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**Requirements for the long-range test network system of launch
vehicles**

运载火箭远程测试网络系统要求

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4 System Composition

4.1 Overall Architecture Remote test network refers to the launch site telemetry and control network (hereinafter referred to as "launch site telemetry and control network") or recovery telemetry and control network of launch vehicles. The network is integrated with the test network of the launch vehicle development unit to complete the information reception and exchange between the launch site and the launch vehicle development unit. A computer network system for switching, transmitting, processing, and displaying data. The remote test network does not include the launch vehicle launch control network or the recovery control network. The network is interconnected with the launch vehicle's launch control network or recovery control network through remote network equipment deployed at the launch site. The remote test network consists of the launch vehicle launch control domain (hereinafter referred to as the "launch control domain") and the launch vehicle recovery control domain (hereinafter referred to as the "recovery control domain"). The remote test network consists of three domains. the "Telemetry, Measurement and Control Domain" (TT&C Domain), the "Launch Vehicle Test Center Domain" (hereinafter referred to as the "Test Center Domain"), and remote transmission links. The system architecture is shown in Figure

1. The launch and control domain, recovery and control domain, and test center domain are typically divided geographically. Each domain has its own dedicated communication and computing facilities. Information is exchanged between machines or servers and isolated through transmission security equipment. Remote transmission links typically use dedicated

carrier lines or satellite communication. This method enables communication between different domains.

4.2 Measurement and Control Domain The telemetry, tracking, and command (TT&C) domain is deployed in the launch site area of the carrier rocket and generally consists of TT&C equipment (including rocket-to-ground communication equipment, power supply and distribution equipment, and TT&C computing). Test network switches, wireless devices (such as Wi-Fi, ZigBee, 5G, etc.), and remote transmission equipment (including communication devices) Computers or servers, network switching equipment), network security equipment (including intrusion detection equipment, etc.), transmission security equipment (including firewalls, security... It consists of a fully isolated zone, cipher machines, etc., and timing equipment. Test, control, and transmission information is sent through a test network switch and remote transmission equipment.

4.3 Recovery Measurement and Control Domain The recovery tracking and control domain is deployed in the recovery area of the launch vehicle's second stage and generally consists of recovery tracking and control equipment (including recovery communication equipment, recovery tracking and control systems, etc.). Computers, etc.), test network switches, wireless devices [such as Wi-Fi, ZigBee, 5G, bandwidth, etc.], remote transmission devices (packages) This includes communication computers or servers, network switching equipment, network security equipment (including intrusion detection equipment, etc.), and transmission security equipment (including anti-interference devices). It consists of firewalls, secure isolation zones, cipher machines, etc., and timing equipment. Information from the recovered monitoring and control equipment is transmitted remotely via network security equipment. Ready to be dispatched.

4.4 Test Central Area The test center domain is deployed inside the launch vehicle test center and typically consists of network equipment (network switching equipment, optical switching equipment) and computing equipment. Equipment (communication computers or servers, cloud server clusters, storage devices, various terminals), network security equipment (including intrusion detection equipment, etc.) Transmission security equipment (including firewalls, secure isolation zones, cryptographic machines, etc.) and wireless devices [such as Wi-Fi, ZigBee, etc.] It consists of [5G, etc.]. It receives and retrieves information sent by the telemetry, control, and measurement domain, and processes, stores, and displays it.

5.1.1 Network Functions

5.1.1.1 The remote test network should have the following functions.

a) **Data Communication.** Network connectivity between the launch and control domain, the recovery launch and control domain, and the test center domain enables information communication; key network nodes... The equipment employs redundant design, such as hot standby redundancy for switches and firewalls, enabling it to operate normally even in

the event of a single failure.

- b) Resource sharing. Provides a secure remote access mechanism, allowing users to access network resources from different locations; key application platforms adopt... Use highly reliable designs, such as employing multiple servers for hot standby or deploying application systems on virtualized cloud platforms.
- c) Application Services. Possesses launch support capabilities, enabling monitoring and retrieval of test data from the test center domain and the test control domain. And equipment operating status; possessing network monitoring and management capabilities, including monitoring the network operation and data interaction status of key communication nodes (such as... Real-time monitoring of network device communication status, port status, etc.
- d) Data Processing. Possesses the ability to acquire and analyze network data packets, and monitors and traces the flow of network data packets within network devices. Condition.

5.1.1.2 The launch control domain and the recovery control domain should respectively meet the telemetry and control requirements of the launch vehicle during the launch and recovery phases, and should mainly possess the following capabilities. The following functions.

- a) The ability to receive, store, manage, and use launch vehicle launch control and recovery data;
- b) For measurement and control equipment, recovery measurement and control equipment, remote transmission equipment, network security equipment, transmission security equipment, wireless equipment, and time control equipment. Provides a channel for information exchange, transmission, processing, and display between devices;
- c) Send rocket launch control information and recovery control information to the test center domain via a dedicated communication computer or server;
- d) Capable of exchanging information with the launch site system for the launch vehicle;
- e) It employs a redundant design, enabling it to operate normally under a single failure;
- f) Extend the wireless network using wireless devices.

5.1.1.3 The remote transmission link should have the following functions.

- a) It can achieve network connectivity between the launch site control domain, the recovery control domain, and the test center domain;

5.1.2 Software Functions

5.1.2.1 Software Information Flow 5.1.2.1.1 The software information flow is shown in Figure

2. The measurement, launch, and control domain and the recovery measurement, launch, and control domain software include real-time transmission software and post-transmission software. During testing... The software suite of Mind Domain includes real-time transmission software, post-transmission software, data service software, data processing software, and data application service software. The real-time transmission software and post-transmission software deployed in the launch control domain and the recovery control domain obtain information from the launch control equipment and then exchange it via the test network. Machines, remote transmission equipment, network security equipment, timing equipment, transmission security equipment, and remote transmission links transmit information to the test center domain. Real-time transmission software and post-transmission software send information to data service software for aggregation, and then to data processing software and data application software. Information is provided using service software. Figure

2. Software information flow in the remote testing network 5.1.2.1.2 The post-transmission software for the test and control domain, the retrieval test and control domain, and the test center domain should have the following functions.

- a) Document transfer function between launch sites and launch vehicle development units, compatible with one-to-one or many-to-one modes;
- b) A function to record the transfer progress; if the transfer is interrupted, it can resume from the last recorded progress until the file transfer is complete.
- c) The ability to directly import structured data into the corresponding database;

d) Function to record the working status and abnormal information during software initialization, operation and shutdown. 5.1.2.1.3 The real-time transmission software for the measurement and control, retrieval measurement and control domain, and test center domain should have the following functions.

- a) Receive test data from various systems in the field within the measurement and control area (including telemetry data, ground survey data, wind field meteorological data, and some audio data). The function of transmitting video signals, etc., into data packets (which should include frame counts and verification information) and then sending them to a remote test network;
- b) The function of receiving data packets, verifying data packets, and recording anomalies;
- c) The function of distributing data packets to their respective designated addresses;
- d) Function to count the number of data packets received and sent;

e) Function to count and analyze the number of dropped frames by frame. 5.1.2.1.4 The test center's data service software should have the following functions.

- a) Simultaneously receive real-time and post-event data (including telemetry data, ground