China Telecom's API Approach

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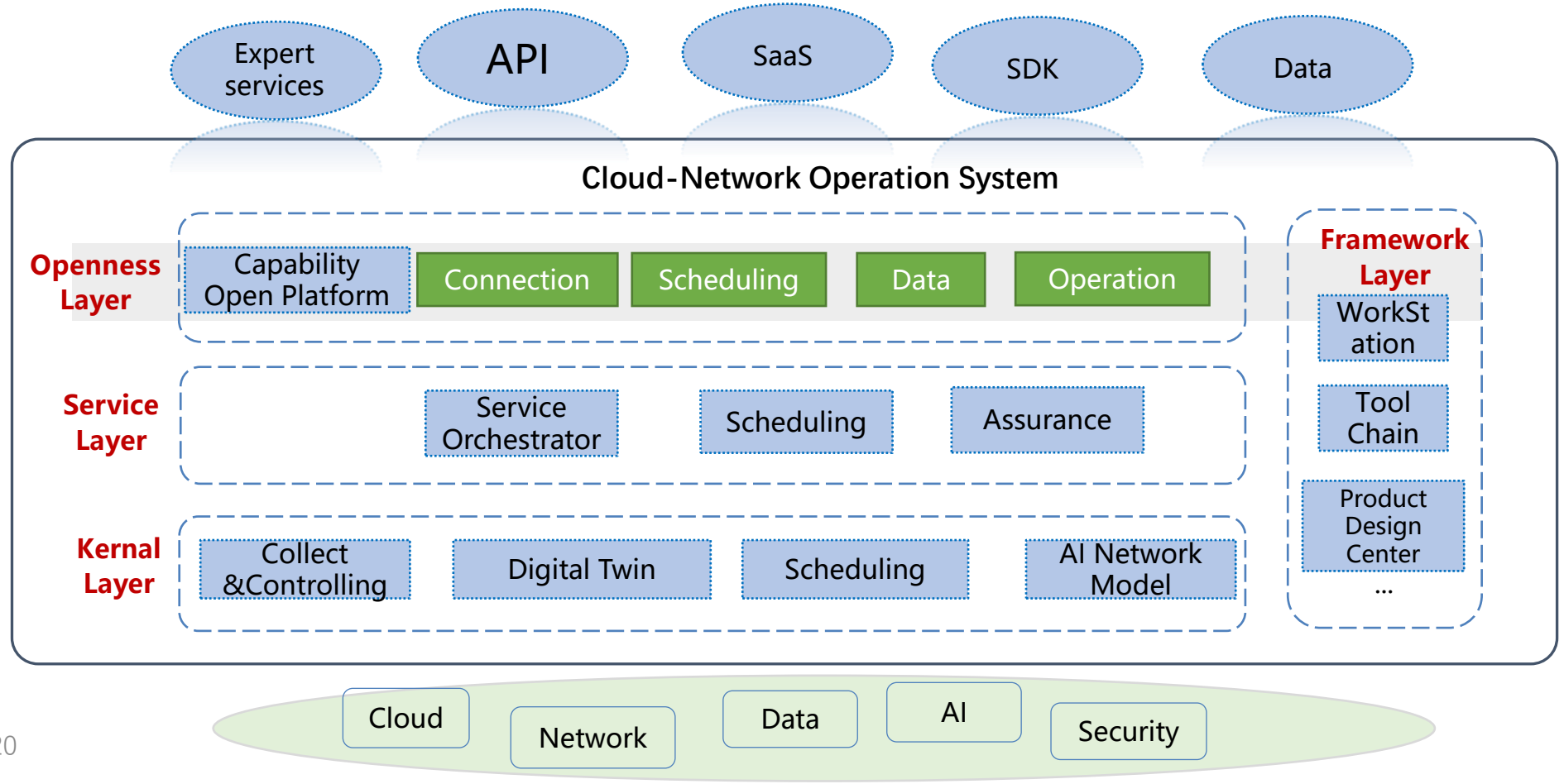
Content

- Background
- Layered PSR model and APIs
- APIs of Network Controller
- Challenges

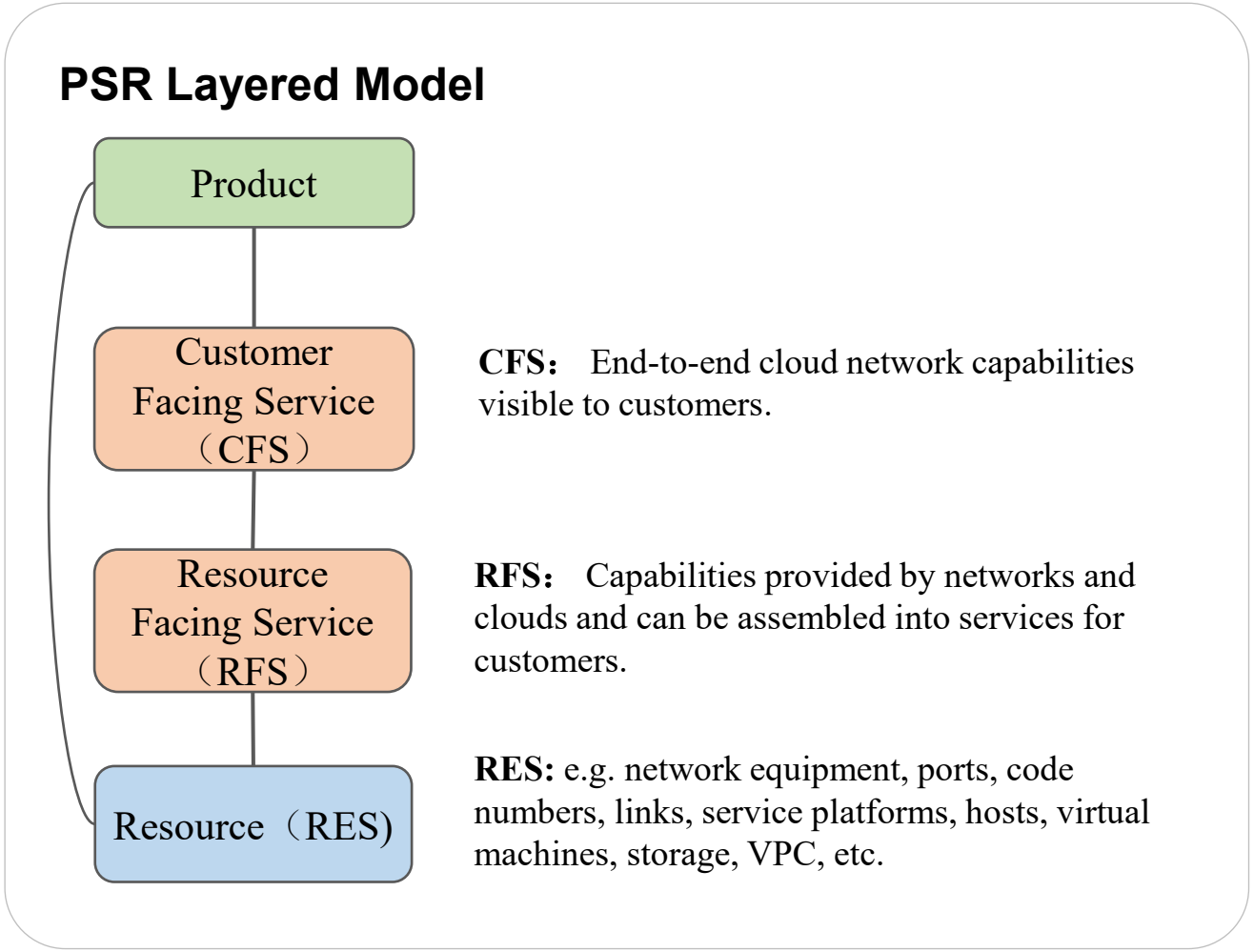
Cloud-Network Operation System

Unified Management & Orchestration: Centralized control, orchestration and scheduling of distributed, heterogeneous resources (network, cloud, security, data, AI, etc.).

Open to Internal and External Applications : Abstract the network and cloud capabilities and expose them to the applications via layered model



Current Status of CT's APIs

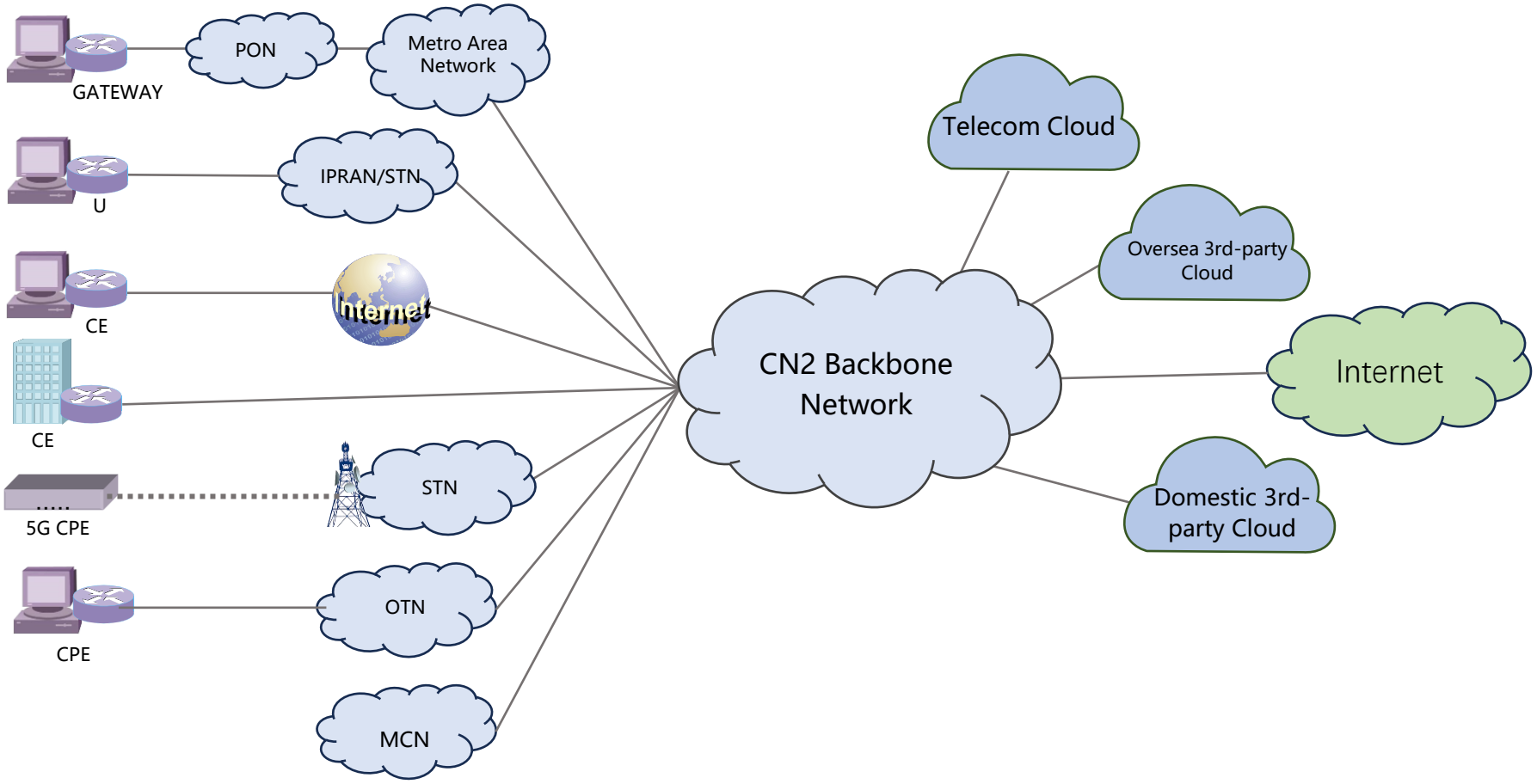


- **Product & Service Design Centre:** 2000+ capabilities and 300+ products, enabling agile delivery and flexible composition.

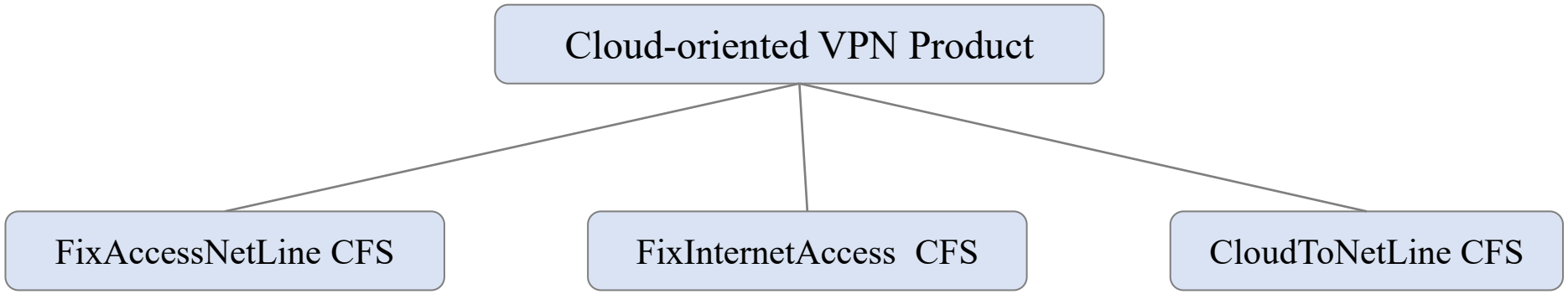
- **Open APIs :** Connectivity Capability, Computing Capability Scheduling, Data Capability, Operation Capability' with 450+ commercial capabilities and a total of 70 billion+ calls.

Example: Cloud-oriented VPN Product

- Provide customers with Internet access, Cloud access, Multi-site network, Multi-cloud network, etc.
- Leverage the capabilities of various access networks and Backbone Networks, involving 7 domains: PON, MAN, IP RAN, STN, OTN, MCN and CN2 Backbone.



Configuration of Cloud-oriented VPN Product



- 20 objects: 3 CFSes and 17 RFSes.
- 288 APIs for product creation, modification and deletion.
- Capability reuse rate reaches to 94%.

APIs of Cloud-oriented VPN Product

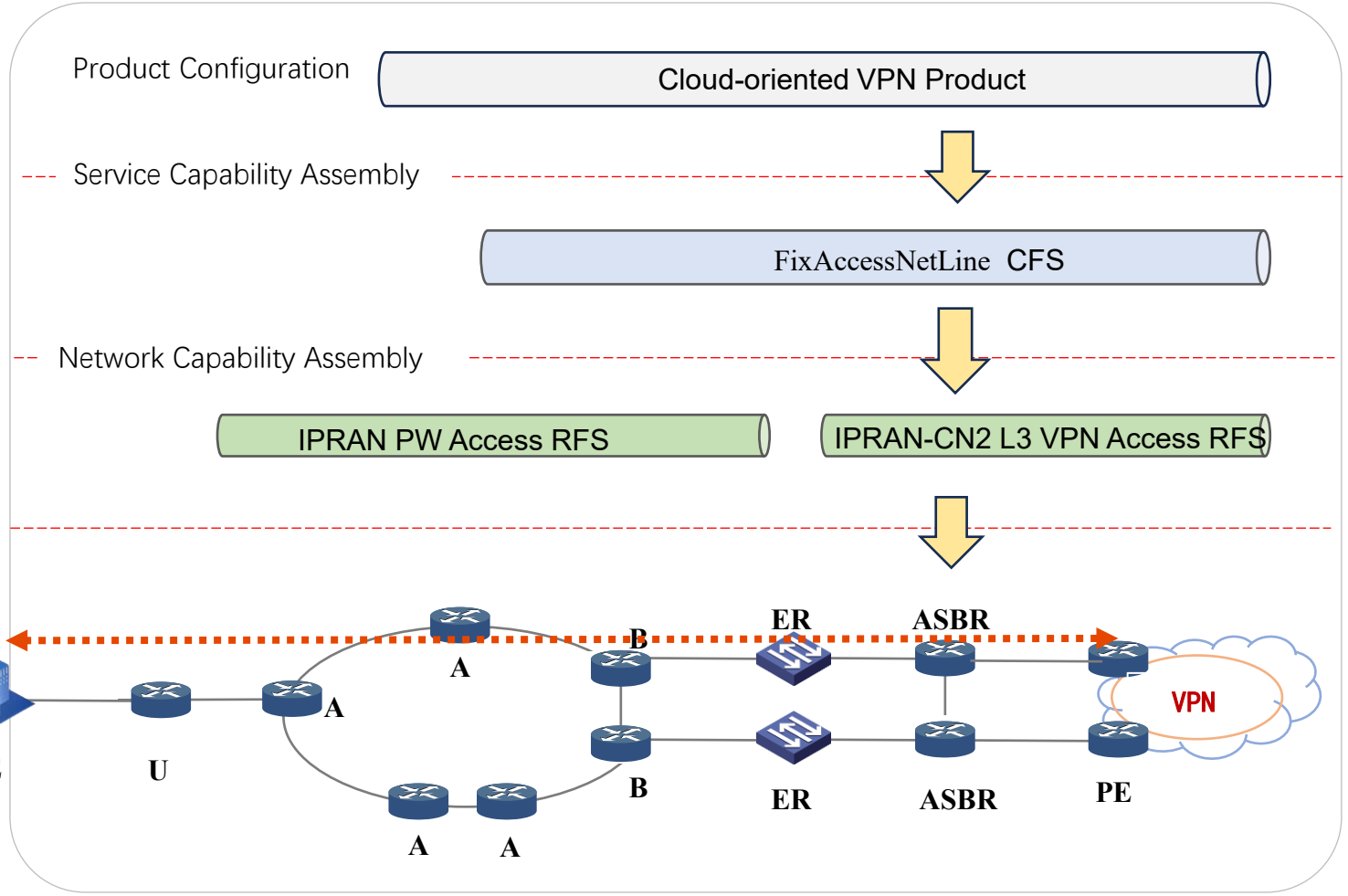
API Type	API Name
API（Orchestration system）	prodCloudVpn_install_api
	prodCloudVpn_remove_api
	prodCloudVpn_change_api
	prodCloudVpn_complete_api
	cfsFixAccessNetLine_install_api
	cfsFixAccessNetLine_remove_api
	cfsFixAccessNetLine_change_api
	rfsPonLink_install_api
	rfsPonLink_remove_api
	rfsPonLink_change_api
	rfsManL3VpnAccess_install_api
	rfsManL3VpnAccess_remove_api
	rfsManL3VpnAccess_change_api
	rfsManCn2L3VpnAccess_install_api
	rfsManCn2L3VpnAccess_remove_api
	rfsManCn2L3VpnAccess_change_api

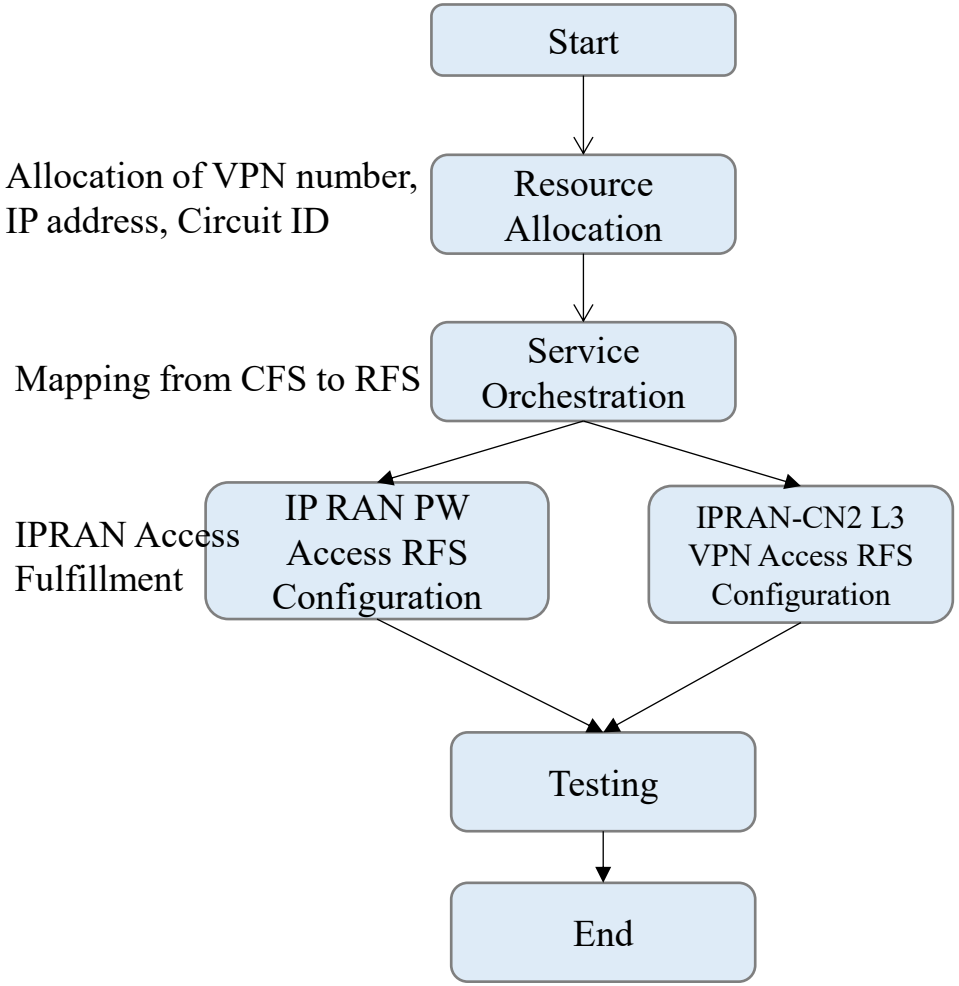
API Type	API Name
API（Resource management system）	prodCloudVpn_serviceDesign_api
	prodCloudVpn_serviceRollback_api
	cfsFixAccessNetLine_serviceDesign_api
	cfsFixAccessNetLine_resourceConfig_api
	cfsFixAccessNetLine_resourceRollback_api
	cfsFixAccessNetLine_resourceQuery_api
	rfsPonLink_resourceConfig_api
	rfsPonLink_resourceRollback_api
	rfsPonLink_resourceQuery_api
	rfsManL3VpnAccess_resourceConfig_api
	rfsManL3VpnAccess_resourceRollback_api
	rfsManL3VpnAccess_resourceQuery_api
	rfsManCn2L3VpnAccess_resourceConfig_api
	rfsManCn2L3VpnAccess_resourceRollback_api
	rfsManCn2L3VpnAccess_resourceQuery_api

API Type	API Name
API（Data collection & device control system）	resA8c_rfsManL3VpnAccess_install_api
	resA8c_rfsManL3VpnAccess_remove_api
	resA8c_rfsManL3VpnAccess_install_api
	RES_PON_PONVLAN_ADD_API
	RES_IP_MANMSE_MPLS_L3VPN_ADD_API
	RES_IP_MANMSE_MPLS_L3VPN_MOD_API
	resOlt_rfsPonLink_install_api
	resOlt_rfsPonLink_remove_api
	resOlt_rfsPonLink_change_api
	RES_IP_MANASBR_MPLS_L3VPN_DEL_API
	RES_IP_MANASBR_MPLS_L3VPN_ADD_API
	resCn2PeRouter_rfsManCn2L3VpnAccess_install_api
	resCn2PeRouter_rfsManCn2L3VpnAccess_remove_api
	RES_IP_ROUTER_PORTMTU_MOD_AP
	RES_IP_CN2PE_MPLS_L3VPN_MOD_API
	RES_IP_CN2PE_MPLS_L3VPN_MOD_API

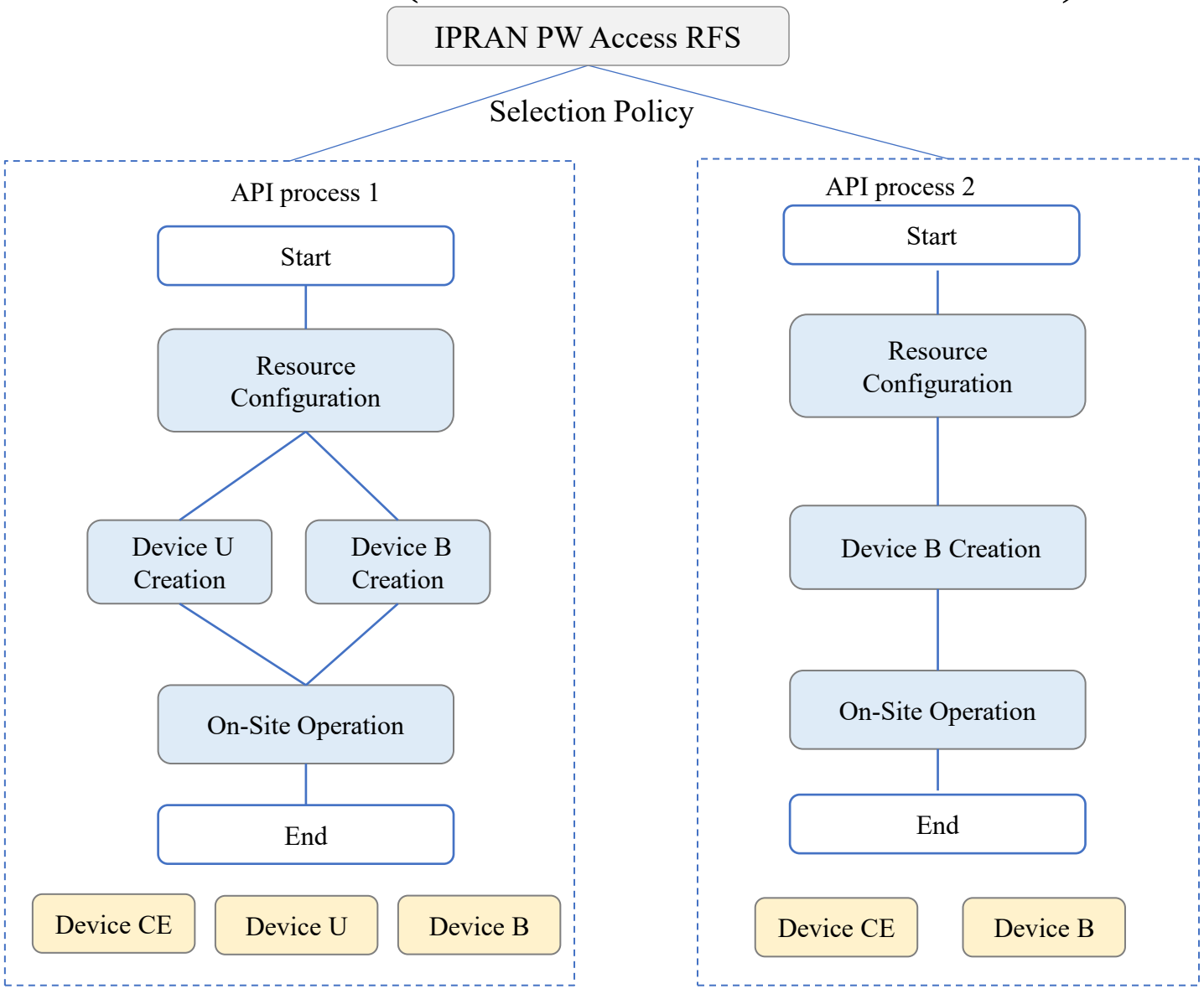
API Type	API Name
综调API（Workforce system）	cfsFixAccessInternet_wholeTest_api
	rfsPonLink_manualConstruction_api
	rfsManL3VpnAccess_manualConstruction_api

API Process of CFS (FixAccessNetLine)





API Process of RFS (IP RAN PW Access)



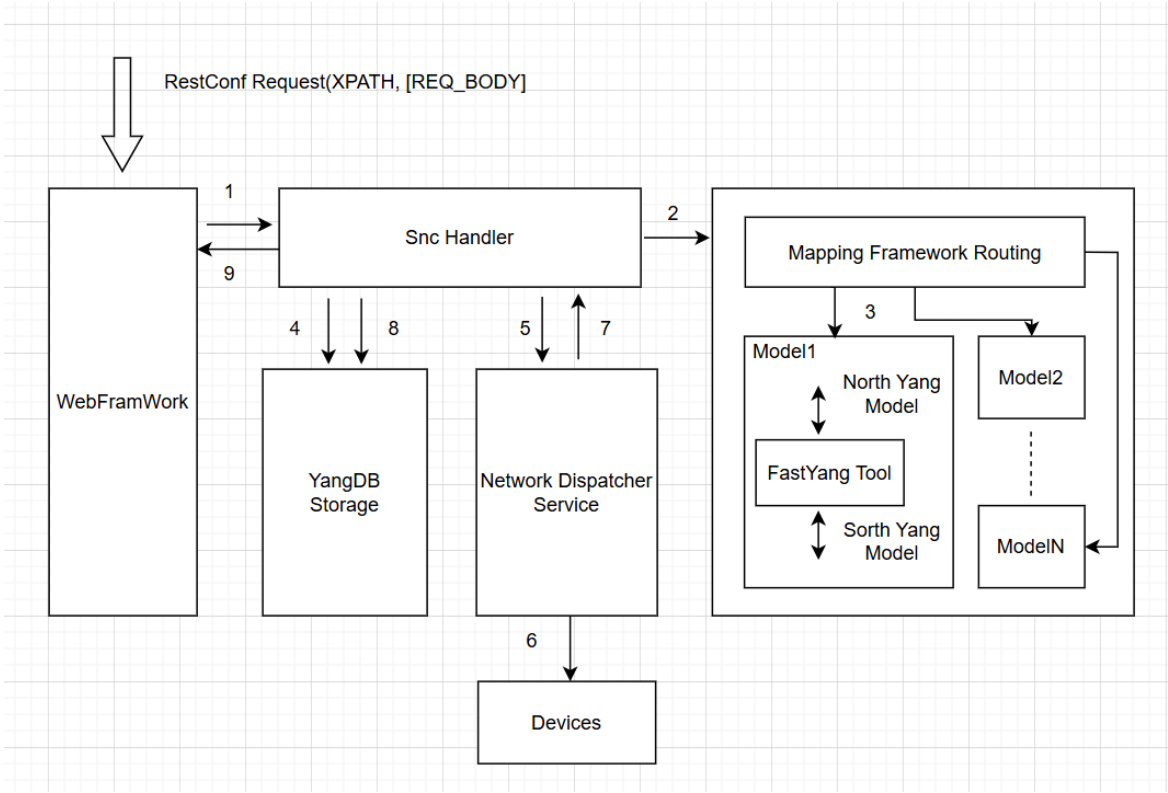
Northbound Interfaces of Network Controller

Unified YANG Model(CT-YANG)： More suitable for complex network configurations and closer to the data form of devices, shield vendor differences and improve the efficiency of information understanding and Processing.

1、B interface：Service level interface, e.g., ct-service-vpn
2、C interface：Module level interface, e.g., ct-device, ct-ifm
3、D interface：Field or configuration item in yang, e.g., interface description in ct-ifm

请求示例：

```
POST
http://10.9.63.110:8448/rest/ctrl/v2/devices/data/srv6_l3_evpn_all
{
    "common": {
        " deviceownnet ": "newcitynet",
        " deviceid ": " hwabc001",
        " deviceidtype ": " systename ",
        "xpath":"/ct-service-vpn:vpn"
    },
    "rawdata": {
        " srv6-evpn": {
            "srv6-evpns": [
                {
                    "vpn-id": "65001",
                    "vpn-inst-name": "vrf1",
                    "description": "l3evpn",
                    "srv6-mode": "be",
                    "sla-params": {
                        "service-type": "service-type",
                        "lattency": 20,
                        "jitter": 50,
                        "loss-rate": 2
```



Mapping from CT-YANG to Vendor YANG/CLI

```
"rawdata": {
    "ct-service-vpn:network-elements": [
        {
            "ne-id": "NE40EX3A_1",
            "vpn-inst-name": "E07-TSXC-HWUP1-1301-LeaseLine",
            "local-as":65001,
            "bgp-route-networks": [
                {
                    "route-prefix": "121.237.95.0/30"
                }
            ],
            "access-info": {
                "access-ifs": [
                    {
                        "if-name": "Eth-Trunk10.39020511",
                        "description": "HLWZX-TEST",
                        "statistic": true,
                        "mtu4":9050,
                        "link-up-down-trap-enable": "disable",
                        "arp-broadcast-enable": true,
                        "urpf": {
                            "mode": "strict"
                        },
                        "access-ipv4": "121.237.95.1/30",
                        "qos-profile-name-inbound": "uni_1000m",
                        "qos-profile-name-outbound": "uni_1000m",
                        "qos-policy-name-outbound": "policy_818",
                        "rb-profile": "rbs-test2",
                        "vlan-info": {
                            "ce-vlan": {
                                "vid-range": [
                                    {
                                        "vlan-end": 522,
                                        "vlan-begin": 522
                                    }
                                ]
                            },
                            "pe-vlan": {
                                "vid-range": [
                                    {
                                        "vlan-end": 3911,
                                        "vlan-begin": 3911
                                    }
                                ]
                            }
                        }
                    }
                ]
            }
        }
    ]
}
```

Configure device logical interface and bind to a specific VPN(Internet leased line service)

Transform Northbound YANG to Southbound Request, to issue configurations to devices, or obtain the performance data

```
<rpc id="5" try_times="3" try_interval="3000">
    <edit-config>
        <target>
            <candidate/>
        </target>
        <error-option>rollback-on-error</error-option>
        <config
            xmlns:nc="urn:ietf:params:xml:ns:netconf:base:1.0">
            <ifm
                xmlns="urn:huawei:yang:huawei-ifm" >
                <interfaces>
                    <interface>
                        <name>Eth-Trunk10.39020511</name>
                        <type>Eth-Trunk</type>
                        <parent-name>Eth-Trunk10</parent-name>
                        <number>39020511</number>
                        <description>HLWZX-TEST</description>
                        <l2-mode-enable>false</l2-mode-enable>
                        <ethernet
                            xmlns="urn:huawei:yang:huawei-ethernet">
                            <l3-sub-interface>
                                <qinq-termination>
                                    <tag>none</tag>
                                    <arp-broadcast-enable>true</arp-broadcast-enable>
                                    <qinq-vids>
                                        <qinq-vid>
                                            <pe-vlan-begin>3911</pe-vlan-begin>
                                            <pe-vlan-end>3911</pe-vlan-end>
                                            <ce-vlan-begin>522</ce-vlan-begin>
                                            <ce-vlan-end>522</ce-vlan-end>
                                        </qinq-vid>
                                    </qinq-vids>
                                </qinq-termination>
                            </l3-sub-interface>
                        </ethernet>
                    </interface>
                </interfaces>
            </ifm>
        </config>
    </edit-config>
</rpc>
```

Operation&APIs R&D and Supportive Team

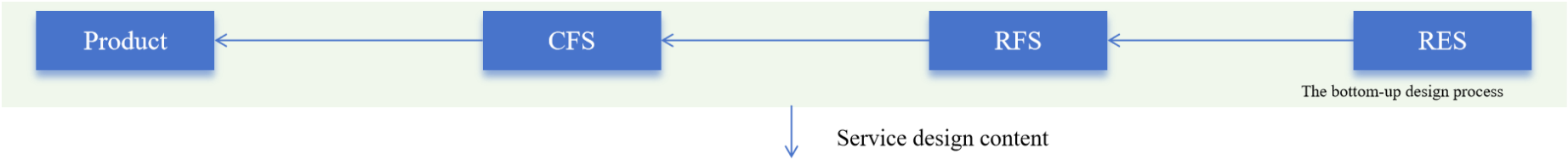
- **500+** members(Full time)： Overall Planning, System Designing, Coding and Development, Testing, Deployment, Standardization
- International Cooperation： TM Forum， ONAP， GSMA, ITU-T, etc.

Challenges

- **Long standardization cycle:** Standardization of IETF progresses slower than vendor implementations. Vendors often develop private YANG models in advance to meet the rapid deployment needs of network operators.
- **Insufficient function coverage**: The IETF models focuses on basic network objects, but lacks a complete functional definition of operator specific scenarios (such as cloud-network collaboration, multi-vendor network element management, etc.), resulting in functional incompleteness.
- **Private extensions by vendors:** Vendors implementations generally exceed the scope of the IETF model. Each vendor has differentiated the fields based on their device functions and characteristics, resulting in semantic deviations and misalignment between the standard and device implementation.
- **Data consistency risk:** When there is a namespace conflict between vendor extended fields and RFC defined fields (such as IETF interfaces and vendor private interfaces models), directly using the standard model will trigger a southbound protocol parsing exception.

Thank You

Service Design Content



PSR component type	Service design content
Product	Object basic information, object property, object structure, API basic information, API parameter, API process and design policy.
CFS	Object basic information, object property, object structure, API basic information, API parameter, API process and design policy.
RFS	Object basic information, object property, object structure, API basic information, API parameter, API process and design policy.
RES	Object basic information, object property, API basic information and API parameter.