Bureau d'étude
Qualité de service dans l'internet

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Summary

1. Introduction
2. Objectives
3. Our choices
4. Work overview
5. Demonstration
6. Conclusion

Introduction

Project organisation

- International team of 5 people
- 2 Tutorial classes
- 3 Labs
- 1 Final integration day

Objectives

We need to ensure :

- Connectivity between hosts on all client's sites
- QoS for VoIP applications

Two network management aproachs :

- Static for the core network
- Dynamic for QoS requests

Our choices

- Core network using MPLS
- VPN-IP tunnel for establishing connection between client's sites
- Bandwidth Broker is a Python web application
- CEs configurations are done via ssh
- Proxy SIP exchange with the BB via http requests

Core Network

We used

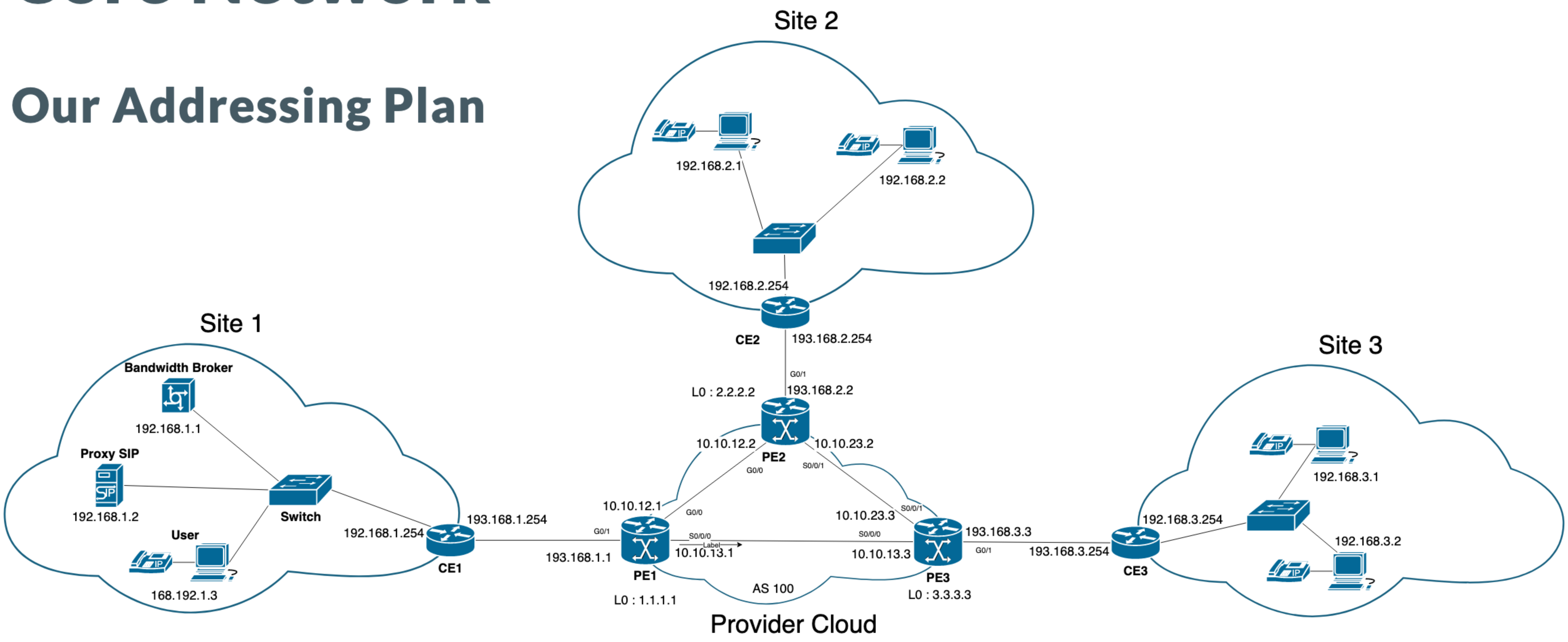
- Cisco Router for PE
- Linux Router for CE
- Switch to connect client's hosts

We setup

- MPLS cloud with OSPF & LDP
- VPN-IP
  - BGP between PE
  - vrf on every PE
- PHB on every core router to ensure QoS

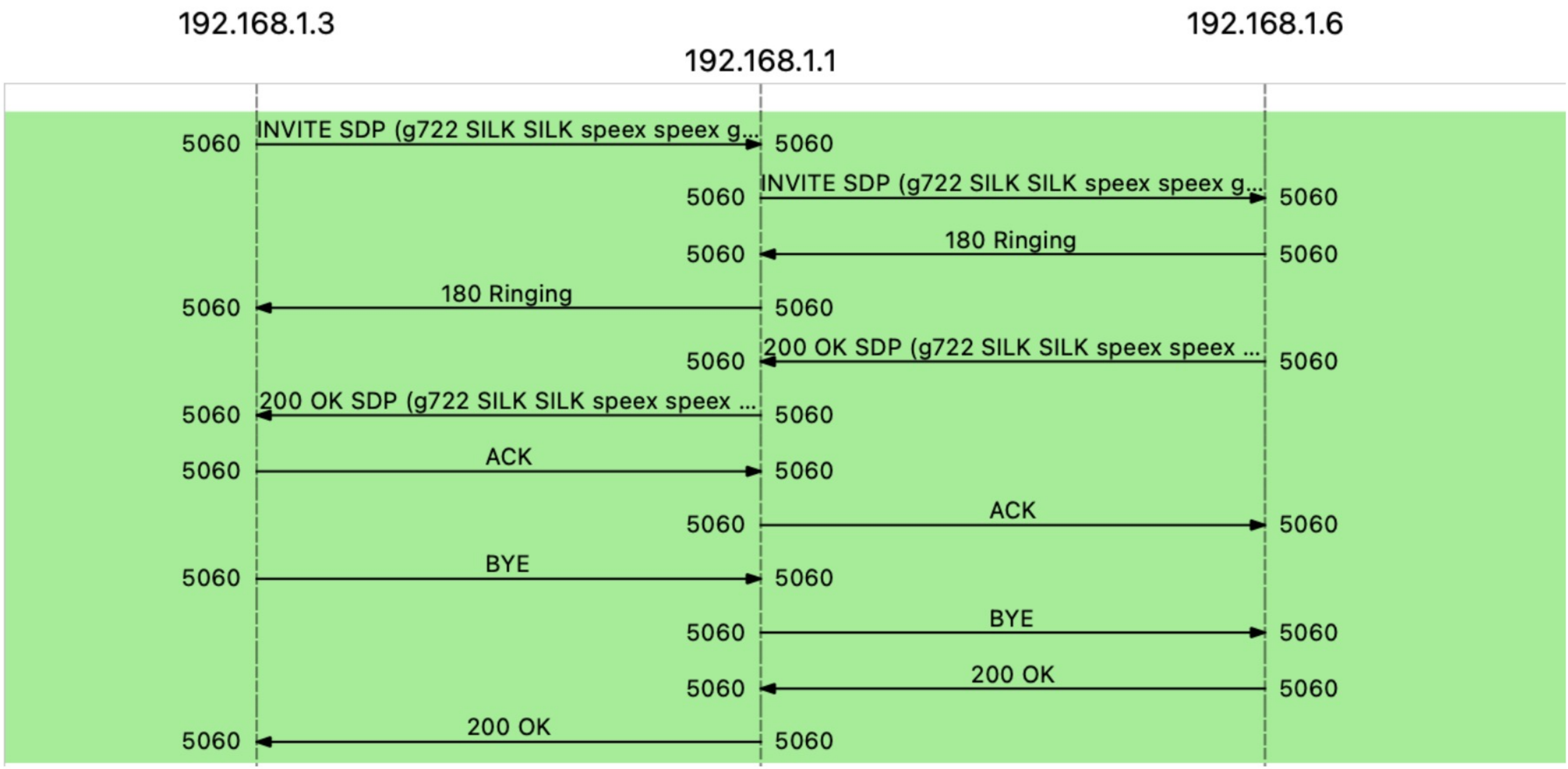
Core Network

Our Addressing Plan

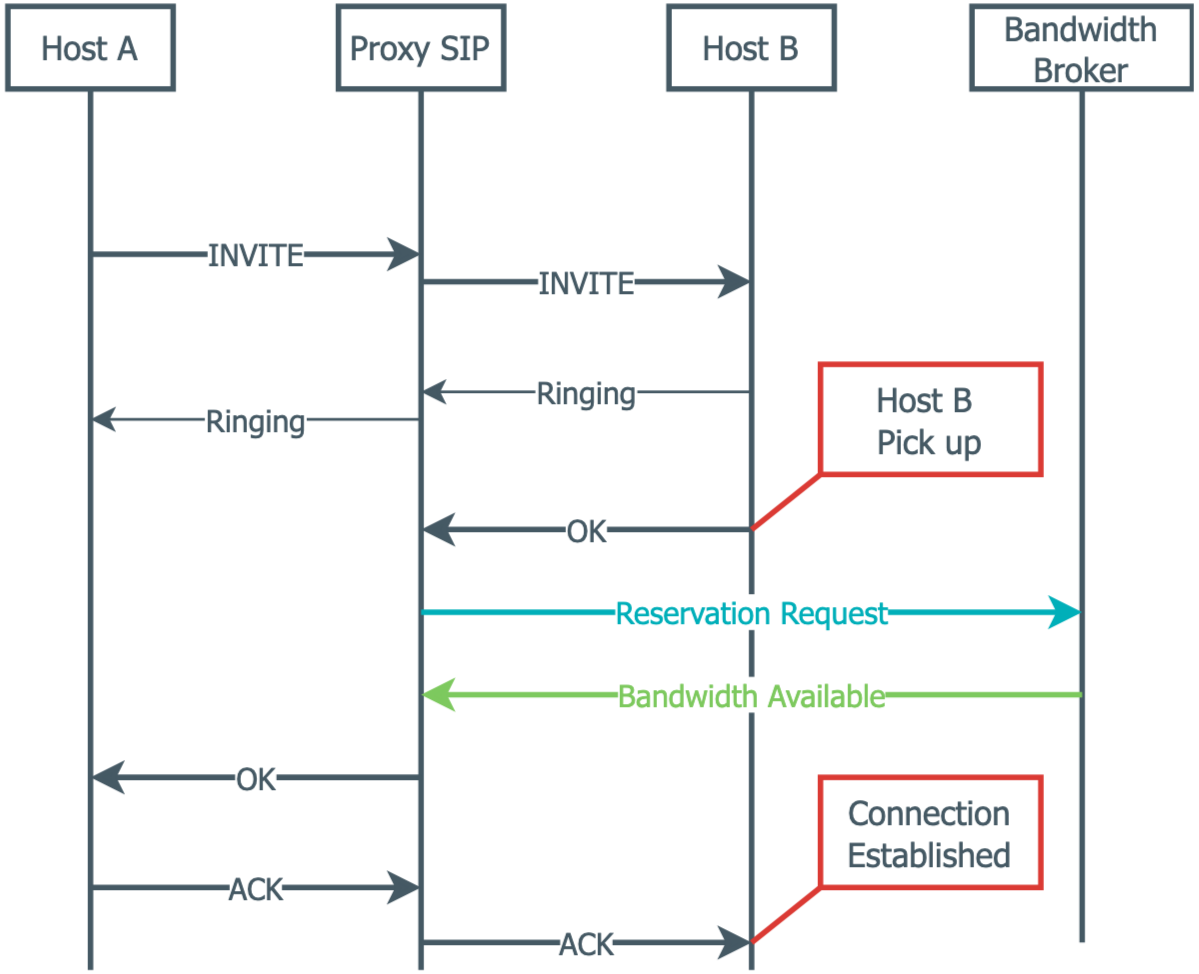


Proxy SIP

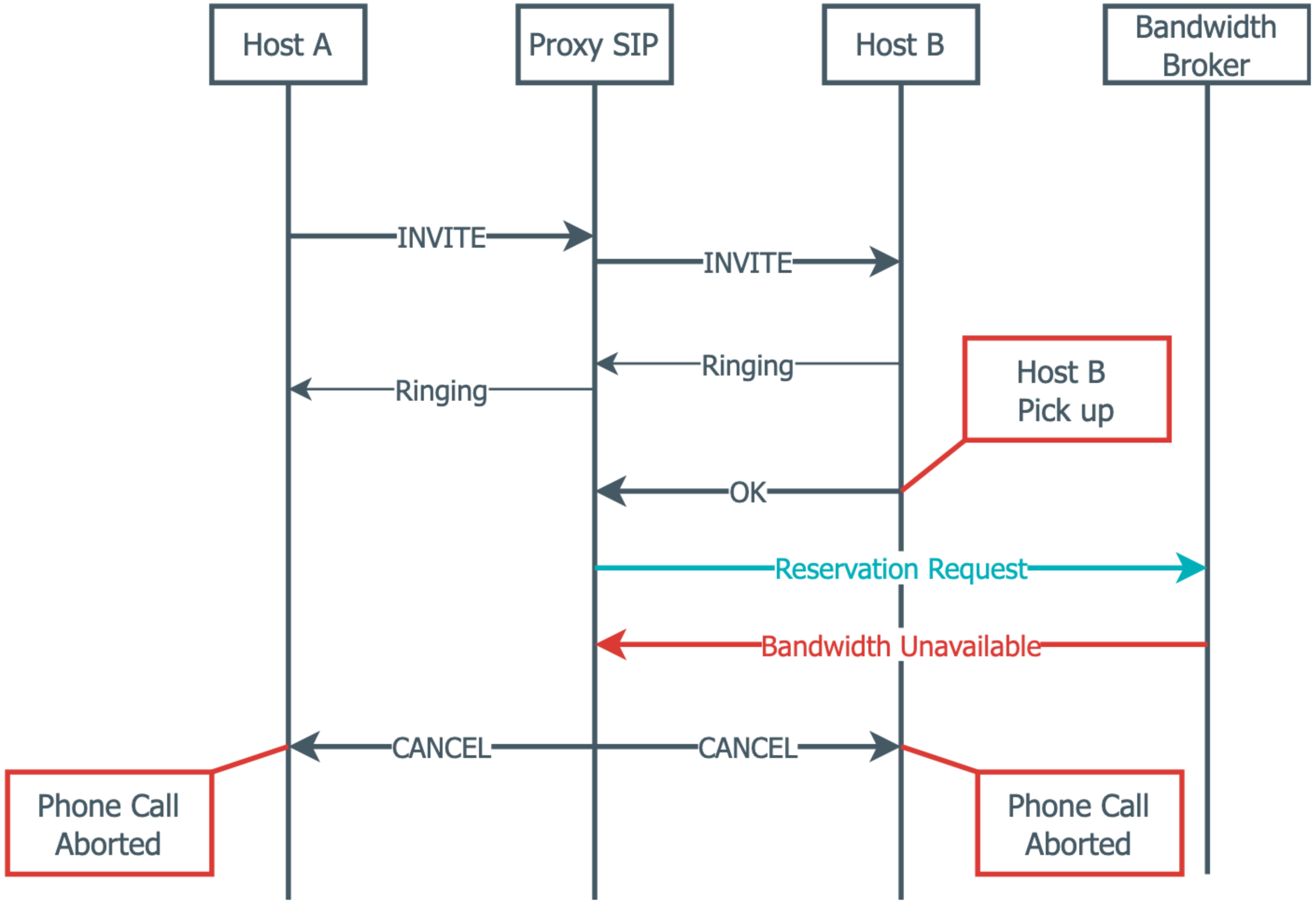
- WireShark capure during labs



Proxy SIP

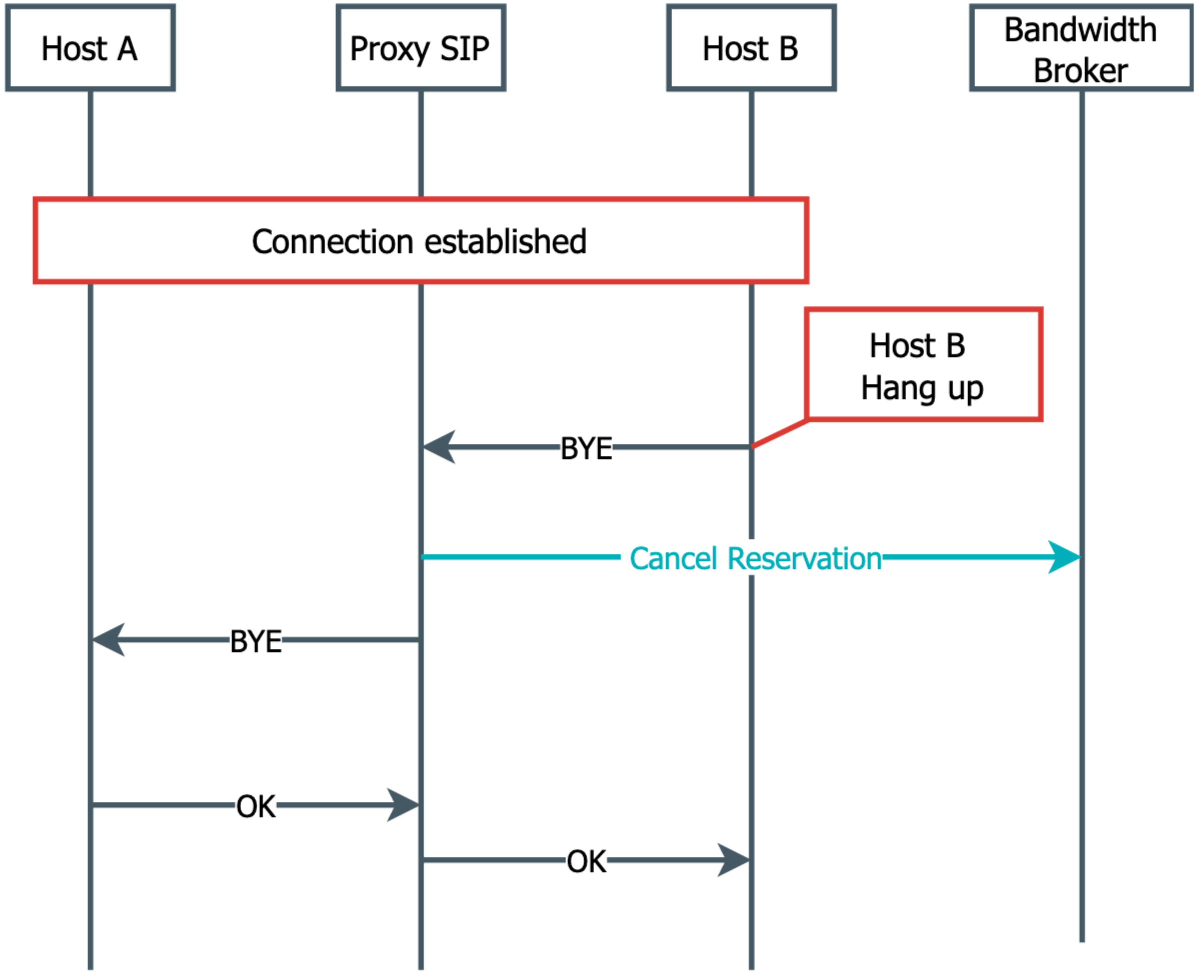

Host A
Proxy SIP
Host B
Bandwidth Broker
INVITE
INVITE
Ringing
Ringing
Host B Pick up
OK
Reservation Request
Bandwidth Available
OK
Connection Established
ACK
ACK

Proxy SIP



Host A
Proxy SIP
Host B
Bandwidth Broker
INVITE
INVITE
Ringing
Ringing
Host B Pick up
OK
Reservation Request
Bandwidth Unavailable
CANCEL
CANCEL
Phone Call Aborted
Phone Call Aborted

Proxy SIP


Host A
Proxy SIP
Host B
Bandwidth Broker
Connection established
Host B Hang up
BYE
Cancel Reservation
BYE
OK
OK

Proxy SIP

Insert request to the BB inside Proxy code

```
process ReponseStatelessly()
    // [...]
    if (cseqHeader.getMethod().equals("INVITE")) {
        SIPREsponse sr = (SIPREsponse) response
    }
```

- The part we struggled the most on 😢

Comminication Proxy SIP <-> BB

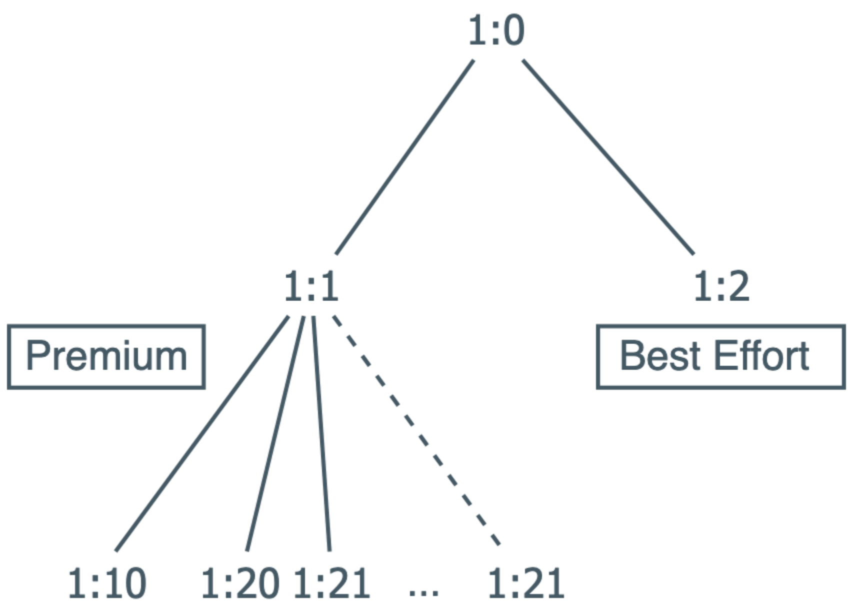
GET request with Json atached

- Exemple of Json for a reservation

```json
{
    "id":"Resa_1",
    "streams" : [
        {
            "portDest" : "1234",
            "addrDest" : "192.168.1.1",
            "portSrc" :"1234",
            "addrSrc" : "192.168.2.1"
        },
        {
            "portDest" : "1234",
            "addrDest" : "192.168.2.1",
            "portSrc" :"1234",
            "addrSrc" : "192.168.1.1"
        }
    ],
    "tspec": 100
}
```

Trafic classification

- Creation of a Hierachical Token Bucket
  - Best effort
  - Premium trafic
- We use iptable to set DSCP field



Bandwidth Broker

Initialisation

```
# Create CEs
CE1= CE('CE1', '192.168.1.2')
CE2= CE ('CE2', '193.168.2.22')
CE3= CE ('CE3', '193.168.3.33')

# Create SLAs
SLA1 = SLA(id='SLA1', clientNetwork=IPv4Network('192.168.1.0/24'), CE=CE1, capacity=1000)
SLA2 = SLA(id='SLA2', clientNetwork=IPv4Network('192.168.2.0/24'), CE=CE2, capacity=1000)
SLA3 = SLA(id='SLA3', clientNetwork=IPv4Network('192.168.3.0/24'), CE=CE3, capacity=1000)

client_SLAs=[SLA1,SLA2,SLA3]
Active_Reservations=[]
Deleted_Reservations=[]
Failed_Reservations=[]
```

Bandwidth Broker

Initial CE configuration

```
def getInitConfig(CE):
    '''
        Return the list of commands to send to the router to unprotect all stream in streams
    '''
    config_commands =[]
    # Create the HTB structure
    config_commands.append(f'tc qdisc del dev {CE.interface} root')
    config_commands.append(f'tc qdisc add dev {CE.interface} root handle 1: htb default 2')
    config_commands.append(f'tc class add dev {CE.interface} parent 1: classid 1:1 htb rate {CE.premium_br}kbit ceil {CE.premium_br}kbit')
    config_commands.append(f'tc class add dev {CE.interface} parent 1: classid 1:2 htb rate 0kbit ceil {CE.premium_br}kbit')
    config_commands.append(f'tc class add dev {CE.interface} parent 1:1 classid 1:10 htb rate {CE.control_br}kbit ceil {CE.premium_br}kbit')
    # Put packet with mark=11 in the control queue
    config_commands.append(f'tc filter add dev {CE.interface} parent 1:0 protocol ip prio 1 handle 11 fw flowid 1:10')
    # Set mark = 11 for packet addessed to 192.168.1.2 = Proxy SIP
    config_commands.append(f'iptables -A PREROUTING -t mangle -d 192.168.1.2 -j MARK --set-mark 11')
    #Set the DSCP field to ensure QoS in core network
    config_commands.append(f'iptables -A POSTROUTING -t mangle -d 192.168.1.2 -j DSCP --set-DSCP EF')

    return config_commands
```

Bandwidth Broker

Reservation handeler

```
@app.route('/ask-resa', methods=['GET'])
def ask_resa():
    request_data = request.get_json()
    # [...]
    if request_data:
        # [...]
        new_resa=Resa(id=id, streams=streams, tspec=tspec,client_SLAs=client_SLAs) # Create a reservation
        resa_OK = new_resa.askResa() # Check if the reservation is possible
        if resa_OK :  # Respond to the request accordingly
            Active_Reservations.append(new_resa)
            return str(resa_OK)
        else :
            Failed_Reservations.append(new_resa)
            return 'Reservation failed', 400
    return 'Bad request', 400
```

Bandwidth Broker

CE configuration on new reservation

```python
def getBookingConfig(CE,streams, tspec):
    '''
        Return the list of commands to send to the router to protect all stream based on the tspec requested
    '''
    config_commands =[]
    # Create a new queue
    config_commands.append(f'tc class add dev {CE.interface} parent 1:1 classid 1:{CE.next_queue_id} htb rate {tspec}kbit ceil {tspec * 1.5}kbit')
    # Association mark <-> queue
    config_commands.append(f'tc filter add dev {CE.interface} parent 1:0 protocol ip prio 1 handle 11 fw flowid 1:{CE.next_queue_id}')
    for stream in streams :
        if CE.ipAddress.network == stream.addrSrc.network :
            # Set the MARK based on destination address
            config_commands.append(f'iptables -A PREROUTING -t mangle -d {stream.addrDest.ip} -j MARK --set-mark 11')
            # Set the DSCP field to ensure QoS in core network
            config_commands.append(f'iptables -A POSTROUTING -t mangle -d {stream.addrDest.ip} -j DSCP --set-DSCP EF')

    return config_commands
```

Bandwidth Broker

Cancel a reservation

```
@app.route('/remove-resa', methods=['GET'])
def remove():
    request_data = request.get_json()
    # [...]
    if request_data:
        if 'streams' in request_data:
            streams = getStreamsfromJson(request_data['streams'])
            matching_resa = find_matching_resa(streams,Active_Reservations) #
        if matching_resa != None :
            matching_resa.cancelResa()
            Active_Reservations.remove(matching_resa)
            Deleted_Reservations.append(matching_resa)
            return f'{matching_resa.id} has been remove'
        else:
            return 'No reservation with matching streams', 400

    return 'Bad request', 400
```

Demonstration

🙏

Conclusion

What we manage to do

- Create an MPLS core network
- Dynamicly protect streams base on @IPdest
- Create a dashboard to monitor network's state

Possible amelioration

- Better integration with the Proxy
- Test traffic control and iptable configuration
- What about a multi domain internet ?