



中国移动
China Mobile

5GC NFV Integration practice Based on OpenStack

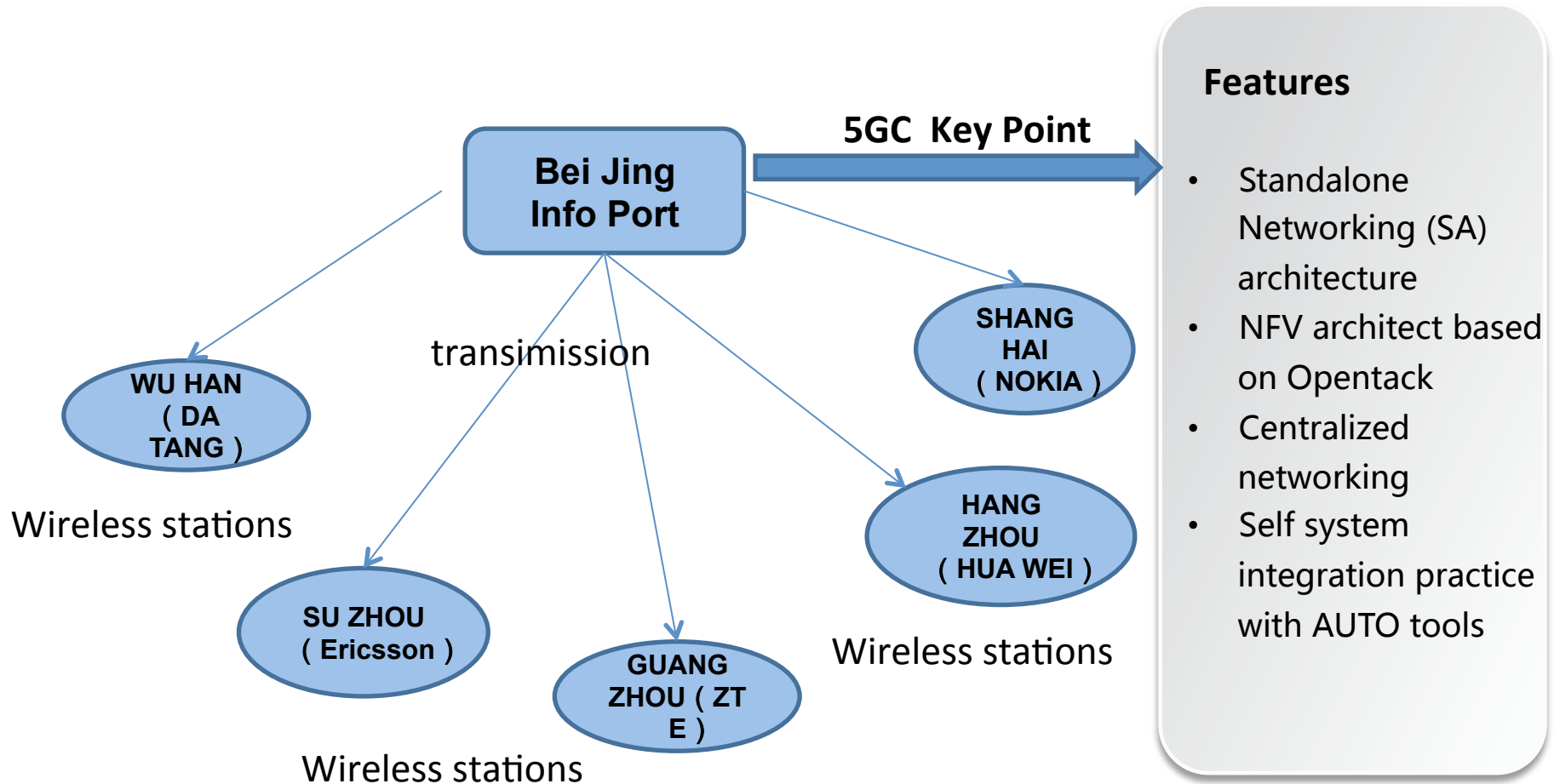
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China Mobile 5GC are depolyed in BeiJing central point, and complete connection with five provinces' s wireless stations through transmission system

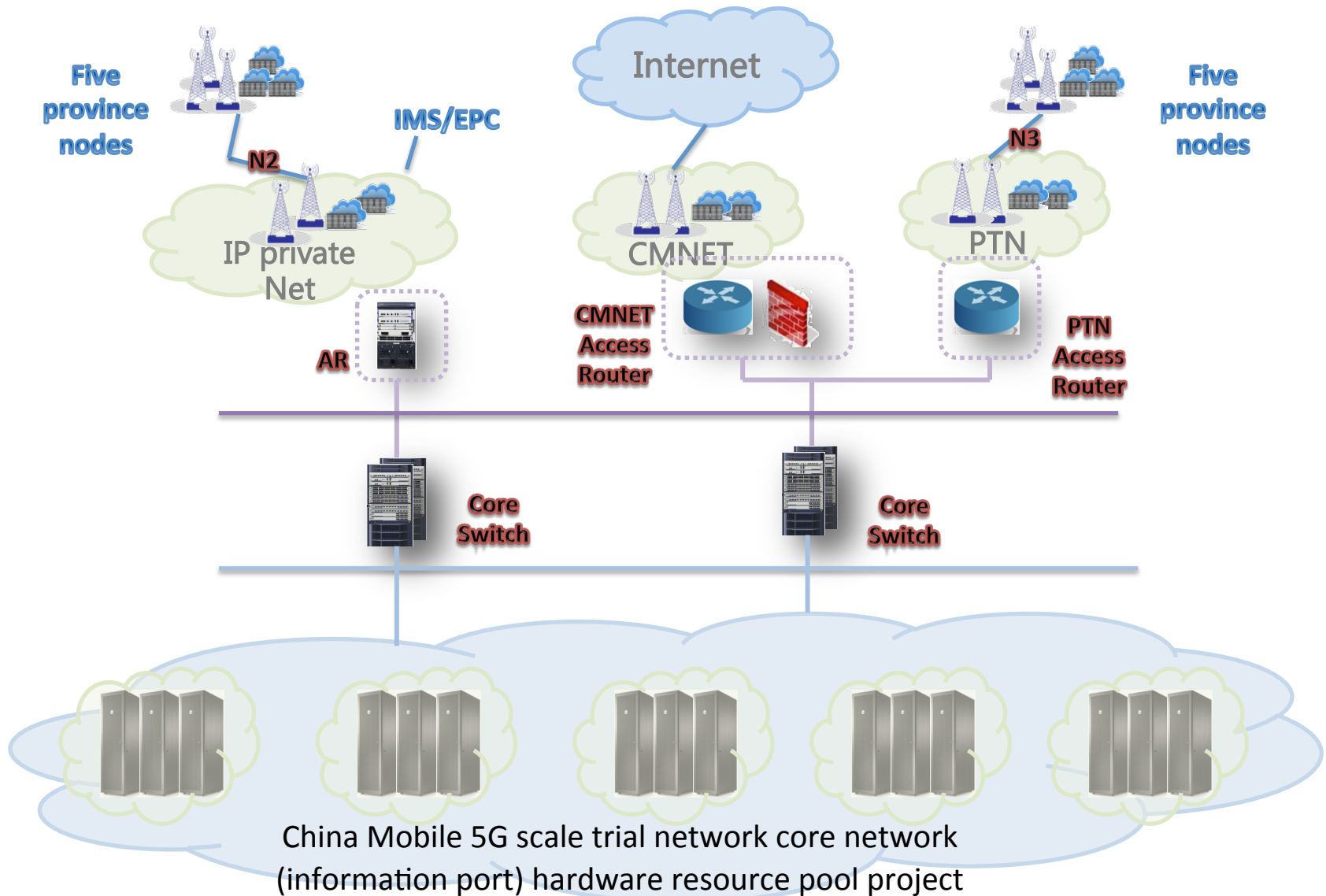


The diagram illustrates the 5G Core Network (5GC) architecture, organized into several functional layers and domains:

- IMS (IP Multimedia Subsystem):** Located at the top, it includes components like IBCF, SBC/P-CSCF, I/S-CSCF, MGCF, AS, and AF. It interfaces with the EPC via Mx/Mw and Sh/Cx, and with the 5GC via N26.
- EPC (Evolved Packet Core):** This layer contains the MME (Mobility Management Entity), DRA (Diameter Routing Agent), PGW (PDN Gateway), and SGW (Serving Gateway). It interfaces with the IMS via S6a/S1-M and with the 5GC via S5-C and S5-U.
- 5GC (5G Core Network):** The central core, divided into:
 - Control Plane:** Includes HSS/UDM (Home Subscriber System/Unified Data Management), PCRF/PCF (Policy and Charging Rules Function/Policy Control Function), PGW-C/SMF (PDN Gateway Control/Session Management Function), and PGW-U/UPF (PDN Gateway User Plane Function).
 - User Plane:** Includes EIR (External Identity Register), UDR (Unified Data Repository), HTTP Proxy, NSSF (Network Slice Selection Function), and BSF (Binding Support Function).
 - Network Functions (NFs):** A series of NFs including AUSF, NRF, UDSF, NEF, SMSF, AMF, and NWDAF, each with specific interfaces (e.g., Nausf, Nnrf, Nudsf, Nnef, Nsmsf, Namf, Nnwdaf).
- Access Network:**
 - LTE access:** Connects to the EPC via S1-MME and S1-U interfaces, passing through an eNB (eNodeB).
 - 5G Access:** Connects to the 5GC via N3 and N2 interfaces, passing through a gNB (gNodeB).
- Terminal:** The User Equipment (UE) at the bottom, which interfaces with the Access Network via N1.
- Supporting Systems:** On the right, BOSS (Business Operation Support System), NMS (Network Management System), and OMC (Operation and Maintenance Center) are shown, interfacing with the 5GC via Nchf.

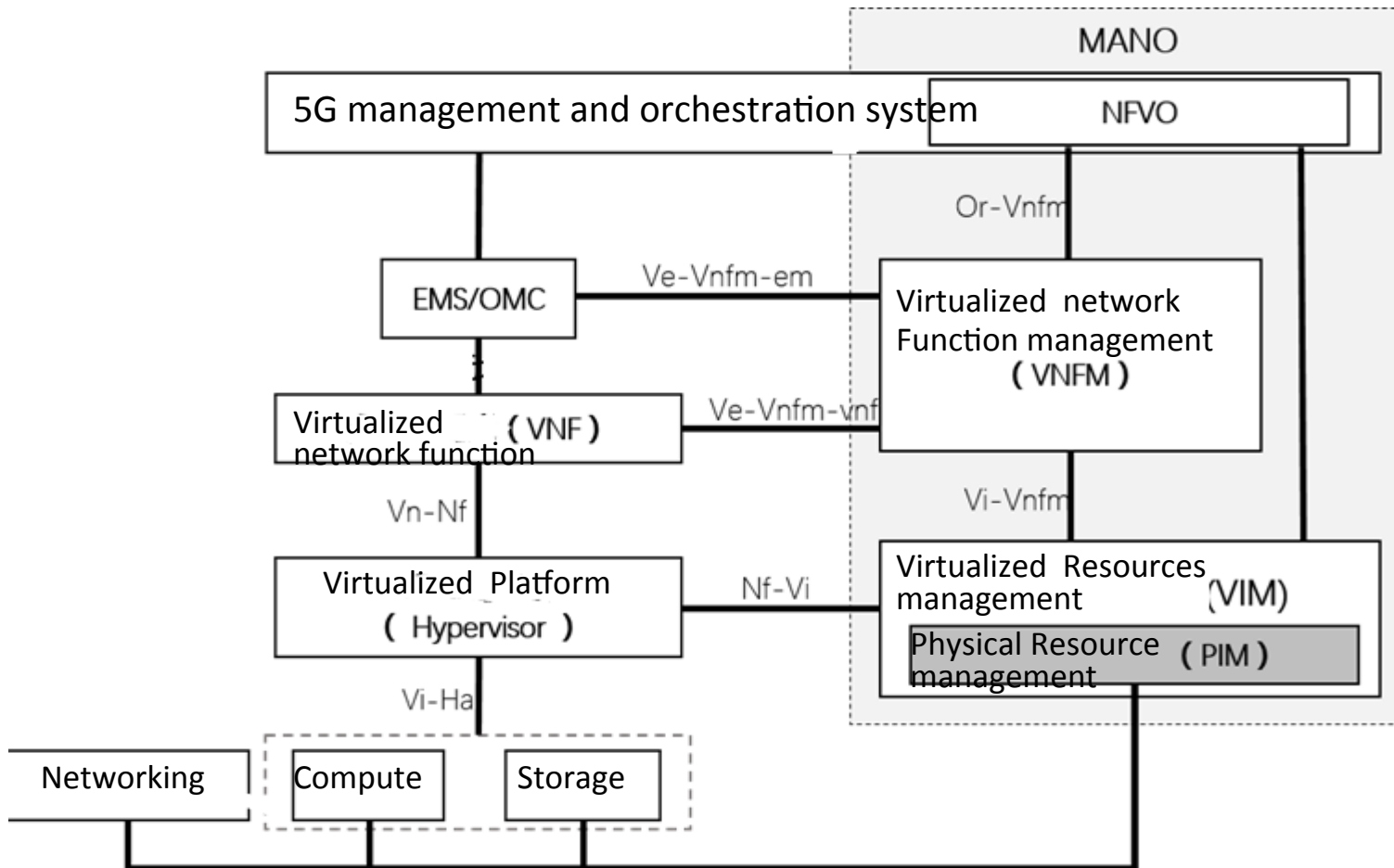
The diagram uses color-coded boxes to represent different network elements and dashed lines to indicate various interfaces and data flows between them.

5G Physical Network Architecture



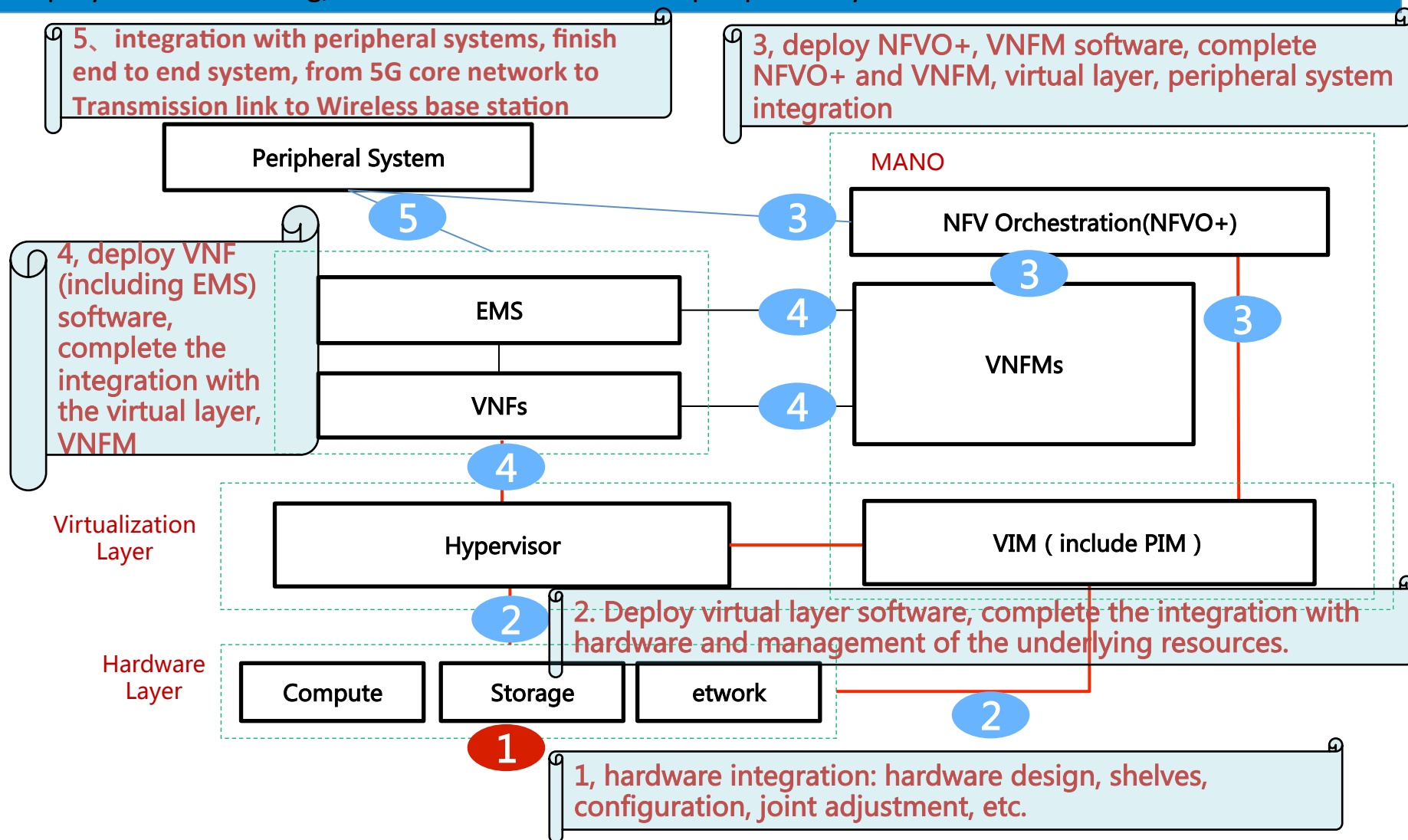
5G core network function based on NFV system structure

The 5G network element acts as a virtualized network element (VNF) in the figure and is deployed on the virtual platform (hypervisor), independent of the hardware. 5G virtualized network function consists of one or several virtual machines (VMs), which is put together to provide 5G core network functions.

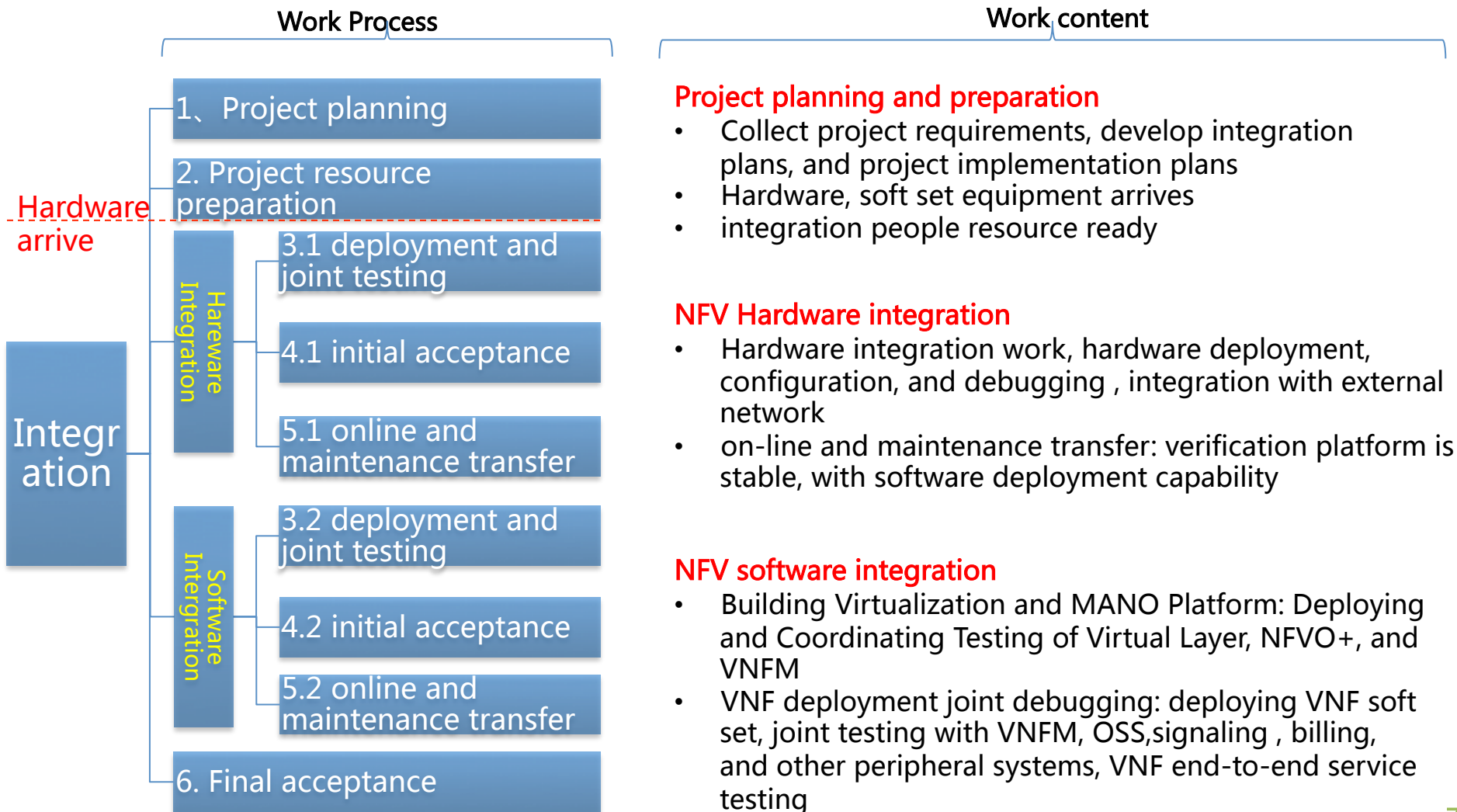


5GC self-integration

Based on the ETSI-based NFV architecture, the entire integration process includes planning and design, hardware integration, virtualization layer deployment and debug, MANO deployment and debug, VNF deployment and debug, and interconnection with peripheral systems



Similar to traditional telecom equipment construction, NFV integration includes steps of project planning, resource preparation, deployment and debugging, online, and maintenance transfer.

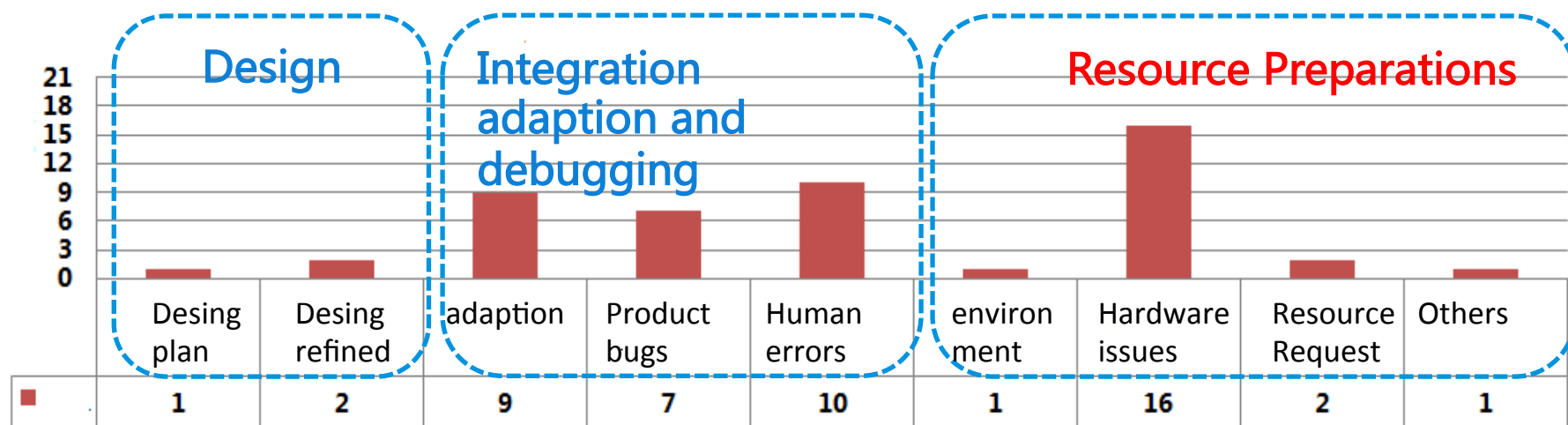


Aggregate analysis of integration issues

A total of 50+ integration issues were found, which were classified into the following types. Among them, problems such as adaption and adjustment of different layer are the key to integration.

strengthen the review

- ✧ **Design** : Divided into design to be refined, etc., need to improve the design plan
- ✧ **Adaption and debugging** : The most problems, involving products issues, different vendor adaption, human error, etc., need to strengthen pre-integration testing, automated configuration, automated inspection.
- ✧ **Resource preparation**: related to the data center room environment, current network resource allocation, equipment issues, etc., need to be prepared as soon as possible, and coordination about related resources.



Integration Key Point

This 5GC scale test have several key experiences in the integration as follows:

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1. Project planning and design

2. Project Resource Preparation

3. Depolymnt and Debugging

4. Initial Test

5. Online and operation transfer

6. Final test

Key point 1 : Identify requirements early and determine planning and design

- Communicate to confirm the internal and external network intercommunication needs of the resource pool, and formulate a solution network plan
- According to the design, prepare the follow-up implementation plan and configuration script in advance, and review the configuration script (conform to the plan without error omission)
- Determine the interconnection scheme and parameter details of the existing network equipment.

Key point 2 : Resource request

- Reauest about network IP addresses and other resources should be submit immediately after the plan was finalized
- The internal VLAN and the private network IP address are planned and allocated after the requirements are clearly defined, which is convenient for the software vendors to refine the design in advance.

This 5GC scale test have several key experiences in the integration as follows:

集成

1. 项目规划设计

2. 项目资源准备

3. 部署及联调测试

4. 初验

5. 割接上线及交维

6. 终验

Key point 3 : Hardware Preparation

- Server basic configuration need to automated batch configuration/checking, shortening hard integration time
- The server firmware version (BMC, BIOS) should be prepared according to the project requirements before leaving the factory. It is recommended to increase the standardization testing of the server;

Key point 4 : network connection check

- After the hardware and connection is ready, the full-scale network connectivity is automatically checked to prevent the subsequent software installation and deployment from being reworked due to network connectivity issues.

Key point 5 : adaption about different vendors

During the integration process of different vendors' devices and systems, more adaptation problems occur. In the current network construction, it is recommended to clarify the matching of each component. After confirming the specification requirements and the version of each component, perform the full-scale simulation verification in the laboratory to eliminate the integration problem and reduce the integration issues in production site.

Key point 5 : alternative plan

In the process of on-site implementation, the alternatives in each stage should be prepared in advance to ensure the construction period.



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