# Open-Source AAA for IPOE and PPPOE Solution

**System Administration Department**

**Sukhbaatar.E**

# Necessity of the IPOE and PPPOE solution

## Challenge

- To integrate a BSS with a Huawei BNG router for AAA broadband users.
- HA Reliable, Open-Source solution.
- Need to manage the IPOE and PPPOE from one MW system.
- **No budget allocated**

## Solution

1. Develop APIs for the BSS
2. Change the FreeRADIUS v3 filters and table structure
3. Set attributes for the Huawei BNG router
4. Set up the redundancy using VRRP
5. Replication, a cluster system for DB
6. Monitoring System

## Open-Source Cluster

- FreeRadius v3
- Rest API in Node JS
- Keepalived service for VRRP
- Galera Cluster MariaDB

# BSS and Internet service

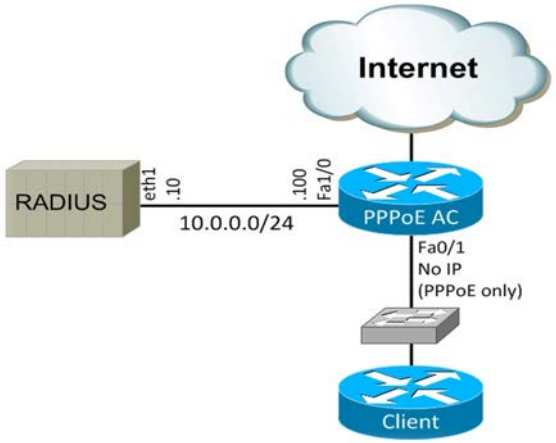
BSS

Rest API

Rest API

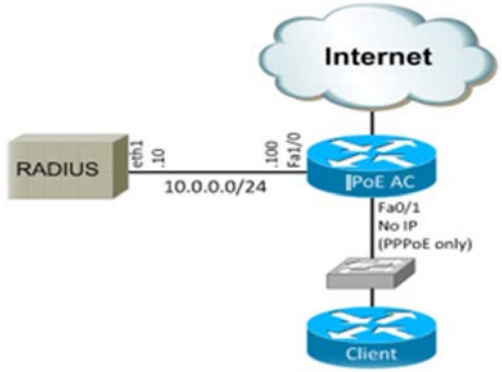
## PPPoE

- Create user (BB00001)
- Generate a Password
- Set Bandwidth (speed)
- Speed policy based on group (shared)



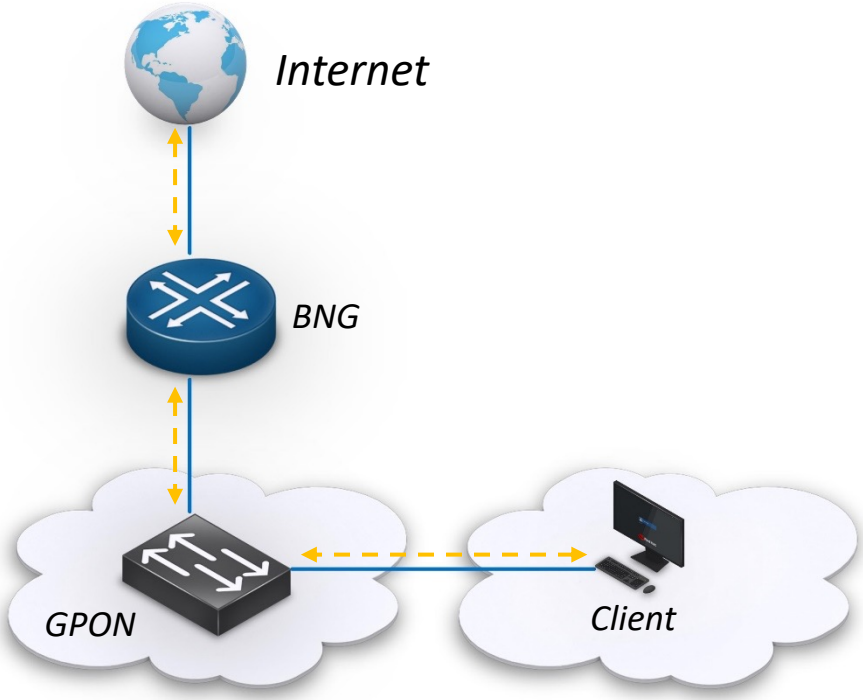

## IPOE

- Create user (IP+VLAN+domain)
- Generate a password
- Set Bandwidth (speed)
- Speed policy based on bitrate and group (dedicated and shared)



# AAA Before and NOW

- ✓ Provisioning: BSS can control user information and manage dedicated IP addresses using the REST API.
- ✓ Standard: Standard connection, and secure Broadband service…
- ✓ Experience: Migrated all broadband users without interruption…




112.72.X.X
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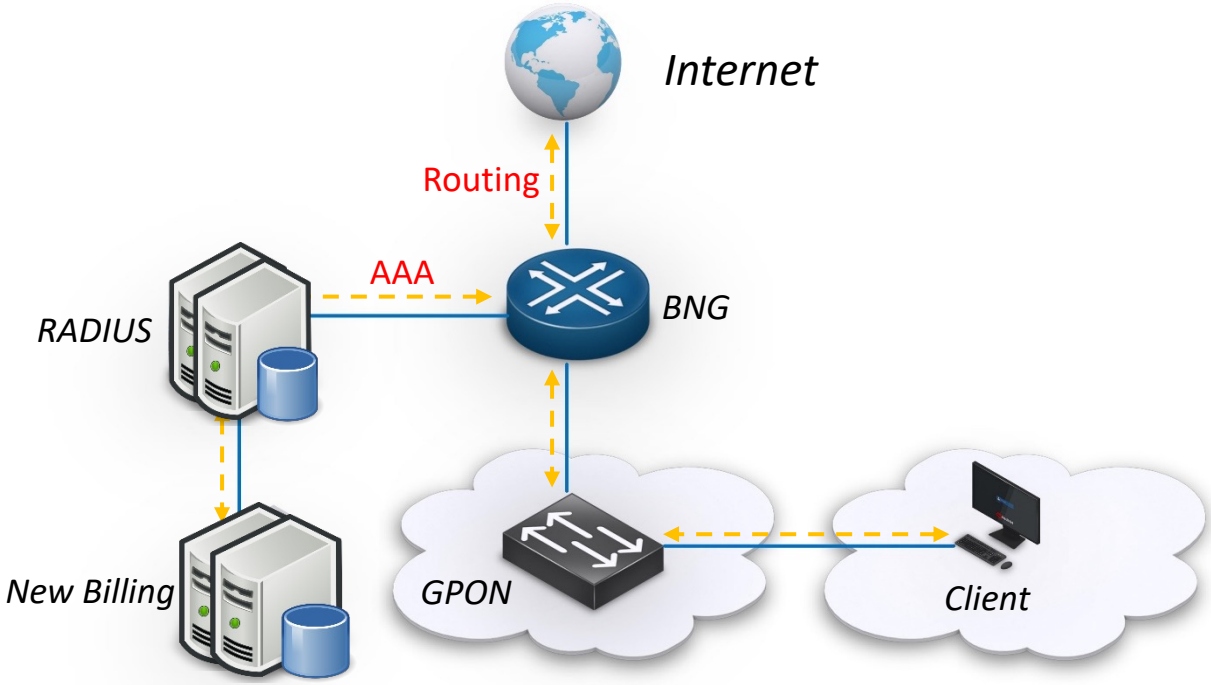
112.72.X.X
112.72.X.X




112.72.X.X09X29X@radius2

# How We Do It ☺

## ✓ Rest API Developing…

root@radius1:/home/radadmin

```
 *         description: Internal Server Error
 */
router.get('/get-user/:username', (req, res) => {

    const userName = req.params.username

    const queryString = "SELECT id,username,attribute,op,value,contnum FROM radcheck WHERE username = ?"
    getConnection.query(queryString, [userName], (err, rows, fields) => {
        if (err) {
            console.log("Failed to query for " + err)
            res.sendStatus(500)
            return;
        }
        if (rows.length === 0) {
            return res.status(404).json({ error: 'User not found' });
        }

        console.log("Successfully loaded user")

        const users = rows.map((row) => {
            return { Userid: row.id, username: row.username, status: row.attribute, op: row.op, password:
        })

        res.json(users)
    })
})

//for Ent//

router.get('/get-contract/:contnum', (req, res) => {

    const contNum = req.params.contnum

    const queryString = "SELECT id,username,attribute,op,value,contnum FROM radcheck WHERE contnum = ?"
    getConnection.query(queryString, [contNum], (err, rows, fields) => {
        if (err) {
            console.log("Failed to query for " + err)
            res.sendStatus(500)
            return;
        }
        if (rows.length === 0) {
            return res.status(404).json({ error: 'Contract not found' });
        }

        console.log("Successfully loaded user")

        const users = rows.map((row) => {
            return { Userid: row.id, username: row.username, status: row.attribute, op: row.op, password:
        })

        res.json(users)
```

## ✓ Table Structure … (We can handle all provisions by contnum)

| id | username | | attribute | op | value | contnum |
|---|---|---|---|---|---|---|
| 289 | 112.72.1 | )0@radius2 | Cleartext-Password | := | | LL121689 |
| 291 | 112.72.1 | )0@radius2 | Cleartext-Password | := | | LL121689 |
| 293 | 112.72.1 | )@radius2 | Cleartext-Password | := | | LL121689 |
| 295 | 112.72.1 | )@radius2 | Cleartext-Password | := | | LL121689 |
| 299 | 112.72.1 | )@radius2 | Cleartext-Password | := | | LL121689 |
| 551 | 112.72.1 | )@radius2 | Cleartext-Password | := | | MLL122694 |
| 555 | 112.72.1 | )@radius2 | Cleartext-Password | := | | MLL122695 |
| 559 | 112.72.1 | )@radius2 | Cleartext-Password | := | | MLL122697 |
| 627 | 112.72.1 | )@radius2 | Cleartext-Password | := | | MLL122691 |
| 633 | 112.72.1 | )0@radius2 | Cleartext-Password | := | | MLL20240827 |
| 635 | 112.72.1 | )0@radius2 | Cleartext-Password | := | | MLL20240827 |
| 637 | 112.72.1 | )0@radius2 | Cleartext-Password | := | | MLL20240827 |
| 639 | 112.72.1 | )0@radius2 | Cleartext-Password | := | | MLL20240827 |
| 641 | 112.72.1 | )0@radius2 | Cleartext-Password | := | | MLL20240827 |
| 643 | 112.72.1 | )@radius2 | Cleartext-Password | := | | MLL20240827 |
| 645 | 112.72.1 | )@radius2 | Cleartext-Password | := | | MLL20240827 |
| 647 | 112.72.1 | )@radius2 | Cleartext-Password | := | | MLL20240827 |
| 649 | 112.72.1 | )@radius2 | Cleartext-Password | := | | MLL20240827 |
| 651 | 112.72.1 | )@radius2 | Cleartext-Password | := | | MLL20240827 |
| 659 | 112.72.9 | )@radius2 | Cleartext-Password | := | | MLL7579 |
| 663 | 112.72.6 | )@radius2 | Canceled | := | | MLL93096 |
| 665 | 112.72.8 | )@radius2 | Cleartext-Password | := | | MLL95570 |
| 667 | 112.72.1 | )0@radius2 | Cleartext-Password | := | | MLL115290 |
| 669 | 112.72.9 | @radius2 | Cleartext-Password | := | | MLL89861 |
| 671 | 112.72.9 | )@radius2 | Cleartext-Password | := | | MLL112784 |
| 675 | 112.72.9 | )@radius2 | Cleartext-Password | := | | MLL54113 |
| 691 | 112.72.8 | )@radius2 | Cleartext-Password | := | | MLL108827 |
| 693 | 112.72.6 | )@radius2 | Cleartext-Password | := | | MLL120905 |
| 695 | 112.72.6 | @radius2 | Cleartext-Password | := | | MLL5071 |
| 697 | 112.72.1 | )0@radius2 | Cleartext-Password | := | | MLL126251 |
| 699 | 112.72.6 | )@radius2 | terminate-2025/04/29 | := | | MLL106811 |
| 701 | 112.72.2 | @radius2 | terminate-2025/04/29 | := | | MLL63985 |
| 703 | 112.72.1 | )0@radius2 | Cleartext-Password | := | | MLL127733 |
| 705 | 112.72.8 | @radius2 | Cleartext-Password | := | | MLL117659 |
| 707 | 112.72.1 | )0@radius2 | Cleartext-Password | := | | MLL121197 |
| 709 | 112.72.9 | )@radius2 | Cleartext-Password | := | | MLL61477 |
| 711 | 112.72.2 | @radius2 | owb-2025/05/22 | := | | MLL110053 |
| 713 | 112.72.2 | )@radius2 | Cleartext-Password | := | | MLL106880 |
| 715 | 112.72.2 | )@radius2 | Canceled | := | | MLL65483 |
| 717 | 112.72.2 | )@radius2 | Cleartext-Password | := | | MLL47781 |

## ✓ API Working result

POST )3000/ipuser-create/

Params Authorization Headers (8) Body Scripts

none form-data x-www-form-urlencoded raw

```
{
    "username": "112.72.:                    )0@radius2",
    "password":
    "contnum": "MLL20250517",
    "groupname": "",
    "radreply": "1050000"
}
```

**Contnum is Contract number of subscribers**

Not secure :3000/get-c

IT инженер хүн эзэ...

Pretty-print

```
[
  {
    "Userid": 3866,
    "username": "112.72.          2900@radius2",
    "status": "Cleartext-Password",
    "op": ":=",
    "password": "
    "contractnum": "MLL20250517"
  }
]
```

# Freeradius v3 configuration (Filter & Policy change)

```
#
#       Example of forbidding all attempts to login via
#       realms.
#
deny_realms {
        if (&User-Name && (&User-Name =~ /*|\\/)) {
                reject
        }
}

#
#       Filter the username
#
#  Force some sanity on User-Name. This helps to avoid issues
#  issues where the back-end database is "forgiving" about
#  what constitutes a user name.
#
filter_username {
        if (&User-Name) {
                #
                #  reject mixed case e.g. "UseRNaMe"
                #
                #if (&User-Name != "%{tolower:%{User-Name}}") {
                #       reject
                #}

                #
                #  reject all whitespace
                #  e.g. "user@ site.com", or "us er", or " user", or "user "
                #
                if (&User-Name =~ / /) {
                        update request {
                                &Module-Failure-Message += 'Rejected: User-Name contains whitespace'
                        }
                        reject
                }

                #
                #  reject Multiple @'s
                #  e.g. "user@site.com@site.com"
                #
                 #if (&User-Name =~ /@[^@]*@/ ) {
                 #      update request {
                 #              &Module-Failure-Message += 'Rejected: Multiple @ in User-Name'
                 #      }
                 #      reject
                 #}

                #
                #  reject double dots
                #  e.g. "user@site..com"
                #
                 #if (&User-Name =~ /\.\./ ) {
                 #      update request {
                 #              &Module-Failure-Message += 'Rejected: User-Name contains multiple ..s'
                 #      }
                 #      reject
                 #}

                #
                #  must have at least 1 string-dot-string after @
                #  e.g. "user@site.com"
"filter" 210L, 4794C
```

## Policy → Filter

- Skip username filters because IPOE username contains “.” and @ (112.72.x.xCEVLANPEVLAN@domain)

# Keepalived (VRRP) and BNG even MAC

## Keepalived configure

- Keepalived (VRRP) service for the redundancy of RADIUS system.

```
! Configuration File for keepalived

global_defs {
   router_id esb_lb
        enable_script_security
        script_user root
}

vrrp_instance VI_1 {
    state MASTER
    interface ens35
    virtual_router_id 51
    priority 100
    advert_int 1
    authentication {
        auth_type PASS
        auth_pass PASSWORD
    }
    virtual_ipaddress {
        IPADDRESS/24
    }
        notify "/etc/keepalived/notify-script.sh"
}

virtual_server IPADDRESS 1812 {
    delay_loop 3
    lb_algo rr
    lb_kind NAT
    persistence_timeout 3600
    protocol UDP

    real_server IPADDRESS 1812 {
        weight 1
        UDP_CHECK {
            connect_timeout 3
            retry 3
            delay_before_retry 3
    }
  }
}

    real_server IPADDRESS 1812 {
        weight 1
        UDP_CHECK {
            connect_timeout 3
            retry 3
            delay_before_retry 3
    }
  }
}

virtual_server IPADDRESS 1813 {
    delay_loop 3
    lb_algo rr
    lb_kind NAT
    persistence_timeout 3600
    protocol UDP

    real_server IPADDRESS 1813 {
        weight 1
        UDP_CHECK {
            connect_timeout 3
```

# BNG router configuration

```
interface Eth-Trunk12.58
 description To:SKM_DC
 ipv6 enable
 ipv6 address auto link-local
 statistic enable
 user-vlan 300 800 qinq 1016
 user-vlan 300 800 qinq 1145 1160
 user-vlan 300 800 qinq 1241 1248
 user-vlan 300 800 qinq 1281 1296
 user-vlan 300 800 qinq 1329 1336
 user-vlan 300 800 qinq 1625 1632
 bas
 #
  access-type layer2-subscriber default-domain authentication skymedia
  access-delay 100 even-mac
 #
#
```

## Radius config

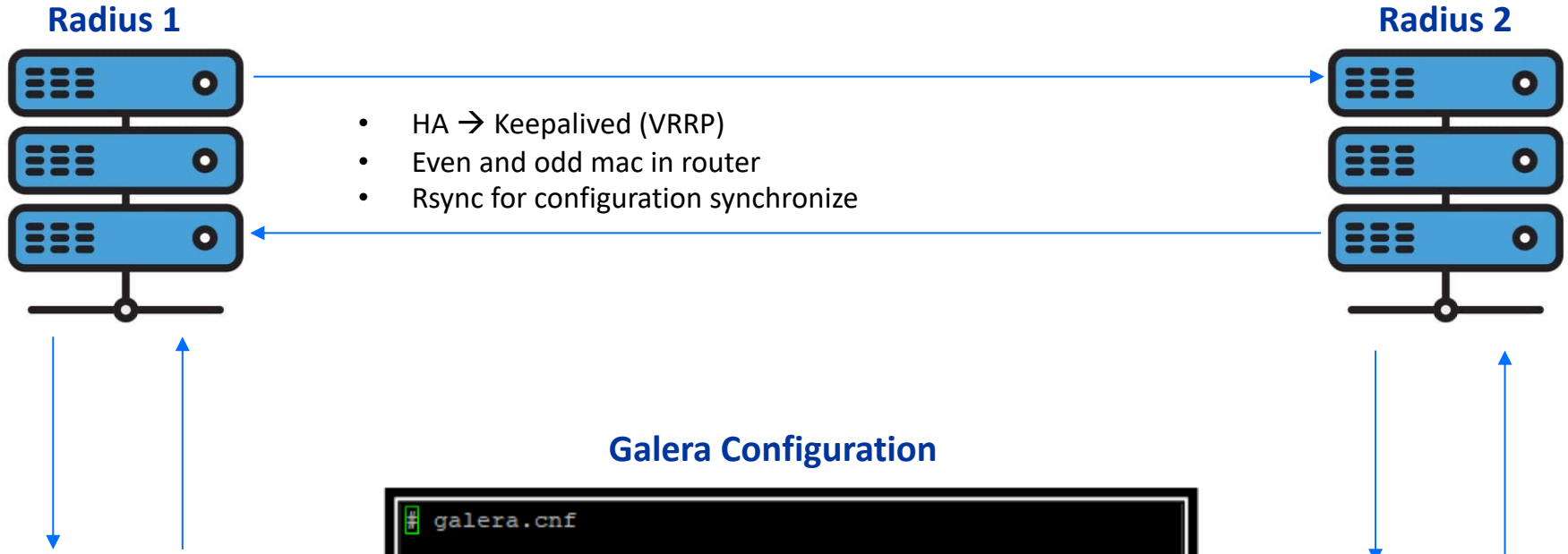
- Radius 1 connected router 1 and Radius 2 connected router 2.
- If router 1 goes down, all requests will go to router 2
- If Radius 1 goes down, Radius 2 can handle all requests by keepalived.

## Even and odd MAC

- Even MAC and odd MAC for the distinguished requests for radius 1 and radius 2.

```
interface Eth-Trunk22.58
 description To:SKM_DC
 ipv6 enable
 ipv6 address auto link-local
 statistic enable
 user-vlan 300 800 qinq 1016
 user-vlan 300 800 qinq 1145 1160
 user-vlan 300 800 qinq 1241 1248
 user-vlan 300 800 qinq 1281 1296
 user-vlan 300 800 qinq 1329 1336
 user-vlan 300 800 qinq 1625 1632
 bas
 #
  access-type layer2-subscriber default-domain authentication skymedia
  access-delay 100 odd-mac
 #
#
```

# MariaDB Galera cluster




## Galera Configuration

```
# galera.cnf

[mysqld]
bind-address=0.0.0.0
binlog_format=row
default-storage-engine=innodb
innodb_autoinc_lock_mode=2

# Galera-specific settings
[galera]
wsrep_on=ON
wsrep_provider=/usr/lib64/galera/libgalera_smm.so
wsrep_cluster_name="radcluster"
wsrep_cluster_address="gcomm://1address,1address"
wsrep_node_address="1address"
wsrep_node_name="raddb1"
wsrep_sst_method=rsync
```

# Contract number column in radiusDB

| id | username | attribute | op | value | contnum |
|---|---|---|---|---|---|
| 289 | 112.72 @radius2 | Cleartext-Password | := | | LL121689 |
| 291 | 112.72 @radius2 | Cleartext-Password | := | | LL121689 |
| 293 | 112.72 @radius2 | Cleartext-Password | := | | LL121689 |
| 295 | 112.72 @radius2 | Cleartext-Password | := | | LL121689 |
| 299 | 112.72 @radius2 | Cleartext-Password | := | | LL121689 |
| 551 | 112.72 @radius2 | Cleartext-Password | := | | MLL122694 |
| 555 | 112.72 @radius2 | Cleartext-Password | := | | MLL122695 |
| 559 | 112.72 @radius2 | Cleartext-Password | := | | MLL122697 |
| 627 | 112.72 @radius2 | Cleartext-Password | := | | MLL122691 |
| 633 | 112.72 @radius2 | Cleartext-Password | := | | MLL20240827 |
| 635 | 112.72 @radius2 | Cleartext-Password | := | | MLL20240827 |
| 637 | 112.72 @radius2 | Cleartext-Password | := | | MLL20240827 |
| 639 | 112.72 @radius2 | Cleartext-Password | := | | MLL20240827 |
| 641 | 112.72 @radius2 | Cleartext-Password | := | | MLL20240827 |
| 643 | 112.72 @radius2 | Cleartext-Password | := | | MLL20240827 |
| 645 | 112.72 @radius2 | Cleartext-Password | := | | MLL20240827 |
| 647 | 112.72 @radius2 | Cleartext-Password | := | | MLL20240827 |
| 649 | 112.72 @radius2 | Cleartext-Password | := | | MLL20240827 |
| 651 | 112.72 @radius2 | Cleartext-Password | := | | MLL20240827 |
| 659 | 112.72 @radius2 | Cleartext-Password | := | | MLL7579 |
| 663 | 112.72 @radius2 | Canceled | := | | MLL93096 |
| 665 | 112.72 @radius2 | Cleartext-Password | := | | MLL95570 |
| 667 | 112.72 @radius2 | Cleartext-Password | := | | MLL115290 |

| id | groupname | attribute | op | value |
|---|---|---|---|---|
| 141 | ipoe_0313 | Framed-Protocol | := | PPP |
| 143 | ipoe_0313 | Service-Type | := | Framed-User |
| 145 | ipoe_0313 | Session-Timeout | += | 259200 |
| 150 | ipoe_0313 | Huawei-Policy-Name | := | 10000K_up |
| 152 | ipoe_0313 | Huawei-Input-Peak-Rate | := | 10500000 |
| 154 | ipoe_0313 | Huawei-Output-Peak-Rat | := | 10500000 |
| 156 | ipoe_0313 | Huawei-Domain-Name | = | radius2 |
| 158 | ipoe_0313 | Fall-Through | := | Yes |
| 168 | ipoe_30M | Framed-Protocol | := | PPP |
| 170 | ipoe_30M | Service-Type | := | Framed-User |
| 172 | ipoe_30M | Session-Timeout | := | 259200 |
| 174 | ipoe_30M | Huawei-Policy-Name | := | 30000K_up |
| 176 | ipoe_30M | Huawei-Input-Peak-Rate | := | 30500000 |
| 178 | ipoe_30M | Huawei-Output-Peak-Rat | := | 30500000 |
| 180 | ipoe_30M | Huawei-Domain-Name | := | radius2 |
| 182 | ipoe_30M | Fall-Through | := | Yes |
| 184 | ipoe_50M | Framed-Protocol | := | PPP |
| 186 | ipoe_50M | Service-Type | := | Framed-User |
| 188 | ipoe_50M | Session-Timeout | := | 259200 |
| 190 | ipoe_50M | Huawei-Policy-Name | := | 50000K_up |
| 192 | ipoe_50M | Huawei-Input-Peak-Rate | := | 50500000 |
| 194 | ipoe_50M | Huawei-Output-Peak-Rat | := | 50500000 |
| 196 | ipoe_50M | Huawei-Domain-Name | := | radius2 |

# Contract number column in radiusDB

| id | username | groupname | priority | contnum |
|---|---|---|---|---|
| 313 | 112.72.1 | 0@radius2 | ipoe_50M | 1 | MLL121689 |
| 315 | 112.72.1 | 0@radius2 | ipoe_50M | 1 | MLL121689 |
| 319 | 112.72.1 | 0@radius2 | ipoe_50M | 1 | MLL121689 |
| 525 | 112.72.1 | 0@radius2 | ipoe_50M | 1 | MLL122695 |
| 529 | 112.72.1 | 0@radius2 | ipoe_60M | 1 | MLL122697 |
| 583 | 112.72.1 | 00@radius2 | ipoe_60M | 1 | MLL20240827 |
| 585 | 112.72.1 | 00@radius2 | ipoe_60M | 1 | MLL20240827 |
| 587 | 112.72.1 | 00@radius2 | ipoe_60M | 1 | MLL20240827 |
| 589 | 112.72.1 | 00@radius2 | ipoe_60M | 1 | MLL20240827 |
| 591 | 112.72.1 | 00@radius2 | ipoe_60M | 1 | MLL20240827 |
| 593 | 112.72.1 | 2@radius2 | ipoe_60M | 1 | MLL20240827 |
| 595 | 112.72.1 | 2@radius2 | ipoe_60M | 1 | MLL20240827 |
| 597 | 112.72.1 | 2@radius2 | ipoe_60M | 1 | MLL20240827 |
| 599 | 112.72.1 | 2@radius2 | ipoe_60M | 1 | MLL20240827 |
| 601 | 112.72.1 | 2@radius2 | ipoe_60M | 1 | MLL20240827 |
| 625 | 91.10.34 | @radius2 | ipoe_20M | 1 | MLL91103443 |
| 627 | 91.10.34 | @radius2 | ipoe_20M | 1 | MLL91103443 |
| 631 | 10.2.2.2 | radius2 | ipoe_50M | 1 | MLL0000007 |
| 633 | 10.2.2.2 | radius2 | ipoe_50M | 1 | MLL0000007 |
| 635 | 10.2.2.2 | radius2 | ipoe_50M | 1 | MLL0000007 |

| id | username | attribute | op | value | contnum |
|---|---|---|---|---|---|
| 209 | 112.72 | @radius2 | Huawei-Input-Peak-Rate | = | 40500000 | MLL122694 |
| 211 | 112.72 | @radius2 | Huawei-Output-Peak-Rate | = | 40500000 | MLL122694 |
| 225 | 112.72 | @radius2 | Huawei-Input-Peak-Rate | = | 50500000 | MLL122691 |
| 227 | 112.72 | @radius2 | Huawei-Output-Peak-Rate | = | 50500000 | MLL122691 |
| 229 | 112.72 | @radius2 | Huawei-Input-Peak-Rate | = | 20971520 | MLL7579 |
| 231 | 112.72 | @radius2 | Huawei-Output-Peak-Rate | = | 20971520 | MLL7579 |
| 237 | 112.72 | @radius2 | Huawei-Input-Peak-Rate | = | 20971520 | MLL93096 |
| 239 | 112.72 | @radius2 | Huawei-Output-Peak-Rate | = | 20971520 | MLL93096 |
| 241 | 112.72 | @radius2 | Huawei-Input-Peak-Rate | = | 31457280 | MLL95570 |
| 243 | 112.72 | @radius2 | Huawei-Output-Peak-Rate | = | 31457280 | MLL95570 |
| 245 | 112.72 | 0@radius2 | Huawei-Input-Peak-Rate | = | 31457280 | MLL115290 |
| 247 | 112.72 | 0@radius2 | Huawei-Output-Peak-Rate | = | 31457280 | MLL115290 |
| 249 | 112.72 | radius2 | Huawei-Input-Peak-Rate | = | 21000000 | MLL89861 |
| 251 | 112.72 | radius2 | Huawei-Output-Peak-Rate | = | 21000000 | MLL89861 |
| 253 | 112.72 | @radius2 | Huawei-Input-Peak-Rate | = | 52500000 | MLL112784 |
| 255 | 112.72 | @radius2 | Huawei-Output-Peak-Rate | = | 52500000 | MLL112784 |
| 261 | 112.72 | @radius2 | Huawei-Input-Peak-Rate | = | 52500000 | MLL54113 |
| 263 | 112.72 | @radius2 | Huawei-Output-Peak-Rate | = | 52500000 | MLL54113 |
| 269 | 112.72 | @radius2 | Huawei-Input-Peak-Rate | = | 21000000 | MLL108827 |
| 271 | 112.72 | @radius2 | Huawei-Output-Peak-Rate | = | 21000000 | MLL108827 |
| 273 | 112.72 | @radius2 | Huawei-Input-Peak-Rate | = | 42000000 | MLL120905 |
| 275 | 112.72 | @radius2 | Huawei-Output-Peak-Rate | = | 42000000 | MLL120905 |
| 277 | 112.72 | radius2 | Huawei-Input-Peak-Rate | = | 52500000 | MLL5071 |
| 279 | 112.72 | radius2 | Huawei-Output-Peak-Rate | = | 52500000 | MLL5071 |
| 281 | 112.72 | 0@radius2 | Huawei-Input-Peak-Rate | = | 21000000 | MLL126251 |

# BSS Rules

## IPOE Rules

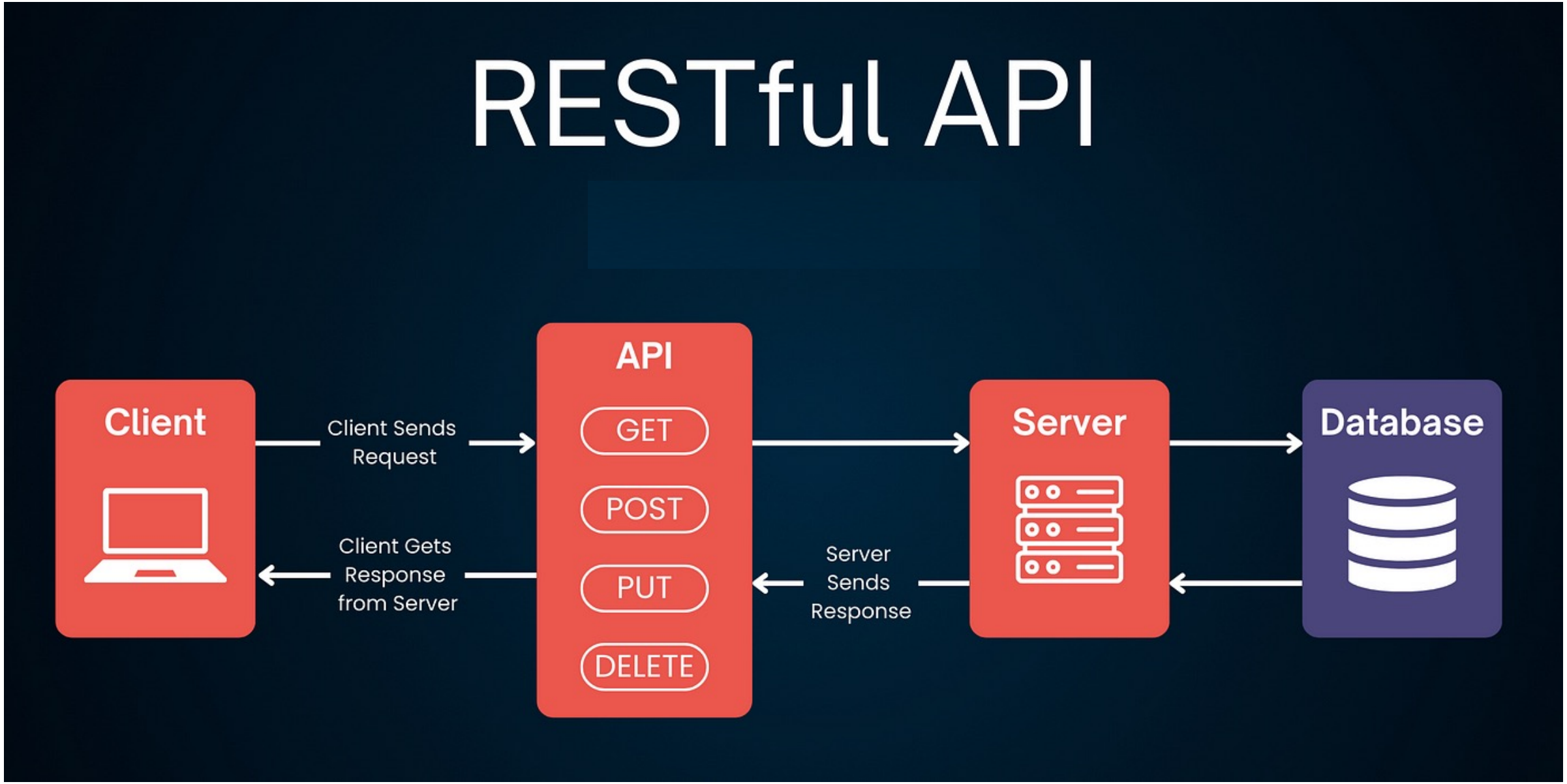
For the IPOE user's username structure is 112.72.x.x – IP address, 09xx – CEVLAN, 29xx – PEVLAN.

1. BSS handles IP addresses and CEVLAN, PEVLAN management.
   e.g.: IP address 112.X.X.2-112.X.X.254 and CEVLAN 0001-4094, PEVLAN 2900-4094
2. One IP pool has one CEVLAN. If a pool reaches the limit (112.72.13.2-254 CEVLAN 0900) next new connection should choose the new pool's IP (112.X.X.2-254 CEVLAN 901), and the CEVLAN increases by 1
3. If CEVLAN reaches the limit of 4094, PEVLAN increases by 1. E.g. x.x.x.x CEVLAN 4094 2900 the next new connection should start x.x.x.x CEVLAN 0001 and PEVLAN 2901.
4. CEVLAN (Customer Edge VLAN), PEVLAN (Provider Edge VLAN)

## PPPOE Rules

1. Give BSS an API that sends a provisioning request to the RADIUS server directly.
2. The BSS system needs to generate the user/password automatically.
3. When a customer changes to another offer with high speed, the GROUPNAME should be updated.

# API in Node JS



# API Logic: Create new user

## API Body:

**API**: http://10.1.X.X:3000/ipuser-create/

**Protocol**: HTTP

**Method**: POST

**Body**:

```
{
    "username": "112.72.13.4509012900@radius2",
```
(Username structure: 112.72.13.45 – IP address, 0901 – CEVLAN, 2900 – PEVLAN /PEVLAN fixed, all customers have the same PEVLAN/)

```
    "password": "xxxx",
    "contnum": "122695",
    "groupname": "ipoe_50M",
```
→ if create Single IP user group name should be null

```
    "radreply": "50500000"
```
→ ⚠ Single IP user's speed format must be 6 – 11 digits as 100500000 is 100 Mbps, 10500000 – 10 Mbps, 1050000 – 1 Mbps, etc (if creating multiple IP users, radreply should be null)

```
}
```

**Response**: Success

```
{
    "status": "New user was added"
}
```

**Response**: Failed

- If a username already exists:

```
{
    "error": "Username already exists"
}
```

- If we send the wrong formatted username:

1.
```
{
    "error": "Invalid username format"
}
```
2.
```
{
    "error": "Invalid password format"
}
```

- If we send the wrong group name:

```
{
    "error": "group not found"
}
```

- If we send the wrong bit rate:

```
{
```

## API Backend:

```
// Check if the radreply value is between 6 and 11 digits
const radreplyRegex = /^\d{6,11}$/;
if (!groupname && !radreplyRegex.test(radreply)) {
    return res.status(400).json({ error: 'Radreply must be between 6 and 11 digits.' });
}

// Check if the username already exists
const queryCheckUsername = 'SELECT COUNT(*) as count FROM radcheck WHERE username = ?';
getConnection.query(queryCheckUsername, [username], (errCheckUsername, rowsCheckUsername, fieldsCheckUsername) => {
    if (errCheckUsername) {
        console.error(errCheckUsername);
        return res.status(500).json({ error: 'Internal Server Error' });
    }

    if (rowsCheckUsername[0].count > 0) {
        return res.status(400).json({ error: 'Username already exists' });
    }

    // If a groupname is provided, check if it exists in the radgroupreply table
    if (groupname && groupname.trim() !== '') {
        const queryCheckGroup = 'SELECT COUNT(*) as count FROM radgroupreply WHERE groupname = ?';
        getConnection.query(queryCheckGroup, [groupname], (errCheckGroup, rowsCheckGroup, fieldsCheckGroup) => {
            if (errCheckGroup) {
                console.error(errCheckGroup);
                return res.status(500).json({ error: 'Internal Server Error' });
            }

            if (rowsCheckGroup[0].count === 0) {
                return res.status(400).json({ error: 'Group not found' });
            }

            // If the group exists, proceed with adding the user
            addUserToDatabase();
        });
    } else {
        // If no groupname is provided, just proceed with adding the user based on radreply
        addUserToDatabase();
    }
});

const addUserToDatabase = () => {
    const query = `
        SET @contnum = ?;
        SET @username = ?;
        SET @value = ?;
        SET @attribute = 'Cleartext-Password';
        SET @groupname = ?;
        SET @radreply = ?;
        CALL userAddOrEdit(@contnum, @username, @value, @attribute, @groupname, @radreply);
    `;
    getConnection.query(query, [contnum, username, password, groupname || null, radreply], (errExecute, rowsExecute, fieldsExecute) => {
        if (!errExecute) {
            res.json({ status: 'New user was added' });
        } else {
            console.log(errExecute);
            res.status(500).json({ error: 'Internal Server Error' });
        }
    });
};
```

# API Logic Change Speed

## API Body: for single IP user

**API**: http://10.1.X.X:3000/ipuser-speed-change/122694 → Contract number (In BSS, it's a contract Number like LL221144)

**Protocol**: HTTP

**Method**: PUT

**Body**:

```
{
    "speed": "50500000"
}
```

**Response**: Success

```
{
    "status": "Speed Changed"
}
```

**Response**: Failed

- If we try to update to the group that that user is already in it:

```
{
    "error": "Please choose a different speed than the current one!!!"
}
```

- If we try to update the speed that doesn't support:

Sample Request:

```
{
    "speed": "00000"
}
```

Response:

```
{
    "error": " Speed value must be between 6 to 11 digits."
}
```

## API Backend

```
// For Ent Individual //
router.put('/ipuser-speed-change/:contnum', (req, res) => {
    const newSpeed = req.body.speed;
    const { contnum } = req.params;
    console.log(newSpeed);

    // Regular expression to check if newSpeed is between 6 to 11 digits
    const speedRegex = /^\d{6,11}$/;

    // Check if newSpeed matches the regular expression
    if (!speedRegex.test(newSpeed)) {
        return res.status(400).json({ error: 'Speed value must be between 6 to 11 digits.' });
    }

    // Check if the username exists in the radreply table
    const queryCheckContnum = 'SELECT COUNT(*) as count FROM radreply WHERE contnum = ?';
    getConnection.query(queryCheckContnum, [contnum], (errCheckContnum, rowsCheckContnum, fieldsCheckContnum) => {
        if (errCheckContnum) {
            console.error(errCheckContnum);
            return res.status(500).json({ error: 'Internal Server Error' });
        }

        if (rowsCheckContnum[0].count === 0) {
            return res.status(400).json({ error: 'This user is not an individual user' });
        }

        // Check if the current speed of the user is the same as the new speed
        const queryCheckCurrentSpeed = 'SELECT COUNT(*) as count FROM radreply WHERE contnum = ? AND value = ?';
        getConnection.query(queryCheckCurrentSpeed, [contnum, newSpeed], (errCheckCurrentSpeed, rowsCheckCurrentSpeed, fieldsCheckCurrentSpeed) => {
            if (errCheckCurrentSpeed) {
                console.error(errCheckCurrentSpeed);
                return res.status(500).json({ error: 'Internal Server Error' });
            }

            if (rowsCheckCurrentSpeed[0].count > 0) {
                return res.status(400).json({ error: 'Please choose a different speed than the current one!!!' });
            }

            // Update the speed for the user
            const queryUpdateSpeed = `
            UPDATE radreply
            SET value = ?
            WHERE contnum = ?;
            `;
            getConnection.query(queryUpdateSpeed, [newSpeed, contnum], (errUpdateSpeed, rowsUpdateSpeed, fieldsUpdateSpeed) => {
                if (errUpdateSpeed) {
                    console.error(errUpdateSpeed);
                    return res.status(500).json({ error: 'Internal Server Error' });
                }

                res.json({ status: 'Speed Changed' });
            });
        });
    });
});
```

# API Logic Change Speed

## API Body: for Multiple IP user

**API**: http://10.1.X.X:3000/ipgroup-speed-change/121689

**Protocol**: HTTP

**Method**: PUT

**Body**:

```
{
    "groupname": "ipoe_60M"
}
```

**Response**: Success

```
{
    "status": "Speed Changed"
}
```

**Response**: Failed

- If we try to update to the group that that user is already in it:

```
{
    "error": "Please choose a different group than the current one!!!"
}
```

- If we try to update the group that doesn't exist:

```
{
    "error": "Group not found"
}
```

- If we try to update the group to a single IP user:

```
{
    "error": "This user is not a multiple IP user"
}
```

## API Backend

```
// For Ent Individual //
router.put('/ipuser-speed-change/:contnum', (req, res) => {
    const newSpeed = req.body.speed;
    const { contnum } = req.params;
    console.log(newSpeed);

    // Regular expression to check if newSpeed is between 6 to 11 digits
    const speedRegex = /^\d{6,11}$/;

    // Check if newSpeed matches the regular expression
    if (!speedRegex.test(newSpeed)) {
        return res.status(400).json({ error: 'Speed value must be between 6 to 11 digits.' });
    }

    // Check if the username exists in the radreply table
    const queryCheckContnum = 'SELECT COUNT(*) as count FROM radreply WHERE contnum = ?';
    getConnection.query(queryCheckContnum, [contnum], (errCheckContnum, rowsCheckContnum, fieldsCheckContnum) => {
        if (errCheckContnum) {
            console.error(errCheckContnum);
            return res.status(500).json({ error: 'Internal Server Error' });
        }

        if (rowsCheckContnum[0].count === 0) {
            return res.status(400).json({ error: 'This user is not an individual user' });
        }

        // Check if the current speed of the user is the same as the new speed
        const queryCheckCurrentSpeed = 'SELECT COUNT(*) as count FROM radreply WHERE contnum = ? AND value = ?';
        getConnection.query(queryCheckCurrentSpeed, [contnum, newSpeed], (errCheckCurrentSpeed, rowsCheckCurrentSpeed, fieldsCheckCurrentSpeed) => {
            if (errCheckCurrentSpeed) {
                console.error(errCheckCurrentSpeed);
                return res.status(500).json({ error: 'Internal Server Error' });
            }

            if (rowsCheckCurrentSpeed[0].count > 0) {
                return res.status(400).json({ error: 'Please choose a different speed than the current one!!!' });
            }

            // Update the speed for the user
            const queryUpdateSpeed = `
            UPDATE radreply
            SET value = ?
            WHERE contnum = ?;
            `;
            getConnection.query(queryUpdateSpeed, [newSpeed, contnum], (errUpdateSpeed, rowsUpdateSpeed, fieldsUpdateSpeed) => {
                if (errUpdateSpeed) {
                    console.error(errUpdateSpeed);
                    return res.status(500).json({ error: 'Internal Server Error' });
                }

                res.json({ status: 'Speed Changed' });
            });
        });
    });
});
```

# API Logic IP shift

## IP shift Multi to Single:

**API**: http://10.1.X.X:3000/ip-shift/122691

**Protocol**: HTTP

**Method**: PUT

**Body**:

```
{
    "ipType": "single",
    "ips": ["112.72.X.X09X29X@radius2"],
    "group": "",      → from multi to single, the group should be null.
    "bit": "50500000"
}
```

**Response**: Success

```
{
    "status": "IP shift successful"
}
```

**Response**: Failed

- If we try to send an empty ipType:

```
{
    "error": " Invalid ipType. Must be \"single\" or \"multi\". ”
}
```

- If we try to send an empty bit or fill the group from Multi to Single-shifting:

```
{
    "error": "For Single ipType, provide a bit rate."
}
```

- If we try to shift an already existing single IP user’s contract:

```
{
    "error": "The contnum 122691 already exists."
}
```

- If we try to shift the wrong format:

```
{
    "error": "Bitrate must be between 6 and 11 digits."
}
```

- If we try to send the request by the wrong contract number:

```
{
   "error": "The contnum 122699 was not found."
}
```

## IP shift Single to Multi:

**API**: http://10.1.X.X:3000/ip-shift/122691 → Contract number (In BSS, it’s Contract Number)

**Protocol**: HTTP

**Method**: PUT

**Body**:

```
{
    "ipType": "multi",
    "ips": ["112.72.X.X09X29X@radius2", "112.72.X.X09X29X@radius2",
"112.72.X.X09X29X@radius2", "112.72.X.X09X29X@radius2", "112.72.X.X09X29X@radius2"],
    "group": "ipoe_50M",
    "bit": "" → from single to multi, bit should be null.
}
```

**Response**: Success

```
{
    "status": "IP shift successful"
}
```

**Response**: Failed

- If we try to send an empty ipType:

```
{
    "error": " Invalid ipType. Must be \"single\" or \"multi\". ”
}
```

- If we try to send an empty group or fill the bit in single to multi-shifting:

```
{
    "error": " For multi ipType, provide a group name."
}
```

- If we try to shift already existing IPs:

```
{
   "error": "The IP address 112.72.X.X09X29X@radius2 already exists."
}
```

- If we try to shift the group that doesn’t exist:

```
{
   "error": "The group ipoe_600M was not found."
}
```

- If we try to send the request by the wrong contract number:

```
{
   "error": "The contnum 122699 was not found."
```

# Increase and Decrease IP address

## Increase IP address:

**API**: http://10.1.X.X:3000/increase-ips/122691

**Protocol**: HTTP

**Method**: PUT

**Body**:

```
{
    "newIps": ["112.72.X.X09X29X@radius2", "112.72.X.X09X29X@radius2",
    "112.72.X.X09X29X@radius2", "112.72.X.X09X29X@radius2",
    "112.72.X.X09X29X@radius2"], → New IPs
    "group": "ipoe_50M" → Speed group policy
}
```

**Response**: Success

```
{
    "status": " IPs successfully added"
}
```

**Response**: Failed

- If we try to send wrong contract number:

```
{
   "errorCode": "CONTNUM_NOT_FOUND",
    "message": "The contnum 122695 was not found."
}
```

- If we try to add an IP address that already exists in the system:

```
{
   "errorCode": "IP_ALREADY_EXISTS",
    "message": "The IP address 112.72.X.X09X29X@radius2 already exists."
}
```

- If we try to set wrong group speed policy:

```
{
   "errorCode": "GROUP_NOT_FOUND",
   "message": "The group ipoe_400M was not found."
}
```

## Decrease IP address:

**API**: http://10.1.X.X:3000/decrease-ips/122691

**Protocol**: HTTP

**Method**: PUT

**Body**:

```
{
    "removeIps": ["112.72.X.X09X29X@radius2", "112.72.X.X09X29X@radius2",
    "112.72.X.X09X29X@radius2", "112.72.X.X09X29X@radius2",
    "112.72.X.X09X29X@radius2"], → Remove IPs
}
```

**Response**: Success

```
{
    "status": " IPs successfully removed"
}
```

**Response**: Failed

- If we try to send the wrong contract number:

```
{
   "errorCode": "CONTNUM_NOT_FOUND",
    "message": "The contnum 122695 was not found."
}
```

- If we try to remove IP addresses that do not exist in the system:

```
{
   "errorCode": "IP_DOESNT_EXISTS",
   "message": "The IP address 112.72.X.X09X29X@radius2 does not exist."
}
```

# Dunning process

## One Way Block

**API**: http://10.1.X.X:3000/ipuser-owb/LL133876

**Protocol**: HTTP

**Method**: PUT

**Body**: None

**Response: Success**

```
{
    "status": "IP contract One Way Blocked"
}
```

**Response: Failure**

- If the user is already in the OWB state:

```
{
    "error": "This contract already OWB"
}
```

- ! If the user does not exist:

```
{
    "error": "Contract does not exist"
}
```

## Suspension

**API**: http://10.1.X.X:3000/ipuser-suspend/121689

**Protocol**: HTTP

**Method**: PUT

**Body**: None

**Response: Success**

```
{
    "status": "IP contract suspended"
}
```

**Response: Failure**

- If user is already in suspended state:

```
{
    "error": "User is already suspended"
}
```

- !If user does not exist:

```
{
    "error": "Contract does not exist"
}
```

## Delete user

**API**: http://10.1.X.X:3000/user-delete-contract/122691

**Protocol**: HTTP

**Method**: DELETE

**Body**: None

**Response**: Success

```
{
    "message": "Successfully deleted contract with contract number: 122691"
}
```

**Response**: Failed

- If user does not exist:

```
{
    "errorCode": "CONTNUM_NOT_FOUND",
    "message": "The contract number 122695 was not found."
}
```

## Re-active service

**API**: http://10.1.X.X:3000/ipuser-reactive/121689

**Protocol**: HTTP

**Method**: PUT

**Body**: None

**Response: Success**

```
{
    "status": "Subscriber activated"
}
```

**Response: Failure**

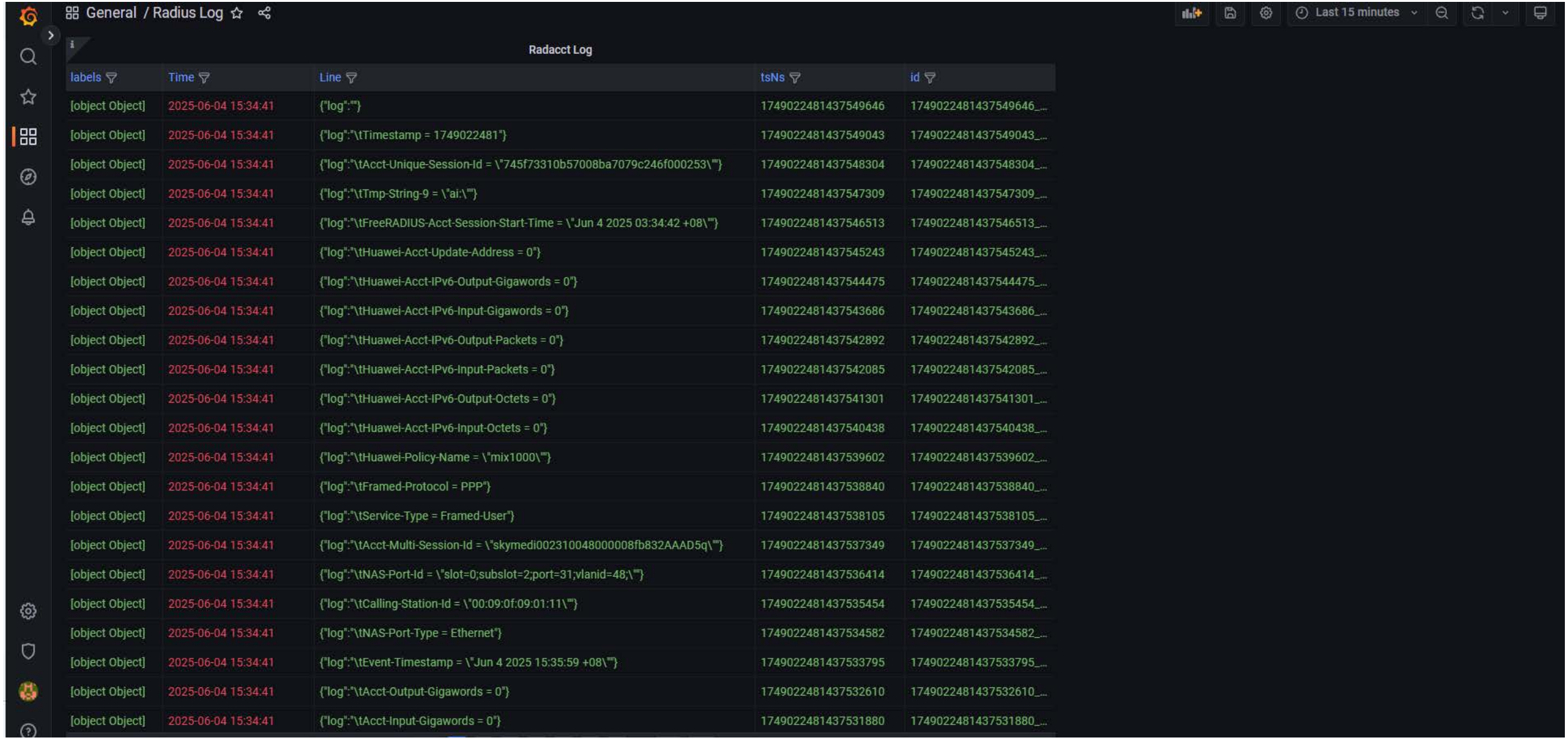
- If user is already in active state:

```
{
    "error": "The subscriber is already an active user"
}
```

- If user does not exist:

```
{
    "error": "subscriber does not exist"
}
```

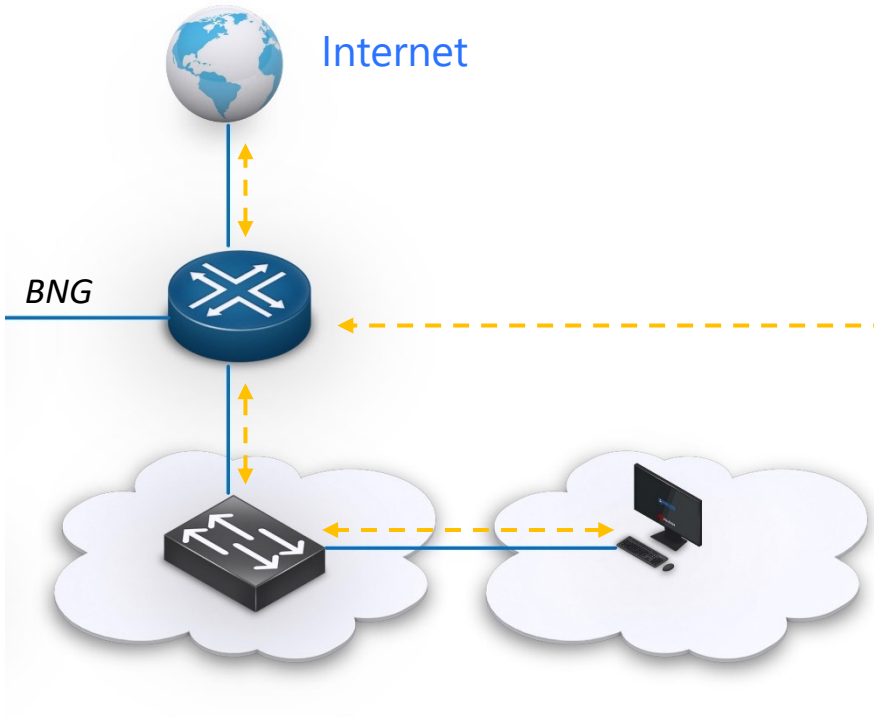
# Log & Monitoring (Loki+Grafana)



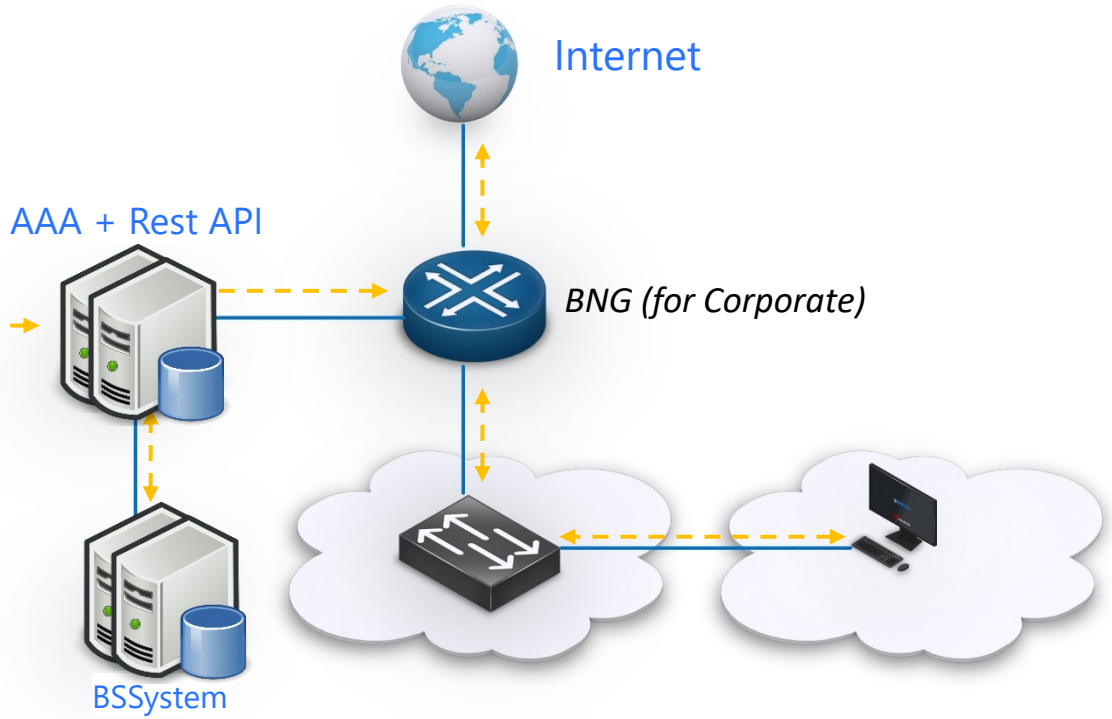

| labels | Time | Line | tsNs | id |
|---|---|---|---|---|
| [object Object] | 2025-06-04 15:34:41 | {"log":""} | 1749022481437549646 | 1749022481437549646_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tTimestamp = 1749022481"} | 1749022481437549043 | 1749022481437549043_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tAcct-Unique-Session-Id = \"745f73310b57008ba7079c246f000253\""} | 1749022481437548304 | 1749022481437548304_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tTmp-String-9 = \"ai:\""} | 1749022481437547309 | 1749022481437547309_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tFreeRADIUS-Acct-Session-Start-Time = \"Jun 4 2025 03:34:42 +08\""} | 1749022481437546513 | 1749022481437546513_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tHuawei-Acct-Update-Address = 0"} | 1749022481437545243 | 1749022481437545243_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tHuawei-Acct-IPv6-Output-Gigawords = 0"} | 1749022481437544475 | 1749022481437544475_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tHuawei-Acct-IPv6-Input-Gigawords = 0"} | 1749022481437543686 | 1749022481437543686_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tHuawei-Acct-IPv6-Output-Packets = 0"} | 1749022481437542892 | 1749022481437542892_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tHuawei-Acct-IPv6-Input-Packets = 0"} | 1749022481437542085 | 1749022481437542085_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tHuawei-Acct-IPv6-Output-Octets = 0"} | 1749022481437541301 | 1749022481437541301_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tHuawei-Acct-IPv6-Input-Octets = 0"} | 1749022481437540438 | 1749022481437540438_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tHuawei-Policy-Name = \"mix1000\""} | 1749022481437539602 | 1749022481437539602_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tFramed-Protocol = PPP"} | 1749022481437538840 | 1749022481437538840_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tService-Type = Framed-User"} | 1749022481437538105 | 1749022481437538105_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tAcct-Multi-Session-Id = \"skymedi002310048000008fb832AAAD5q\""} | 1749022481437537349 | 1749022481437537349_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tNAS-Port-Id = \"slot=0;subslot=2;port=31;vlanid=48;\""} | 1749022481437536414 | 1749022481437536414_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tCalling-Station-Id = \"00:09:0f:09:01:11\""} | 1749022481437535454 | 1749022481437535454_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tNAS-Port-Type = Ethernet"} | 1749022481437534582 | 1749022481437534582_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tEvent-Timestamp = \"Jun 4 2025 15:35:59 +08\""} | 1749022481437533795 | 1749022481437533795_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tAcct-Output-Gigawords = 0"} | 1749022481437532610 | 1749022481437532610_... |
| [object Object] | 2025-06-04 15:34:41 | {"log":"\tAcct-Input-Gigawords = 0"} | 1749022481437531880 | 1749022481437531880_... |

# Finally, what we have

## PPPOE for Fam clients




## IPOE For Corporate Clients




### PPPOE Structure

- Framed IP address (Using DHCP from router)
- Generated username
- Generated Password
- Group policy for all IP users
- Final username: **Prefix BB + 6 digit**
  **Sample: BB012345 (BB means Broadband)**

### IPOE Structure

- Framed IP address (Dedicated IP)
- CEVLAN
- PEVLAN
- Domain
- Group policy for multiple IP users
- Single Policy (bitrate) for a Single IP user
- Sample IP:112.72.13.x + CEVLAN: 0905 + PEVLAN 2901 + Domain: radius2.
  Final username: **112.72.13.x09052901@radius2**

# Summary

## Summary

- Found the whole open-source solutions
- Learning Node JS…
- Keepalived (VRRP) for Rednundancy
- Galera Cluster for HA
- IP and Customer info control from BSS

**Email: Sukhbaatar.e@skytel.mn**
**Whatsapp: Sukhbaatar Erdenee**

## Next Steps that I want

Kubernetes instead of VMs

Gather each user's data usage from RADACCT, and do some prediction using ML


# Thank you for your attention!!!