

# Requirements and Resource Reservation of Computing in Network

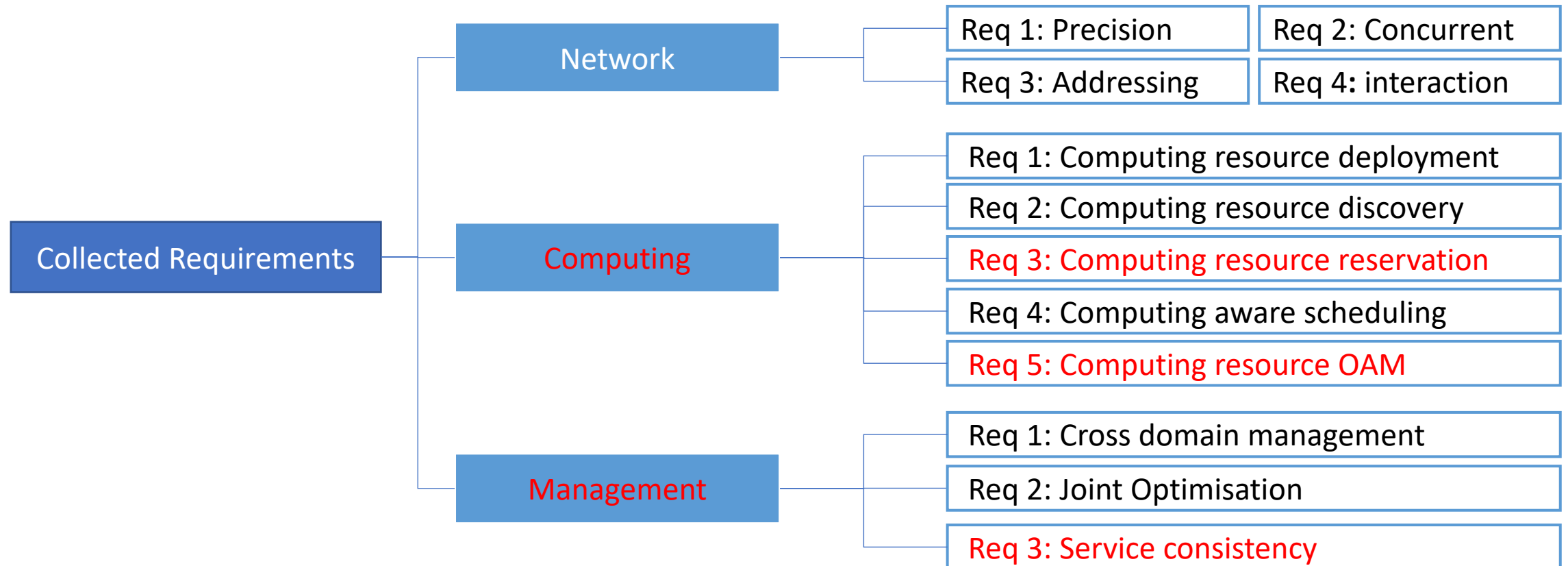
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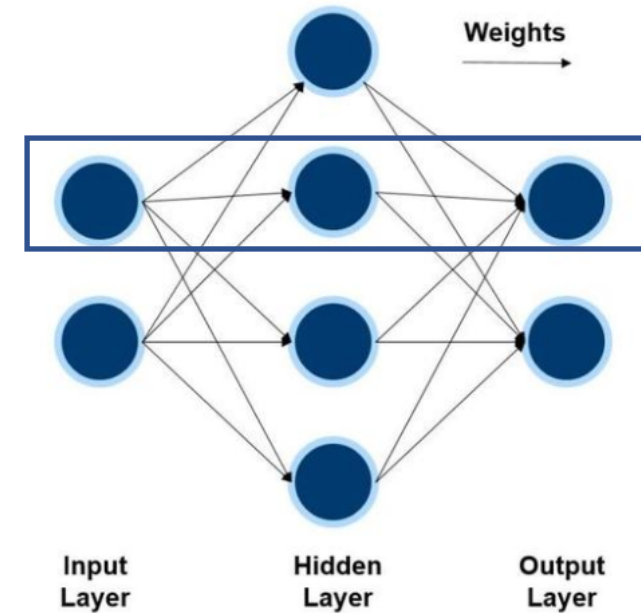
# Major Changes from IETF 107

- [?] Add the requirements of computing and management
- [?] Consider some existing protocol might meet the requirements.



# Computing Req 3: Computing resource reservation

- Network may not only need to reserve bandwidth resource, but also reserve computing resource, to meet the demand of some applications.
- In a serial distributed computing process, different resources need to be reserved for different nodes. The previous iteration will affect the next calculation results, and the computing resources required for each iteration are not the same.
- For example, AI or neural network algorithm has a model of step-by-step iteration among multiple nodes[1], or the SFC may also have the same process.



# Computing Req 5: Computing resource OAM

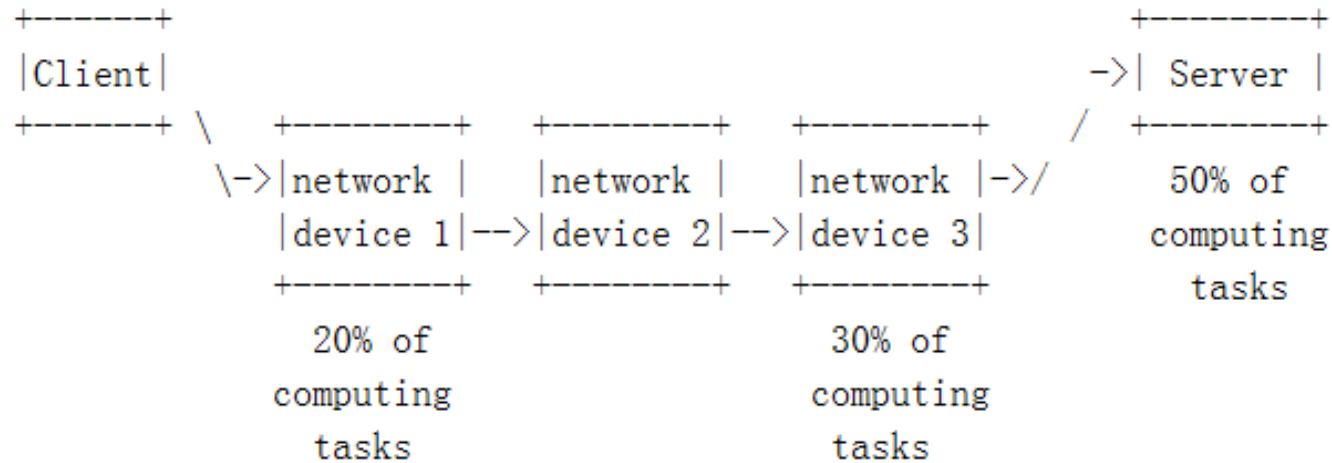
- OAM of computing resource is more complex than network.
- Network monitoring is relatively simple, like bandwidth, latency, jitter
- computing can be divided into many categories, relating to different chip, hardware, storage and app demand[2]...

# Management Req 3: Service consistency

- Many existing applications, such as games, remote video conferencing, are usually multi-accessed and interacted by several users at the same time
- users accessing to the same app need the consistency of SLA, which can be achieved through network manager or application layer controlling.

# Computing resource reservation- Serial distributed model

- A typical example is the artificial intelligence algorithm, which involves the multi-layer convolution iterative process and can be completed by multiple computing device in serial.
- Devices 1 and 3 process part of the computing task, since then, the traffic will also change after passing through devices 1 and 3, so the bandwidth resources to be reserved are different.



# Existing protocol

Existing resource reservation protocols, such as Resource ReSerVation Protocol(RSVP) and Path Computation Element Protocol (PCEP) , can be used to reserve bandwidth resources.

RSVP/RSVP-TE is a traditional protocol, which only focuses on how to initiate the reservation of resources, not the establishment of path.

PCEP was designed to separate the path calculation and path establishment functions of RSVP-TE firstly, which means that the path calculation part before resource reservation can be realized.

Therefore, RSVP and PCEP can be used together or separately.

# Reference Method- Distributed Resource Reservation

The process is as follows:

1. The client sends the path message, carrying the requirements for network (bandwidth, delay, etc.) and Computing (chip, algorithm, etc.) Moreover, the network and computing resources of each node are collected along the path.
2. The server receives the path message and calculates the reserved network and computing resources of each node, returning the message to reserve the resource.

It can be realized by defining new object of RSVP. For example, redefining a new class num as 30, carries the following message body:

```
[L = 0, IPv4, 64, IP address1, bandwidth 1, computing resource 1]
```

```
[L = 0, IPv4, 64, IP address2, bandwidth 2, computing resource 2]
```

```
[L = 0, IPv4, 64, IP address3, bandwidth 3, computing resource 3]
```

```
[L = 0, IPv4, 64, IP address4, bandwidth 4, computing resource 4]
```

# Reference Method- Centralized Resource Reservation

Centralized resource reservation can be realized by the network. The process is as follows:

- The user initiates a service request to the Network manager.
- Network manager selects the path and requires to report the network and computing power information.
- Network manager develop the resource reservation strategy based on the network and computing power information.
- Network manager sends resource reservation configuration to the device.

Object	Label	Reserverd	Interface	In/
Type	ID	Bandwidth	IP Address	Out

PCEP extension

```
module: rs-computing-network
  +--rw rs-computing-network
    +--rw added-device[id]
      | +--rw service id      string
      | +--rw user id        string
      | +--rw bandwitdh      mbps
      | +--rw computing resource  tbd
    +--rw deleted-device[id]
```

Reference yang module tree



# Next steps

- More analysis of technology and research direction of requirements
- Off-line discussion about the related trends and technologies

Comments?

## Reference:

- [1] Scalable training of deep learning machines by incremental block training with intra-block parallel optimization and blockwise model-update filtering(ICASSP),IEEE, 2016.
- [2] The Case For In-Network Computing On Demand, EuroSys Conference 2019
- [3] In-Network Computing and Next Generation HDR 200G InfiniBand, 2019