networking is proposed based on the ubiquitous network connection and highly-distributed computing resources, it proposes new mechanisms to be aware of the distribution and status of computing resources in network, and combines service orchestration, optimal routing and load balance to schedule the computing and network resources based on the awareness of service request, to improve the  efficiency of the computing and network resources.

---ITU-T Y.CAN-reqts “Functional requirements of computing-aware networking”



# Computing aware networking and alto




CAN Framework and ALTO

– **CAN framework and alto:** computing-aware networking can realize awareness, control and scheduling of computing and network resources, and perform dynamic and on- demand service scheduling. The function of computing and network management layer may be realized by Alto or by opening interface with Alto server.

–**Deployment of CAN with ALTO:** More stable static information should be considered in service deployment, such as: Network topology, computing topology, etc. Unlike the request scheduling , service deployment should still follow the principle of proximity. If the resources are insufficient, the operator can be informed to increase the hardware resources. Alto can be used to transmit information. (similar idea with draft-contreras-alto-service-edge-03)

–**Scheduling of CAN with ALTO:** Scheduling needs to consider more dynamic information such as: Mobility, status of network and computing, service requirements.

–Alto can still help collect real-time network and service node information:

- Providing the best choice of network and service nodes. Based on the collected information and service requirements.
- Providing data analysis and policy distribution, real-time node selection still depends on distributed routing, such as dyncast.

# Questions and Considerations

Satisfy the CAN framework or any components of it might not be the substantial work of ALTO now, but the trend of infrastructure redefinition may bring the new opportunity of ALTO, since it can help to give the suggestion to deploy the service nodes and collected some useful information. If the network can get the computing information, it can also send to the alto server.

- **Questions received from mailing list :**
- Q1:one or multi-protocol to collect network and computing information? And synchronization?
  - multi-protocol will bring the issue of synchronization, which is not easy and cause some additional expenses. (If the network is deterministic network that support synchronization such as detnet, it will be better.)
  - One protocol may be the right way. Extending BGP can be an option, while the frequency is another problem which will be mentioned later.
- Q2:Alto client- decouple alto from a specific CAN architecture.
  - consider a single ALTO Client as part of the Computing and Network Management Layer aggregating all the requests towards the ALTO Server, This also could decouple the solution from a specific CAN architecture

# Questions and Considerations

- Q3:Requirements of “real-time” information and how to shorten the period of information refreshment?
  - “real-time” could be relative and may affect the result of scheduling. If it is good, the scheduling can be more accurate and better meet the application requirements; If the real-time performance is not good, the network or node state may change when the flows arrive, resulting in the demand can not be met.
    - RFC7971:
      - The ALTO service may not know the instantaneous congestion status of the network.
      - The ALTO service may not know all link bandwidths, i.e., where the bottleneck really is, and there may be shared bottlenecks.
      - The ALTO service may not have all information about the actual routing.
  - BGP is an option where RFC7971 shows BGP prefixes, AS numbers, AS distances, or other BGP metrics could be collected,but may not be satisfied for the application with very high delay requirements, so how to improve the performance of BGP or announce the corresponding information through other ways need to be research.
    - The ALTO service may not know whether the candidate endpoint itself is overloaded.

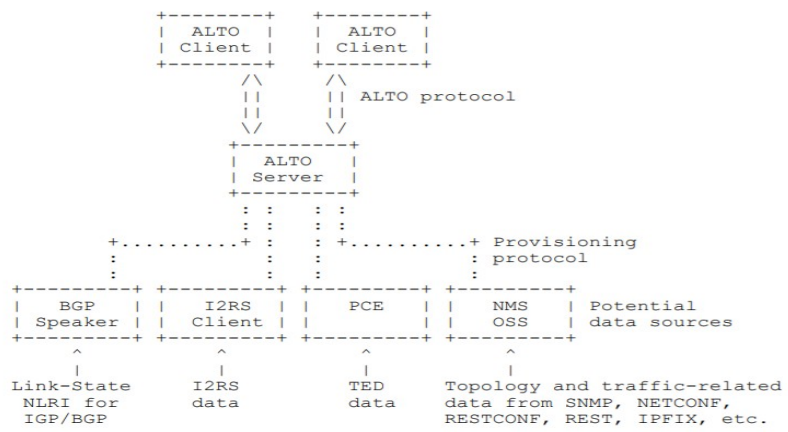


Figure 8: Potential Data Sources for ALTO

Whether the service also need to be scheduled among the endpoint?

Thanks for listening

Welcome for comments