

The First World Vocational College Skills Competition

Competition Rules

I. Name of the Skill

No.: W11

Chinese name: 通信网络管理

English name: Communication IT Network Administration

Industry: Electronic information industry

II. Competition Purpose

The World Vocational College Skills Competition (the “Competition”) aims to bring together standards, technologies, equipment, teachers and students in the field of vocational and technical education at home and abroad, promote China's vocational education to go global and serve international cooperation in production capacity, build an important platform for teachers and students of international vocational schools to deepen friendship, exchange skills and show expertise, and promote the development of a world community of skills. Through the skills competition, expertise show and experience exchange, this Competition can be a platform to share the best practices of international vocational and technical education, enhance the influence of China's vocational and technical education in the world in this field, and promote the development of China's vocational and technical education in line with global vocational and technical education.

With 5G new-generation information technology and industry applications as the core, the Communication Network Administration Skill Competition in the World Vocational College Skills Competition (the "Competition") features 5G communication network detection and intelligent connected vehicle (ICV) applications. China has built the world's largest 5G network, with more than 1.4 million 5G base stations, accounting for more than 60% of the world, covering all prefecture-level cities and counties and more than 80% villages and towns of the country. Steady progress has been made in 5G "new infrastructure", preliminary results have been achieved in 5G investment, and the number of 5G users has grown rapidly. In addition, 5G has been gradually applied in industries, with the number of enterprise users growing rapidly. A number of typical applications have been formed in transportation, energy, manufacturing and other industries, and new models and new business forms such as 5G+ intelligent network connection, 5G+ remote consultation, 5G+ industrial Internet, and 5G+ remote education constantly spring up. 5G is increasingly becoming an important driving force that supports high-quality economic development. Through inter-industry connection and ripple effects, 5G will generate demand for tens of millions of talent. Therefore, it is particularly important to cultivate high-quality skilled talent who masters the basic principles of 5G communication network and has practical engineering application ability. Competitors are required to complete tasks such as 5G communication network configuration, detection case execution, instrument operation and detection result analysis in accordance with national testing standards, which aims to cultivate and assess their

professional basic knowledge, detection standards and practical operation skills. Competitors are also required to complete the system construction, application scenario design, development process and implementation of 5G ICV application, which aims to cultivate and assess their professional basic knowledge, engineering practice ability and innovative application ability.

III. Competition Content

The Competition content is designed based on typical skills for real 5G communication network jobs, covering 5G OM link management, 5G transmission link management, 5G RF link management, 5G cell parameter management, 5G RF signal index parameter detection, 5G terminal equipment access configuration, 5G ICV application debugging and other job skills. The Competition is divided into two phases, and competitors' mastery of 5G communication network administration technology will be comprehensively assessed step by step through the Competition content in different phases.

1. 5G communication network detection task.

1.1 Configuration for 5G communication network detection.

In this part, through 5G simulation software, two foreign competitors jointly complete the preliminary base station parameter configuration in the 5G base station communication network detection task, including 5G OM link management, 5G transmission link management, 5G RF link management, 5G base station system parameter management and other tasks.

1.2 Implementation of 5G communication network detection.

In this part, two domestic competitors jointly complete the RF signal detection in 5G base station communication network detection task, including detection of 5G base station transmitter power, detection of 5G base station ACLR (Adjacent Channel Leakage Ratio), transient response detection of 5G base station transmitter, 5G base station general scattering detection, autotest and other detection tasks.

2. Configuration and debugging task of 5G ICV.

2.1 ICV configuration.

In this part, through ICV simulation software, two foreign competitors jointly complete the configuration, including the environment configuration of 5G ICV system, debugging and operation of lane line identification code, lane line identification test based on real video and other tasks.

Assessment points: Configuration of 5G network environment, debugging of lane line identification code, application of lane line identification code in 5G network

2.2 Intelligent network connection debugging.

This part is completed by two domestic competitors. The content includes the configuration and debugging of the network environment of 5G ICV, the debugging and operation of lane line identification code, the transmission of lane line identification image based on 5G network, debugging and operation of target detection code, 5G ICV operation on sand table and other tasks.

Assessment points: Configuration of 5G network environment, application of lane

line identification code in 5G network, image transmission application in 5G network, debugging and operation of target detection code in 5G network, comprehensive application of 5G ICV.

3. Competition Content corresponds to the core knowledge and core technical points.

No.	Test content	Knowledge points	Percentage
Phase I	Configuration for 5G communication network detection	5G network element functions, the hardware structure of 5G base station products, the hardware parameters of base station, the application configuration of typical base station scenarios, and the smooth upgrade strategy of base station. Tool preparation before connection, transmission link configuration, board configuration, network planning, RF frequency resource configuration, cell parameter configuration.	13%
	Implementation of 5G communication network detection	RF basic knowledge: Basic concepts of frequency, power and bandwidth, frequency band distribution and signal characteristics of mainstream communication systems. Basic knowledge of major RF devices, such as filter, attenuator, combiner, circulator and limiter.	50%
		Basic principle of spectrum analyzer: Basic architecture of spectrum analyzer, significance of setting items such as frequency, power, trigger, reference clock, RBW, SWEEP TIME and detection mode of spectrum analyzer.	
		Fundamentals of RF index test: Significance of commonly used test indexes, output power of transmitter power, ACLR, scattering test, transmitter transient response, etc.	
	Spectrum analyzer program control command, autotest interface, program running logic		
Phase II	ICV configuration	Python-based 5G network environment configuration, 5G network based image processing and image transmission	12%
	Intelligent network connection debugging	Deep learning-based 5G network application, random access process of 5G intelligent connected terminal, registration process of 5G intelligent connected terminal, establishment of 5G service session.	25%

IV. Competition Method

i. Team formation

- "0.5+0.5" hand-in-hand Chinese-foreign mixed team ("mixed team") is adopted, which consists of one Chinese student and one foreign student. Each team can have 2 instructors. Competitors should sign up, compete and win prizes in teams.
- Domestic competitors must be registered full-time students in higher vocational colleges, as well as registered undergraduate students in vocational colleges.
- Foreign competitors must be foreign full-time students in related majors of vocational schools or colleges and universities providing vocational education, and international students of undergraduate schools in China are also encouraged to participate.
- Competitor replacement: If a competitor is unable to participate for any reason during the preparation, the relevant department should issue a written explanation ten

working days before the start of the corresponding Competition. The competitor will be replaced after verification by the office of the Executive Committee of the Competition ("Executive Committee"). After the Competition starts, the team is not allowed to replace any competitor.

ii. Competition method

The Competition will be conducted in the forms of on-site Competition + recorded broadcast. Domestic competitors will compete on site; if foreign competitors are unable to attend the on-site competition, they will compete through recorded broadcast. Foreign competitors must send the competition video that meets the competition requirements to the mailbox designated by the Executive Committee seven days before the official competition day, and the Executive Committee will check and try to broadcast the videos and seal them for the record. On the official competition day, the videos should be unsealed by the jury, and those from the foreign competitors should be broadcast on the big screen on site. The marking criteria should be the same as those for on-site competition. Requirements for competition video: The file format is MP4; the resolution is not less than 1280*720, the recommended aspect ratio is 16:9, and the video content needs to fully display the competition process.

V. Competition Process

Competition timeline and process

Time	Content
7:30-8:00	Sign-in and drawing lots by teams to form groups
8:00-10:00	Group A: Competition in Phase I
10:20-12:20	Group B: Competition in Phase I
12:20-13:30	Competitors take a rest and have lunch
13:30-15:30	Group C: Competition in Phase I
15:50-16:50	Group A: Competition in Phase II
17:10-18:10	Group B: Competition in Phase II
18:30-19:30	Group C: Competition in Phase II
19:30-20:30	Judges' marking and review
20:30-21:00	Competition results announcement
21:00-22:00	Competition results recording and reporting

VI. Competition Task Paper

The design expert panel appointed by the Executive Committee is responsible for the design of the Competition Task Paper. In accordance with the content requirements of the Competition Rules, the direction and difficulty are determined based on the relevant professional training standards of vocational schools and national occupational standards. After the paper design is completed, the Competition Task Paper will be submitted to the experts appointed by the Executive Committee for review. Competition Task Paper will be made public through the Competition information release platform one month before the start of the Competition. Please refer to the appendix for the sample questions of the Competition.

VII. Competition Rules

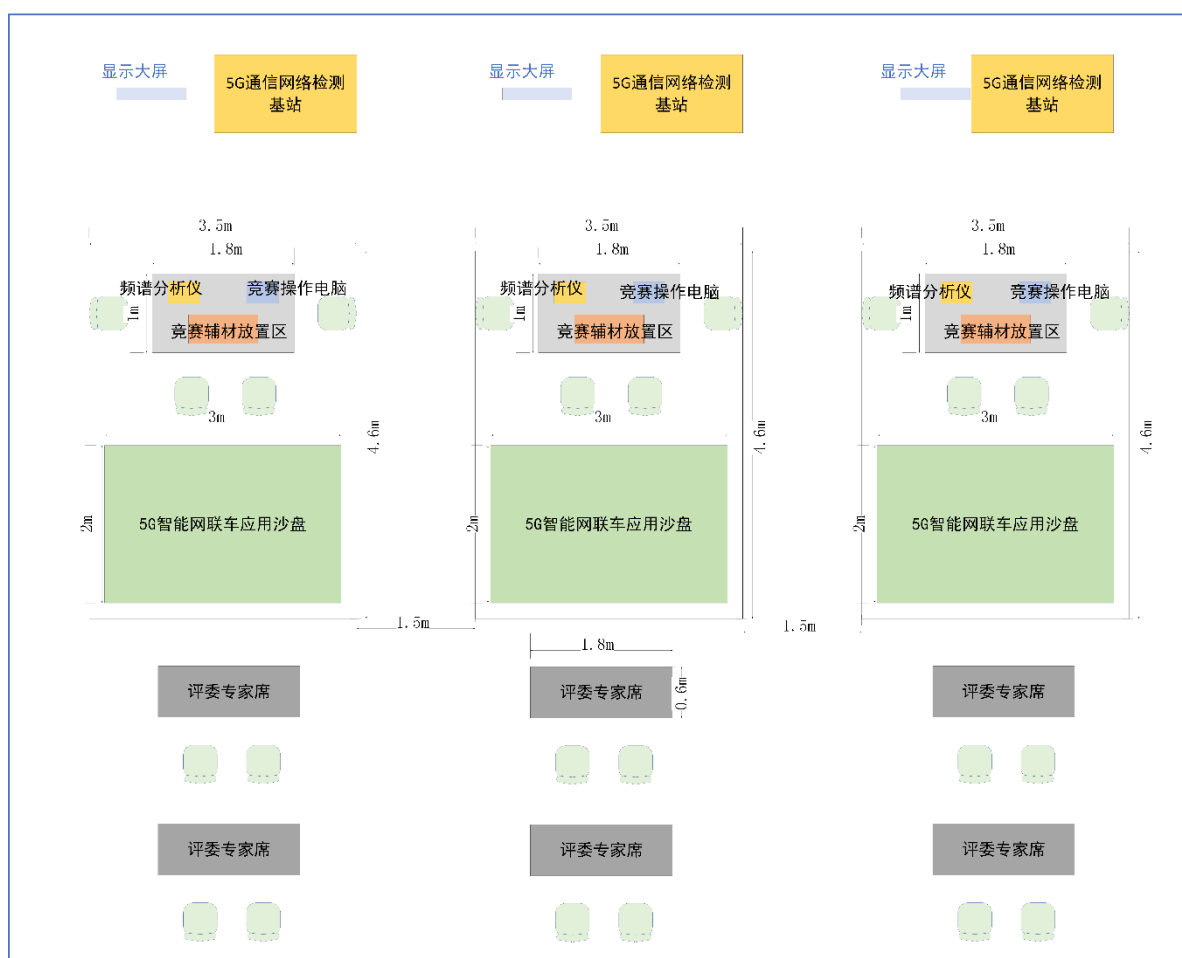
i. Familiarize with the workshop

1. The Executive Committee will arrange all the teams to get familiar with the workshop in a unified and orderly manner. When familiarizing themselves with the workshop, teams are limited to the observation area and are not allowed to enter the Competition area .
2. It is strictly forbidden to communicate with on-site staff. Please refrain from making unfounded remarks that can cause damage to the overall image of the Competition.
3. Teams should strictly observe all rules for the Competition when familiarizing themselves with the workshop. In order to avoid accidents, crowding and talking loudly are strictly forbidden .

ii. Official Competition

1. In each round, competitors will start the Competition following the jury president's start instruction. Competitors should make reasonable plans and complete the tasks by utilizing all the conditions provided on site.
2. Closed management will be conducted for competitors will during the Competition.
3. During the Competition, competitors must strictly follow the safety operating procedures and receive the supervision and warnings of judges to ensure safety. In case of a personal safety accident and an equipment fault due to the personal mis-operation of a competitor, the jury president should have the right to stop the competitor from continuing the competition. In the event of failure to continue the competition due to an equipment fault arising from non-personal factors of competitors, the jury president should make a decision based on the specific situation (shifting the team to a standby workstation or rearranging the team to the last competition session). If the jury president confirms that the equipment fault can be removed by technical support staff and the team can continue the competition, the competitors should be given additional competition time to make up for the delay.
4. If a competitor wants to end the competition earlier, he/she should raise hands to give a sign to the judge. The judge will record the competitor's its end time of the competition.
5. The jury president will remind the remaining time and issue the closing instruction during the Competition. When the Competition ends, all competitors who have not completed their tasks must stop operation immediately.
6. Competitors are not allowed to bring any team or personal information, any communication and storage equipment, paper materials and other items into the workshop. All necessary items will be provided in the workshop.
7. The Competition results such as the competitor report submitted by a competitor should be confirmed by the judges and the competitor's workstation number.
8. The Executive Committee will make interpretation or decision for other matters not covered or emergencies.

VIII. Competition Environment



显示大屏	Large display screen
5G 通信网络监测基站	5G network monitoring base station
频谱分析仪	Spectrum analyzer
竞赛操作电脑	Operation computer for the Competition
竞赛辅材放置区	Competition auxiliary materials area
5G 智能网联车应用沙盘	Sand table for 5G ICV application
评委专家席	Judge and expert panel

i. The Competition venue is the anti-5G base station, demonstration area, competition area and judges' work area from top to bottom, which covers an area of 180 square meters (15m * 12m).

ii. Hardware equipment and corresponding software are provided in each workstation in the competition area for the use of competitors. The workstation should be big enough for four people to operate at the same time. The area of each workstation should be 16.1 square meters. The specific requirements for hardware and software are formulated by the Executive Committee.

iii. Judges' work area should have enough space to meet the work needs, be equipped with computers, printers and other necessary auxiliary equipment and stationery.

iv. The medical area is equipped with commonly used emergency medicines,

pandemic prevention materials and medical personnel, and a temporary quarantine area.

IX. Technical Specifications

i. Communication industry standards

1. Safety Technical Requirements of 5G Mobile Communication Network YD/T 3628-2019
2. Technical Requirements for Enhanced Mobile Broadband Terminal Equipment Using 5G Digital Cellular Mobile Communication Network (Phase I) YD/T 3627-2019
3. General Technical Requirements for Wireless Access Network of 5G Digital Cellular Mobile Communication Network (Phase I) YD/T 3618-2019
4. Technical Requirements for Network Functions of Core Network of 5G Mobile Communication Network YD/T 3616-2019
5. General Technical Requirements for Core Network of 5G Mobile Communication Network YD/T 3615-2019
6. Technical Requirements and Test Methods for Xn/X2 Interface of 5G Digital Cellular Mobile Communication Network (Phase I) YD/T 3620-2019
7. Technical Requirements and Test Methods for NG Interface of 5G Digital Cellular Mobile Communication Network (Phase I) YD/T 3619-2019
8. Electromagnetic Compatibility Performance Requirements and Measurement Methods for Cellular Mobile Communication Equipment - Part 17: 5G Base Station and Its Auxiliary Equipment YD/T 2583.17-2019
9. Electromagnetic Compatibility Performance Requirements and Measurement Methods for Cellular Mobile Communication Equipment - Part 18: 5G User Equipment and Auxiliary Equipment YD/T 2583.18-2019
10. 3GPP R15 Standard Protocol
11. 3GPP R16 Standard Protocol

ii. Vocational qualification standards

1. National Vocational Standard for Information and Communication Network Maintenance Personnel (Vocational Code 4-04-02-01)
2. National Vocational Standard for Information and Communication Network Operation Managers (Vocational Code 4-04-04-01)
3. Vocational Skill Level Standard for 1+X Mobile Communication Base Station Testing

iii. Relevant knowledge and skills

1. Basic concepts and principles of mobile communication.
2. 5G key technologies and protocol specifications.
3. Basic knowledge of 5G equipment, equipment configuration and operation,

detection environment construction.

4. Operation capability of 5G simulation system.
5. Cognition of auxiliary materials for 5G RF test.
6. 5G RF test principle.
7. 5G terminal access process.
8. 5G vertical industry applications.

iv. Basic technologies and requirements

1. Environment construction for 5G communication network detection, principle of wiring calibration for RF conduction test.
2. Configuration technology for 5G communication network detection.
3. Detection technology of transmission power of 5G base station.
4. Detection technology of ACLR of 5G base station.
5. Detection technology of transient response of 5G base station transmitter.
6. Test detection technology of general scattering of 5G base station.
7. 5G terminal access process technology.
8. Vertical industry application technology of 5G private network.

X. Technology Platform

No.	Name of the equipment and software	Specifications and requirements	Quantity	Unit
Hardware of main equipment for the Competition				
1	5G core network	<p>5G core network hardware: Rack-mounted server; 2U height; two Intel Gold 5218 2.3GHz 16-core CPUs; two 480 GB SATA disks + two 1.2 TB raid controller cards with batteries, and mainboard with batteries; number of PCIe slots ≥ 7; 256GB (16*16GB) or (8*32GB) DDR4-2400 intelligent memory; three 10G dual-optical-port 10Gb network adapters; 10GE multimode optical modules supporting SR-IOV; passthrough supported, DPDK supported; corresponding guide rails and redundant power supply (hot-swappable power supply, 1+1 redundancy, 220V AC and -48V low-voltage DC power supply, with two power cords).</p> <p>5G core network system software: B/S architecture core network platform built according to 3GPP R15 standard, which includes integrated control plane, user plane, policy, and user data management functions, provides functions such as unified user access, unified policy management, unified authentication and authorization, unified operation and maintenance, and supports typical functions such as edge computing, network slicing, and service-oriented interfaces. Flexible network slicing is supported. The user can manage and</p>	1	Set

orchestrate different combinations of network functions to construct network slices with different features. Three application scenarios defined by the ITU are supported, namely enhanced mobile broadband scenario, large connection scenario, and low latency and high reliability scenario. Specific functions are as follows:

1. AMF (access and mobility function) management.

Registration management: initial registration, periodic registration, mobile registration, deregistration; Security management: 5G-AKA authentication, NAS encryption, integrity protection; Mobile management: Xn switch, N2 switch; Connection management: service request; Slice selection: slice selection at initial registration, slice selection at session establishment; EPC interworking: N26 idle state mobility, N26 switching interworking; POOL management: AMF POOL load balancing.

2. SMF (session management function).

Session management: establishment, modification, and release of sessions; Downlink data notification; Termination of NAS message in SMF part; UE IP address allocation and management; UPF function selection and control; Configuration of UPF shunt: UL-CL, BP shunt, IPv6 multi-homing shunt; Determination of the SSC mode of the session; Policy control: QOS policy control and billing policy control; Billing: billing data collection and billing interfaces support.

3. UDM (unified data management) function.

User signing data management; Generation of 3GPP AKA authentication certificate; User signing data management; User data subscription and notification; Roaming and area restrictions; Mobility management; Session management: establishment and release of sessions.

4. AUSF (authentication service function)

UE authentication function, supporting 5G AKA and EAP-AKA' authentication process; providing KEY derived information for the requested NF.

5. PCF (policy control function)

Access and mobility policy control function; Session management policy function; QOS control: QOS flow rate control, PDU session rate control, non-GBR service flow rate control; Gating function; Establishment, update, and deletion of policy association; Charging control: charging policy control.

6. NRF

Service management function; Service discovery; Service authorization; NF status subscription and notification.

7. NSSF (network slice selection function)

Select a collection of network slice instances serving UE; Determine the permissible NSSAI; Determine the NSSAI configuration; Determine the list of candidate AMFs;

8. UPF (user plane function)

Packet routing and forwarding; UL CL (uplink classifier) function; BP (branch point) supporting multi-host PDU sessions; QoS traffic processing on the user plane; Service identification: Layer 3, layer 4 and application layer service identification; QOS function: processing

		<p>QOS rules; Billing function: Collection and reporting of billing information; IPv4/IPv6 double stack.</p> <p>9. Operation maintenance</p> <p>VNFM function; Configuration management; Fault management; Performance management; Safety management; Log management; Software management</p>		
2	5G bearer network	<p>Three-layer 10G optical switches, with each containing 20 1/10G SFP+ optical ports, 4 10G/25G SFP28 optical ports, and 2 40G QSFP+ optical ports. The whole machine supports 32 10G ports, with modular power slot 150W AC power module, and modular fan slot.</p>	1	Set
3	Baseband processing unit of 5G base station	<p>It is core main equipment of 5G system. It completes baseband processing of 5G signals and is responsible for processing algorithm protocols such as physical layer and MAC layer, including switching control and transmission unit board, baseband processing board, power supply board, fan board and subrack.</p> <p>I. Function Requirements:</p> <p>1. Function requirements for switching control and transmission unit board:</p> <p>1) It supports the synchronization between base station system and Beidou/GPS;</p> <p>2) It supports the 24-hour synchronization in the case of satellite signal loss;</p> <p>3) It supports the interface and interface protocol processing between the core network;</p> <p>4) It supports the service and signaling exchange between the BBU internal boards;</p> <p>5) It supports presence and survival detection of internal boards;</p> <p>6) It supports power on/off control of internal boards;</p> <p>7) It supports the clock distribution for BBU internal boards.</p> <p>2. Function requirements for baseband processing board:</p> <p>1) It supports physical layer processing;</p> <p>2) It supports link layer processing;</p> <p>3) It supports system synchronization;</p> <p>4) It supports power controlled delay start;</p> <p>5) It supports I²C SLAVE management.</p> <p>3. Function requirements for power board:</p> <p>1) It supports power conversion from -48V to 12V, and provides power for all EMB6216 boards.</p> <p>2) It supports input voltage DC43-55V.</p> <p>4. Function requirements for fan board:</p> <p>1) It provides heat dissipation for the BBU system;</p> <p>2) It includes fan unit temperature measurement (temperature sensing function), fan speed measurement and fan speed control;</p>	3	Set
4	5G RF remote unit	<p>It is core main equipment of 5G system. It completes digital if (intermediate frequency) processing of 5G signals and provides 2 RF channel links for sending and receiving. It can be used for networking in 5G outdoor remote coverage scenario or indoor distributed antenna coverage scenario.</p> <p>Main technical indicators:</p> <p>Operating bandwidth: 160M</p> <p>Operating band: N41</p> <p>Radiation power: 2X100w</p> <p>Number of channels: 2TR</p> <p>Input power: AC220V (voltage range 140V-300V)</p>	3	Set

		<p>Power consumption: 480W Band range: 2515-2675MHz Supported mode: TDD NR+TD-LTE Optical port: 2*25Gbps Sensitivity of single channel receiver: ≤-97 dBm RF port: N type (5 cascaded) Mounting: Pole mounting, wall mounting, tower mounting and other mounting methods are supported Equipment specifications: 430mm x295mm x156mm; 20kg Environmental temperature: -40°C-+55°C Relative humidity: 5%-95% Protection class: IP65</p>		
5	5G antenna unit	<p>Type: Directional antenna Number of antenna ports: 2 Polarization mode: ±45° Operating band: 2515-2675MHz Maximum gain: 13dBi Sidelobe suppression ratio: 7dB Cross polarization ratio: 33dB Front-to-back ratio: 31dB</p>	1	Set
6	5G module	<p>Basic Parameters Packaging: M.2; 30 x 52 x 2.3mm Weight: TBD Operating voltage: 3.2V-4.6V, Typical 3.8V Operating temperature: -30-+75°C Extended temperature: -40-+85°C AT command set: 3GPP TS 27.007 and 27.005, proprietary FIBOCOM AT commands Number of antenna: 4 FOAT/DFOTA/VoLTE/Audio/eSIM is supported (optional, built-in domestic eSIM chip)</p> <p>Function features It supports SA/NSA networking mode and ENDC 5G Sub-6: n1/28/41/78/79 LTE FDD: B1/2/3/5/7/8 LTE TDD: B34/38/39/40/41 WCDMA: B1/2/5/8 5G NR: DL 4*4 MIMO: n1/41/78/79 UL 2*2 MIMO: n41/78/79 LTE : DL 2*2 MIMO: B1/2/3/5/7/8/34/38/39/40/41 UL 1*1 MIMO</p> <p>Data features NR SA: 1.9Gbps(DL) / 750Mbps(UL) NR ENDC: 2Gbps(DL) / 340Mbps(UL) LTE: 500Mbps(DL) / 150Mbps(UL) WCDMA: 42Mbps(DL) / 11Mbps(UL)</p> <p>Interface capability UART/I2C ×1 GPIO I2S ×1 USB3.0 ×1 USB2.0 ×1 PCIe2.0 ×1 UIM ×2 MIPI ×1</p>	3	Set

		<p>Operating System Linux / Android /Windows</p> <p>Authentication Regulatory certification: CCC* / SRRC* / NAL* / RoHs* Operator certification: CMCC* / CTCC* / CUCC*</p>		
7	5G private network SIM	Customized 5Gsim card	3	Piece
8	5G ICV	<p>I. Specifications Intelligent driving vehicle</p> <p>1. Chassis: (1) Size: 290×195mm (including tires) (2) Motor parameters Motor voltage: 6V-12V (inclusive). (3) Steering engine parameters Product size: 38*16*36mm. Operating voltage: 4V-9V (inclusive). Metal gears are used.</p> <p>2. Type A deep learning circuit board GPU 128 CUDA cores. CPU quad-core ARM Cortex-A57 MPCore processor. 4 GB 64-bit LPDDR4 video memory. Memory: 16 GB eMMC 5.1. Camera: USB interface plug and play is supported. Display interface: HDMI interface is supported.</p> <p>3. Type A electronic control board Operating voltage: 4V-6V (inclusive). Input voltage: 7V-12V (inclusive). Pin direct current: 20 mA. Flash memory: 32KB.</p> <p>4. Type B electronic control board Operating voltage: 8V-16V (inclusive). Input voltage: 12V±3V. Digital I/O port 12 (including 8-channel PWM output). Analog input port 8. Direct current of each I/O port: 40 mA. Flash memory: 512KB. Dominant frequency: 16 MHz.</p> <p>6. Plane sand table Size: 3M*2M Traffic lights, obstacles, fences and other props are available</p> <p>II. Function Requirements (1) It supports open source customized development and transparent scheduling throughout the process, which can clearly show the system kernel and usage. It can fully show the operation of the vehicle and the system can support control of timely response; (2) The system is fully open, supporting developers to adjust and optimize the environment modification and dependent modification of the overall system based on the existing system; (3) The internal information circulation of the vehicle is obtained via subscription. Through the coordination of the host node and the slave node, the information can be transmitted to the subscribed nodes in real time and quickly. (4) Overall information transmission and information</p>	3	Set

		<p>content are transparent. Directly view of the status and content of information flow is supported, and response can be made to changes in the system content at any time;</p> <p>(5) The vehicle system is equipped with mainstream frame, and can support users to optimize, adjust, remake and replace the frame, with better autonomy;</p> <p>(6) The vehicle system supports remote direct access and can synchronize all the status of the vehicle system in real time. All functions supported by the vehicle system can be completed through remote connection, including but not limited to controlling the vehicle, vehicle development, deep learning framework development, and vehicle architecture development.</p> <p>(7) Deep learning-based visual-only lane line recognition, traffic light recognition, obstacle recognition, and traffic signs recognition functions are supported. All recognition can be completed only through the visual images from the camera, and the whole process can be verified and replicated through the car system. The vehicle can complete the above-mentioned functions without assistance from external equipment;</p> <p>(8) The algorithm model can be customized so that one model fits multiple scenarios, that is, only one model can be used to complete all functions. In addition, the vehicle can complete the corresponding response and movement after identification to integrate software and hardware as a whole. The vehicle is able to support integration of hardware and software.</p> <p>(9) The vehicle system can adaptively support the model of the corresponding deep learning framework, and can quickly complete replacement of the deep learning model with one click. The vehicle system provides standard model file, and only the file of deep learning framework model for the vehicle system is needed to complete the replacement.</p> <p>(10) Access to 5G private network is supported, which can be used to present and control the perspective of the vehicle in real time to affect the vehicle status, including driving perspective, overlooking perspective, vehicle rear perspective, and emergency parking. The real-time control delay must be less than or equal to 10ms.</p>		
9	Spectrum analyzer	<p>Indicator requirements: Range of frequency domain measurement: 10K- 3.6GHz; Analysis bandwidth: ≥ 1GHz; Ground noise: ≤ -90dBm/MHz; Range of internal attenuation: 0-70dB;</p> <p>Function indicators: 1. It should support spectrum analysis function; 2. It should support signal time domain analysis; 3. It should support channel power statistics; 4. It should support ACLR statistics; 5. It should support bandwidth usage statistics;</p>	3	Set
10	Vector signal generator	<p>Indicator requirements: Range of frequency domain measurement: DC-3GHz; Ground noise: ≤ -90dBm/MHz;</p> <p>Function indicators:</p>	1	Set

		<ol style="list-style-type: none"> 1. Support CW signal transmission; 2. Support modulation signal transmission; 3. Support line loss compensation; 4. Support 5G NR modulation signal transmission; 5. Support delay parameter modulation; 		
11	48V DC power supply	DC power subrack Support three-circuit separate DC output Support AC output under stabilized voltage Support DC combined output DC power core module Input voltage: AC190-250V Output voltage: 3*48V Power factor: ≥ 0.98 Output power: 2000W	1	Set
Competition software				
1	Simulation software for 5G operation and maintenance	<ol style="list-style-type: none"> 1. It should have functions such as 5G base station opening, cell parameter configuration, version change and maintenance, software and hardware interface planning, and network architecture topology. 2. It should support five RAN Network Elements, i.e. BBU, AAU, RRU, rHub, and pRRU, and support free deployment of all BBU boards. RF units should support networking in normal mode, cascading mode, load balancing mode, and active/standby mode; support the operation and maintenance simulation of base stations, including 5G transmission link configuration and fault location, 5G RF link planning, cell parameter configuration, software and hardware interface planning, network architecture topology and other simulation functions; Main technical parameters: <ol style="list-style-type: none"> 1) Cabinet index, subrack index, board index, link index, and route relationship can be configured. 2) It provides real 5G base station data upload and analysis for experimental teaching use. 3) The baseband processor status, link status, and startup process status can be queried. 4) It has functions such as log management, fault management, and alarm management. Alarm severity, alarm sound, and alarm severity color can be customized. 5) It supports parameter configuration for cell center frequency, operating bandwidth, operating band, subcarrier interval, format, SSB frequency point, cell PCI, mobile country code, mobile network code, ID of tracking area to which cell belongs, port type, PDCCH DRMS power, SSB transmission power, GNB global ID, beam type, pss transmission power, PDSCH DMRS power, and cell phase compensation switch and provides video demonstration evidence. 6) It should be compatible with windows 7 or a later version of windows. 	3	Set
2	Virtual simulation for 5G hardware test	<ol style="list-style-type: none"> 1. It supports the high-end spectrum analyzer and signal source virtual simulation to realize analysis of sending and receiving signals through wireless communication; 2. It includes spectrum analysis of 5G FR signals, power statistics of 5G broadband debugging signals (TDD and FDD), ACLR test of 5G FR signals, bandwidth occupancy test of 5G FR signals, vector amplitude error test of 5G FR signals and other functions; 	3	Set

		<p>Main technical indicators</p> <ol style="list-style-type: none"> 1) Measurement bandwidth DC-6GHZ; 2) Ground noise -90dBm/MHz; 3) Measurement dynamic range -90dbm-50dBm; 4) Support external attenuation selection (0-65dB); 5) Support attenuation compensation function; 6) Detection modes such as instantaneous value and root mean square are supported; 7) It should be compatible with windows 7 or a later version of windows; 		
3	Autotest platform	<p>Function requirements:</p> <ol style="list-style-type: none"> 1. It is python-based CS architecture platform; 2. It should be compatible with windows 7 or a later version of windows; 3. It can realize the control of all instruments that meet VISA library standards, including at least spectrum analyzer, vector signal source and vector network analyzer; 4. It supports test case library management (support case addition, deletion, change, view), at least covering YD/T2583.17 standard; 5. Secondary development interface can be opened to support students to develop test cases for 5G mobile communication base station; 	3	Set
Competition auxiliary materials				
1	RF feeder	<p>N type RF coaxial feeder Complex impedance: 50Ω Attenuation: 1dB/m±0.3 Operating band: 9K-3GHz</p>	16	Piece
2	Adjustable attenuator	<p>Interface: Type N male connector Matching impedance: 50Ω Attenuation: 20dB±0.3 Operating band: 9K-3GHz</p>	4	Piece
3	Optical module	<p>Type: Single-mode optical fiber module Rate: 25Gbps</p>	20	Piece
4	Optical fiber	<p>Type: Multi-mode fiber</p>	15	Piece
5	RF load	<p>Interface: Type N male connector Matching impedance: 50Ω Power: 5w Operating band: 9K-3GHz</p>	3	Piece
Site equipment				
1	Computer for the Competition	<ol style="list-style-type: none"> 1. CPU: Intel Core 8 generation I5 or later is recommended. 2. Memory: 8G and above; 3. Operating system: 64-bit Chinese operating system for WIN 7 or a later version of windows; 4. Graphics card: NVIDIA GeForce GTX 970, AMD Radeon R9 290 equivalent or higher; 5. Video output: HDMI 1.4, DisplayPort 1.2 or above is supported; 6. Resolution: 1920*1080 and above; 7. Pre-mounted screen capture software, screen recording software. 	10	Set
2	5G equipment frame	<p>1m*0.6m*1.8m</p>	3	Set
3	5G satellite	<p>Customized timing antenna mounting kit, which supports</p>	1	Set

	timing antenna frame	pole mounting		
4	Competition console	1.8m*1m*0.8m	3	Set
5	Category 5 cable	Type: Category 5 cable CAT5E shielded cable*4x2*100Ω*1/350 MHz*PVC*-20/80°C	16	Piece
6	Large display screen	65 inches	3	Set

XI. Result Evaluation

(1) Requirements for judges (including encryption judges)

No.	Professional and technical directions	Requirements for knowledge and competence	Judging, teaching and work experience	Professional and technical titles (level of professional qualification)	Headcount
1	Mobile communication technology	Mobile communication network architecture and common technologies; Being familiar with mobile communication related national testing standards and methods.	Having relevant teaching experience or relevant working experience in enterprises of five years or above, having been a judge in provincial or industrial vocational skills competitions.	Having the associate senior professional title or above or senior technician professional qualification	6
Total number of judges	6				

The venue is under the jury president responsibility system. The jury president is responsible for the overall judging of the Competition. The jury president is selected and approved by the Executive Committee.

(2) The total marks of each competition content are the total marks of the teams, according to which the teams will be ranked from high to low. In the event of a tie, the jury will decide the ranking of the competitors based on the different marking priorities, in descending order of priority: implementation of 5G communication network detection > debugging of 5G ICV > configuration for 5G communication network detection > configuration of 5G ICV. If the comparison of marking priorities still fails to distinguish the overall ranking of the competitors, the marking judges will vote on all subjective marking items (judgment) of the Competition modules of the competitors with the same ranking. The competitor with higher votes will be ranked higher.

(3) Result announcement

The jury president will submit the marking results of the workstations (competition entries) within eight hours after the end of the Competition. After the results are re-checked and confirmed to be correct, the jury president, supervising personnel and arbitrators will sign for confirmation before announcement, and the announcement duration is two hours. If there is no objection to the announcement, the arbitrators will sign on the marking form and announce the results. Results will be submitted simultaneously to the competition administration system.

XII. Awards and Prizes

A gold, silver and bronze medal will be awarded to each different team, and the teams in the top 50% of the overall results (other than the top three) will be awarded the winning prize.

XIII. Preliminary Plans for the Competition Venue

Relevant contingency plan is as follows:

1. Reliability of the competition system: The Competition software and hardware environment and the computers run one week before the Competition, and are stress tested for at least three times to verify the normal functions.

2. Competition system servers: One primary and two secondary servers are provided on the Competition site.

The primary and secondary servers can realize fast switching and synchronization of the Competition data. All servers are equipped with UPS power supply to prevent accidental power failure.

3. Venue standby computers: The venue provides a spare computers. If the computer fails during the Competition (which cannot be solved by restart), the competitor should raise his/her hand and signal to the judges. After the judges and technical support personnel confirm the problems, the competitor can use a spare computer to answer the questions. If the computer failure is caused by the competitor's personal subjective misoperation, no compensation for the delay will be given after the competition time ends. If the computer failure has nothing to do with the competitor, the team will be compensated as appropriate for the time delay after the competition time ends.

4. Power supply and guarantee in accidents: In the event of equipment power failure, faults, and other accidents during the Competition, on-site judges need to promptly confirm the situation and arrange technical support personnel to handle the problem. Moreover, they should record the details and fill in the registration form for the make-up time. After reporting to the jury president for approval, they can arrange to give additional time to the corresponding competitors to make up for the delay.

5. Personnel safety: Ambulances and medical personnel should be on standby outside the venue during the Competition. In case of any accident such as illness or injury, medical personnel should take emergency first-aid measures and treat the competitor(s) in time. In case of serious illness or injury, they should be sent to the nearest hospital for treatment in time.

6. Pandemic prevention and control: If any competitor has fever in the venue, the on-site medical personnel in the medical area will deal with it according to the pandemic prevention and control plan of the Executive Committee.

7. Entry methods for foreign competitors: One week before the Competition officially starts, it should be confirmed whether foreign competitors can complete the Competition in the workshop according to the requirements of pandemic prevention and control. If it is confirmed that they cannot complete the Competition in the workshop, foreign competitors will be organized to complete the relevant tasks remotely by means of live broadcast or video recording.

XIV. Safety

i. Security

There should be a security group with the persons in security department of host school as members. The person responsible for security should be designated, and detailed security system and security plan must be formulated. The specific policy is as follows:

1. Ensure that all channels are unobstructed, and assign specialized personnel to stop irrelevant personnel from entering the venue, control personnel flow and audience saturation, and paste safety indicating signs.
2. For the social audience, the security group should properly conduct legal and reasonable inquiries and checks. For those who carry suspicious items and refuse to inquiry and check, the security group should prohibit them from entering the venue.
3. The security group should inspect and supervise the workshop at any time to ensure safety.
4. There should be necessary medical personnel and medical supplies as well as emergency rescue plans.
5. In order to ensure a smooth competition, all competitors are required to enter the workshop with valid documents issued by the Executive Committee. Those irrelevant to the Competition are not allowed to enter the workshop or affect the normal progress of the Competition in any way.
6. Flammables, explosives, and all kinds of hazardous materials unrelated to the Competition should be strictly prohibited from being brought into the workshop, and no bag can be brought into the workshop.
7. Network security control should be carried out on the competition site to avoid information exchange inside and outside the venue, which aims to fully reflect the seriousness, fairness and impartiality of the Competition.
8. No one is allowed to pull any kind of power cord in the venue.
9. There must be schematic diagram of emergency evacuation.

ii. Venue rules

1. All persons entering the venue should strictly abide by the order of the venue and obey the direction and arrangement of the venue staff. Observers should observe in the designated area, and should not cross the warning line.
2. When observing in the venue, observers should not shout loudly or push and shove, so as not to affect the normal progress of the Competition.
3. Smoking is strictly prohibited in the venue and inflammables and explosives are

strictly prohibited.

4. Persons entering the division should take good care of various items on site and public environment, and should not post personal information without permission.

5. Persons in the venue should consult site staff for help in case of any problems and accidents.

6. In case of fire or emergency, persons in the venue should obey the instructions of the site staff and evacuate the site in an orderly manner to avoid panic and trampling.

7. Competitors should actively cooperate with the health and pandemic prevention department. If any competitor has a fever or other symptoms, he/she must contact the medical and health team of the Competition in time.

8. Persons in the venue should keep calm and stay for a short time in a relatively safe place in case of an emergency. In a crowded situation, they should cover their chest with both hands to prevent crushing and damage to internal organs. If they accidentally fall in the crowd, they should immediately shrink their body and hold their head tightly to reduce damage as much as possible.

9. In case of special circumstances, they should obey the unified command for the Competition.

iii. Accident handling

If an accident occurs during the Competition, whoever finds it should report to the Executive Committee immediately, and also take measures to prevent it from further deterioration. The Executive Committee should immediately activate the contingency plan to address the problem and report to the Executive Committee of the division. A Competition may be suspended if there is a major safety problem, and whether to suspend it should be determined by the executive committee of the division. After the event, the executive committee of the division should report the details to the Executive Committee.

XV. Competition Notice

i. Notice for teams

1. The name of each team should be the name of the representative team of the region, not the name of the school or other organization.

2. Teams should read the documents issued by the Executive Committee carefully to learn the timeline and judging details of the Competition to ensure their smooth participation. They should arrive at the site of pre-competition briefing on time according to the unified requirements of the Executive Committee. During the briefing session, they should carefully understand the content of the session. If they have any questions, they can turn to the staff directly.

3. Teams should hold an entry card issued by the Executive Committee and valid IDs to participate in the Competition and relevant activities, in accordance with the Competition process.

4. During the Competition, the Executive Committee will arrange food and accommodation for the competitors and instructors. The organizer shall respect the culture and beliefs of ethnic minorities and arrange the food and accommodation for

the competitors and coaches of ethnic minorities in accordance with relevant national ethnic policies.

5. Each team must provide the relevant certification materials of all members and prepare relevant pandemic prevention and protection articles in accordance with the requirements of the host school. The host school and the hotel will jointly check such materials and articles to confirm whether they can participate in the Competition.

6. Teams should purchase personal accident insurance for the competitors before the Competition.

7. The jury would have the right to make a decision on behavior not covered herein. In the event of a dispute, the decision by the supervision and arbitration team would be considered as the final decision.

8. The Executive Committee reserves the right to interpret the projects for the Competition.

ii. Notice for instructors

1. Each team should carry forward the good morals, listen to the command, obey the judges, and do not falsify. Anyone found to have falsified will be disqualified and their results will be invalid.

2. Team leaders should unswervingly implement all regulations of the Competition, strengthen the management of competitors, make the pre-competition efforts, and prompt competitors to take their IDs and relevant materials for the Competition.

3. During the Competition, except for the competitors, judges, and on-site staff and approved personnel, team leaders, instructors and other people are not allowed to enter the workshop.

4. If the team has any objection to the competition process, the team leader may submit a written report to the supervision and arbitration team of the Competition within the specified time.

5. Team leaders should take the lead to obey and execute the arbitration result of the appeal and communicate with the competitors about the result. Competitors should not stop the Competition due to the appeal or objections to the arbitration opinion, or they will be treated as forfeited.

6. Instructors should check the notice and content on the special webpage of the competition in time, study and master the rules, technical specifications and requirements of the venue, and guide the competitors to make all technical preparations and competition preparations before the competition.

iii. Notice for competitors

1. Competitors must fill in the registration form truthfully. Anyone found to have falsified will be disqualified and their results will be invalid.

2. Competitors should dress appropriately and maintain good appearance. They should participate in the Competition and related activities with their ID card and participation card, and go to the designated place according to the schedule and the specified time.

3. Competitors should familiarize themselves with the venue in advance at the

designated place according to specific arrangements.

4. Competitors are not allowed to bring reference materials, communication equipment, storage equipment, electronic tools and other items into the workshop. Anyone who violates this rule will be regarded as cheater.

5. Competitors should enter the workshop within the specified time, confirm the site conditions, and start the Competition according to the unified instruction.

6. No competitor is allowed to leave the workshop or affect other teams during the Competition, otherwise the competitor will be disqualified.

7. Competitors can submit the competition results in advance, but they must leave the workshop at the specified time and are not allowed to leave in advance.

8. Competitors should only fill in the workstation number of their team on the competition results.

Competitors are forbidden to make any marks irrelevant to the test questions, otherwise they will be disqualified from the evaluation for award.

9. When the judge announces that the competition time is up, competitors must stop their operation immediately, otherwise it will be deemed as a violation of rules and they will be disqualified from the evaluation for award. If a competitor intends to submit the competition results in advance, he/she should raise hand. After the competitor ends the competition, he/she is not allowed to answer any questions or operate. All competitors will leave the workshop at the same time.

10. Competitors should strictly abide by operating procedures to ensure personal and equipment safety. In case of equipment failure, the competitor should raise hand and the judges will make a decision depending on the circumstance. In case of safety incident or equipment failure caused by personal reasons of competitors, but no serious consequences are caused, marks will be deducted according to relevant rules; but if serious consequences are caused, the chief judge will make a decision on the relevant competition results. In case of safety incident or equipment failure that is not caused by personal reasons of the competitors, the chief judge will make a decision to allow the competitors to make up for the troubleshooting time depending on the circumstance.

11. Competitors are not allowed to take the test paper and draft paper out of the workshop. Anyone who does not obey will be treated as rule breaker and will be disqualified from the evaluation for award.

12. All equipment are not allowed to shut down until the Competition is over.

13. Competitors should strictly abide by the rules of the workshop, obey the judges, and compete in a civilized manner. If any competitor cheats, he/she will be disqualified for competition and award, and will get zero points for the item. If the competitor disobeys the instructions of the judge and disturbs the order of the workshop, corresponding marks will be deducted according to the rules. If the circumstance is serious, the competitor will be disqualified and the result will be canceled.

iv. Notice for staff

1. Staff of the Competition must obey the unified command of the Executive

Committee, and conscientiously perform their duties and provide services for the Competition. The staff should provide relevant certification materials according to the pandemic prevention requirements of the place where the host school is located.

2. The staff should arrive on time according to the work division and perform their duties with due diligence to ensure the smooth progress of the Competition.

3. Technology officer of the workshop should always stay at his post. In case of any technical problem (including equipment and devices) during the Competition, the technology officer should contact the head of the jury and deal with it in time. If there is a need to restart the Competition, it can only be carried out with the approval of the Executive Committee.

4. In case of emergencies, the staff should report to the Executive Committee in time, and at the same time take emergency measures to avoid major accidents.

5. Staff should conscientiously organize the registration and preparation of the competitors, maintain the order of the Competition. In case of any major problem, they should contact the Executive Committee for a solution in time.

6. Competitors are not allowed to bring communication equipment, such as mobile phone, to the workshop. Check-in personnel and service personnel in the venue must turn off their mobile phones during the Competition, and they should not leave the venue unless for special reasons.

7. No chatting, slapstick or any other behavior that may affect the competitors is allowed. No staff member is allowed to talk to the competitors without permission.

8. On-site judges should invigilate impartially. In the event of doubt or dispute, instructions from the jury president are needed, and the jury president's decision should be the final decision on site.

9. When teams enter the venue, the venue staff should review the items brought by competitors into the venue in accordance with the regulations. Items that are not allowed to be brought into the venue should be handed over to the accompanying team members for safekeeping. The venue does not provide storage services.

XVI. Appeal and Arbitration

During the Competition, in case of injustice or rule violations by relevant personnel, team leaders can submit a written appeal to the supervision and arbitration team within two hours after the end of the Competition. The content, time, people involved, and basis of the appeal should be adequately and truthfully described in the written appeal that should be signed by team leaders in person. Non-written appeals will not be accepted.

A two-level arbitration mechanism is adopted for the Competition. There is an arbitration committee in each division and there is a supervision and arbitration team for each skill competition. The arbitration committee of the division works under the leadership of the Executive Committee and is responsible to the Executive Committee. The supervision and arbitration team works under the leadership of the Executive Committee and is responsible to the Executive Committee. The supervision and arbitration team will organize a review within two hours after receiving the appeal report and inform the complaining party in writing of the review result in a timely manner. If the complaining party still disagrees with the review result, the team leader

may submit an appeal to the Supervisory Arbitration Committee of the division. The arbitration award of the Supervisory Arbitration Committee of the division shall be final.

XVII. Competition Observation

The exhibition and performance process is open to the public, and the audience should be guided to observe in an orderly manner.

XVIII. Live Competition

The workshop is equipped with video equipment to broadcast the whole process live, including the Competition process, opening and closing ceremonies, etc. The whole process of the Competition can be recorded by video, which can be observed by the relevant persons of the teams outside the workshop. The video also meets the requirements of the public to watch the Competition.

XIX. Resource Conversion

Majors served: Communication engineering, ICV technology, modern communication technology, etc. Converted resources should be uploaded to an online information release platform designated by the Competition.

XX. Miscellaneous

A series of Competition related activities will be held, such as seminar on construction of communication engineering, meeting for communication engineering technology exchange, and teaching achievements display. This aims to fully demonstrate the achievements of vocational education reform and the spirit of teachers and students in a scientific and reasonable competition setting, an international way and rich and colorful activities.

Forms of activities	Detailed activities
Seminar on construction of communication engineering	Course construction and practical training construction for communication engineering will be discussed on the seminar.
Meeting for communication engineering technology exchange	Industry experts will share technology at the meeting.
Teaching achievements display	The teaching experience and the achievement of major construction will be shared by the major foregoers and winners of each school.

Appendix: Sample Test Projects

Competition Phase I: 5G communication network detection

Task 1: Configuration for 5G communication network detection (13 marks)

1. Task background

5G mobile communication equipment must pass the network access test authentication by China Telecommunication Technology Labs of the Ministry of Industry and Information Technology before they are officially launched on the market to obtain the legal network access license. Now xx manufacturer has added one xx model 5G equipment, which needs to complete test tasks for authentication to obtain network access license. Before the test, the corresponding test environment should be set up and the base station startup configuration should be completed.

The physical environment is set up as follows:



频谱分析仪	Spectrum analyzer
可调衰减器	Adjustable attenuator
5G 射频拉远单元	5G RF remote unit
同轴负载	Coaxial load
5G 核心网	5G core network
5G 承载网单元	5G bearer network unit
5G 基带处理单元	5G baseband processing unit
测试控制电脑	Computer for test and control
同轴射频馈线	Coaxial RF feeder
单模光纤	Single-mode optical fiber
五类网线	Category 5 cable
多模光纤	Multi-mode fiber

2. Task requirements

Master the configuration process of equipment network detection and logical relationship through 5G base station equipment deployment and network planning. Complete the base station startup configuration according to the base station startup engineering parameters. After the final configuration, save the configuration file (.cfg) and submit it.

Table 2-1 lists the configuration requirements for the detection environment.

Table 2-1 Configuration Requirements for the Detection Environment

Device	Parameter	Parameter requirements
Core network	Core network AMF/SMF address	172.30.2.110/24
	Core network UPF address	172.30.6.110/24
	Core network mobile country code	460
	Core network mobile network code	10
	Core network TAC	4388
	WWID	180126
	Core network index	0
Switch	Switch SCTP link port address	182.40.10.1/24
Base station	Number of the cabinet for mounting the BBU	0
	BBU subrack number	0
	BBU subrack model	EMB6116
	Main control panel model	HSCTD
	Slots for the main control panel	1
	Model of baseband board 1	HBPOD-B
	Slots for baseband board 1	6
	Model of baseband board 2	HBPOD-B
	Slots for baseband board 2	7
	Model of baseband board 3	HBPOD
	Slots for baseband board 3	8
	Base station SCTP link port index	0
	AAU1 model	TDAU5364N41
	AAU1 cell ID	1
	AAU1 operating bandwidth	100MHz
	AAU1 center frequency	2595000
	AAU1 coverage	8Km
	AAU1 antenna gain	23
	AAU1 effective coverage power (\geq)	-80dbm
	AAU1 port configuration	Four ports
	Type of AAU1 antenna	TYDA-202615D4 T7
	AAU1 layout mode	Normal mode
	Index for AAU1 optical port 1 connecting to the optical port of the baseband board	(6,0)
	Series of AAU1 optical port 1	1
	AAU1 frame structure	format1
	AAU2 model	TDRU512N41
	AAU2 cell ID	2
	AAU2 operating bandwidth	80MHz
	AAU2 center frequency	2565750
	AAU2 coverage	3Km
	AAU2 antenna gain	13
	AAU2 effective coverage power (\geq)	-80dbm
AAU2 port configuration	Two ports	
Type of AAU2 antenna	ANT_NUM-2	

	AAU2 layout mode	Cascading mode
	Index for AAU2 optical port 1 connecting to the optical port of the baseband board	(7, 0)
	Series of AAU2 optical port 1	1
	AAU2 frame structure	format2
	Micro station NCU model	pHUB5100
	Index for micro station NCU optical port	1
	Index for micro station NCU connecting to the optical port of baseband board	(8, 2)
	pico1 model	pRU5212
	pico1 cell ID	3
	pico1 operating bandwidth	60MHz
	pico1 center frequency	2625000
	pico1 coverage	150m
	pico1 effective coverage power (\geq)	-80dbm
	pico1 port configuration	Single port
	Index for pico1 optical port	0
	pico1 layout mode	Cascading mode
	Index for pico1 connecting to micro station NCU RF optical port	0
	pico1 frame structure	format0
Resource transmission	Global PDCP user interface protection switch	Open

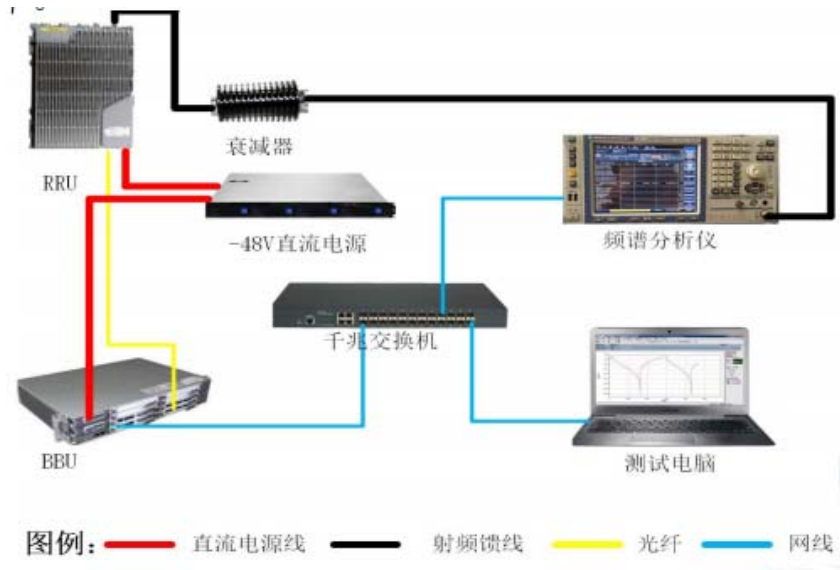
Task II: Implementation of 5G communication network detection (50 marks)

1. Task background

5G communication network detection aims to strictly check the function, performance, reliability, compatibility and stability of products from the perspective of users, so as to experience the user experience in advance and improve the market competitiveness of products.

Figure 1-1 shows the physical environment setup:

Figure 1-1 Physical Environment Setup Requirements



衰减器	Attenuator
-48V 直流电源	-48V direct current
千兆交换机	Gigabit switch
频谱分析仪	Spectrum analyzer
测试电脑	Computer for test
图例：	Figures:
直流电源线	Direct current power cord
射频馈线	RF feeder
光纤	Fiber
网线	Network cable

2. Task requirements

Now one xx type 5G TDD base station of XX manufacturer has completed the base station parameter configuration and activated the cell. Its RF channel can transmit signals normally, the operating band is 2515~2675MHz, the operating bandwidth is 100MHz, the center frequency is 2565MHz, and the rated power is 35d bm. The measuring instruments are all connected to the first channel of external trigger.

Please test the following four radiation signal performance indicators according to the test specifications. Please save the final instrument screenshots after the completion of a single operation (for the result of a single test, no more than two screenshots are needed; for the highest score, one screenshot is needed). "Transmitter output power test detection" should be an autotest. Competitors are required to write autotest script programs on site, and output test result files. Specific tasks and test specification requirements are as follows:

(1) Specifications for transmitter output power test detection

Case number:	1.1	Priority:	Required
Test purpose:	Verify the rated output power and stability of the tested transmitter		
Reference networking:	Fig. 1		
Items assessed:	Wiring calibration for RF conduction test, signal bandwidth, signal center frequency, NR-TDD signal frame structure, effective bandwidth of 5G signal, signal detection mode, safe use of spectrum analyzer, etc.		

Preconditions:	<ol style="list-style-type: none"> 1. Set up a test environment and calibrate path loss based the network, and add the path loss to the instrument; 2. Set the meter to external reference signal synchronization and frame trigger. Data acquisition is performed only in downlink time slot.
Test steps:	<ol style="list-style-type: none"> 1. Set the measuring instrument according to the band, bandwidth and center frequency specified for the equipment to be tested; 2. NR currently operates in NR-FR1-TM1.1 mode, and transmits at maximum power; 3. For each carrier, test the integral power of all successive downlink subframes in the channel bandwidth for 20ms, and test the total integral power of all carriers;
Expected results:	The maximum transmitting power of each carrier in a single channel of the transmitter is allowed to fluctuate within ± 1 dB of its rated power;
Notes:	The rated transmitting power in a single channel is defined as the rated power of the equipment divided by N (N is the number of equipment channels)

(2) Specifications for ACLR test detection


Case number:	1.2	Priority:	Required
Test purpose:	Verify the characteristics of the transmitter's influence on adjacent channels outside the operating band		
Reference networking:	Fig. 1		
Items assessed:	Wiring calibration for RF conduction test, signal bandwidth, signal center frequency, NR-TDD signal frame structure, 5G signal, adjacent channel effective bandwidth, signal detection mode, safe use of spectrum analyzer, etc.		
Preconditions:	<ol style="list-style-type: none"> 1. Set up a test environment and calibrate path loss based the network, and add the path loss to the instrument; 2. Set the meter to external reference signal synchronization and frame trigger. Data acquisition is performed only in downlink time slot. 		
Test steps:	<ol style="list-style-type: none"> 1. Set the measuring instrument according to the band, bandwidth and center frequency specified for the equipment to be tested; 2. NR operates in NR-FR1-TM1.1 mode, and transmits at maximum power; 3. Use a spectrum analyzer to test the ACLR of adjacent and secondary channels, and the bandwidth range of adjacent channel frequency band should not exceed the operating band range of the station under test in principle to exclude the influence of filters; 		
Expected results:	When all detection results meet the following technical requirements, a pass can be given, otherwise pass cannot be given.		
Notes:			

(3) Specifications for scattering test detection

Case number:	1.3	Priority:	Required
Test purpose:	Verify the signal strength of the transmitter scattered in bands outside the operating band of 10MHz of the unit.		
Reference networking:	Fig. 1		
Items assessed:	Wiring calibration for RF conduction test, signal bandwidth, signal center frequency, NR-TDD signal frame structure, 5G signal, adjacent channel effective bandwidth, signal detection mode, safe use of spectrum analyzer, etc.		
Preconditions:	<ol style="list-style-type: none"> 1. Set up a test environment and calibrate path loss based the network, and add the path loss to the instrument; 2. Set the meter to external reference signal synchronization and frame trigger. Data acquisition is performed only in downlink time slot. 		

Test steps:	1. Set the measuring instrument according to the band, bandwidth and center frequency specified for the equipment to be tested; 2. NR operates in NR-FR1-TM1.1 mode, and transmits at maximum power; 3. According to the requirements of the general scattering test index in the 9KHz-3.6GHz band, measure the last scattering index by a spectrum analyzer.
Expected results:	When all detection results meet the following technical requirements, a pass can be given, otherwise pass cannot be given.
Notes:	

(4) Specifications for detection test of transmitter transient response

Case number:	1.4	Priority:	Required
Test purpose:	Verify whether the switching time of the transmitter meets the requirements.		
Reference networking:	Fig. 1		
Items assessed:	Wiring calibration for RF conduction test, general scattering indicator requirements, signal bandwidth, signal center frequency, NR-TDD signal frame structure, signal detection mode, safe use of spectrum analyzer, etc.		
Preconditions:	1. Set up a test environment and calibrate path loss based the network, and add the path loss to the instrument; 2. Set the meter to external reference signal synchronization and frame trigger. Data acquisition is performed only in downlink time slot.		
Test steps:	1. Set the measuring instrument according to the band, bandwidth and center frequency specified for the equipment to be tested; 2. NR operates in NR-FR1-TM1.1 mode, and transmits at maximum power; 3. Measure the first cycle turn-off time and the fifth cycle turn-on time with a spectrum analyzer.		
Expected results:	When all detection results meet the following technical requirements, a pass can be given, otherwise pass cannot be given.		
Notes:	Sketch Map of Time Domain on and off Position 		

(5) "Transmitter output power test detection" in autotest

Complete the development of autotest program script of "transmitter output power test detection" based on the autotest platform provided at the venue. Requirements are as follows:

- 1) Programming language: python;
- 2) The spectrum analyzer parameters required by the channel power test case can be automatically configured;
- 3) Communication with the autotest platform provided at the venue can be realized;
- 4) Generate the test result file (save path: the same directory as the script program, file format: csv, name: PowerResult; example: PowerResult.csv). The content format of the result file must meet the following requirements:

No.	Category	Results
1	Measurement mode	"Fill this box with current measurement mode queried"
2	Center frequency	"Fill this box with current center frequency queried"
3	Integral bandwidth	"Fill this box with current integral bandwidth queried"
4	Display bandwidth	"Fill this box with current display bandwidth queried"
5	Analysis bandwidth	"Fill this box with current analysis bandwidth queried"
6	Scan time	"Fill this box with current scan time queried"
7	Time domain delay	"Fill this box with current time domain delay queried"
8	Statistical duration	"Fill this box with current statistical duration queried"
9	Trigger mode	"Fill this box with current trigger mode queried"
10	Gate status	"Fill this box with current gate status queried"
11	Detection method	"Fill this box with current detection method queried"
12	Compensation for path loss	"Fill this box with current compensation for path loss queried"
13	Compliance threshold	"Obtain the current compliance threshold and fill it in this box"
14	Channel power	"Fill this box with current channel power queried"
15	Compliant or not	"Fill in this box with the current situation of reaching the standard, which is too low or too high"

Appendix: Interface Function and Parameter Description

dome(tcpip_res, cfg) function:

This function is a function for communication between the program script (testdome.py) of channel power autotest and the hardware RF autotest platform. It contains two parameters, tcpIP_RES and CFG.

tcpip_res parameter function:

1) This parameter is a function for communication between the script program and the instrument through TCP/IP protocol. Write function in tcpip_res is used to set instrument parameters, and query function in tcpip_res is used to query instrument parameters. The usage example is as follows:

Set the spectrum analyzer reset command: `tcpip_res.write("SYST:PRES")`

Query the current center frequency of spectrum analyzer:
`tcpip_res.query(("FREQ:CENT?"))`

"SYST:PRES" and "FREQ:CENT" are standard VISA commands. Other spectrum analyzer settings and query commands can be obtained by clicking the "help" button of the instrument.

cfg parameter:

The parameter type is "list". The list contains seven elements. The list content is as follows:

["Center frequency", "operating bandwidth", "integral bandwidth", "time domain delay", "statistical duration", "compensation for path loss", "compliance threshold"], which is the setting parameter content of the "channel power" use case in the use case library of the autotest platform.

Example of script program:

```
#!/usr/bin/env python
```

```

# -*- coding: utf-8 -*-
#!C:\Python27
# -----
# Name:          SpectrumSetDome
# Purpose:       AutoTestCompetition
# Author:        xk
# Created Time:  7/04/2022
# Copyright:     (c) XK 2022
# Licence:       <your licence>
# -----

import csv
import time

def dome(tcpip_res,cfg):
# Configure spectrum analyzer
#-----

# The following is the program statement for resetting spectrum analyzer. "tcpip_res"
is the interface for communicating with the spectrum analyzer, "write" is the
configuration function, and "SYST:PRES" is the corresponding VISA command;
tcpip_res.write("SYST:PRES")

# The result will be obtained 10s after parameter configuration. The method is as
follows:
#-----

time.sleep(10)
# Obtain the result
# -----

#The following is the statement to obtain the current frequency of the spectrum
analyzer. tcpip_res is the interface for communicating with the spectrum analyzer,
"query" is to obtain the function, and "FREQ:CENT?" is the corresponding VISA
command. This statement assigns the returned result to the variable "cf1".
cf1 = tcpip_res.query("FREQ:CENT?")

#Obtain result processing (The returned value is a long string. Use the split(',')
function to split the contents of the long string by ", " to select the correct result by
slicing. Convert the character format to "floating point" by the "float" method,
preserve 3 significant digits to the decimal point by the "round" method, convert the
unit to MHZ and use the "STR" method to convert the floating point format back to
"string". At last, concatenate the "MHZ" unit character with the "+" operator.

```



```

cf = str(round(float(cf1.split(',')[0]), 3) / 1000000) + " MHz"
# Save the result file (.csv)
# -----
# Write the "table header" content
DataArr = [u 'No.', u 'Category', u 'Result']
# Chinese output should be transcoded in "gbk" character format
for i in range(3):
    dataArr[i] = dataArr[i].encode('gbk')
bodydata = [dataArr]
# Output file format, path, name, write method. The following method path is the
same as the current script program, the file name is "PowerResult", the file format is
"csv", and the write mode is "append mode".
csvfile = file("PowerResult.csv", 'ab+')
writer_csv = csv.writer(csvfile)
writer_csv.writerows(bodydata)
# Write table content (not include the content in "center frequency" in the second line
of the table header)
data_v = [u'2', u' center frequency', cf]
for i in range(3):
    data_v[i] = data_v[i].encode('gbk')
data = [data_v]
writer_csv.writerows(data)
csvfile.close()
if __name__ == '__main__':
    dome()

```

Competition Phase II: Configuration and debugging of 5G ICV

Task 1: ICV configuration (12 marks)

1. Task background

A new automobile manufacturing enterprise, committed to the development of intelligent connected new energy vehicles based on vehicle-road integration, fully verifies its new energy intelligent vehicle self-driving technology in the core area of a pilot city's economic development zone, within the scope of ICV infrastructure of several typical intersections. Before an intelligent vehicle can hit the road, the vehicle's intelligent network connection system must be coded and configured.

2. Task requirements

According to the connection and automatic driving requirements for ICV, the code and environment configuration specifications should be strictly followed to load the development environment and dependencies, correctly configure the 5G network environment of the system, and output the specified value. Next, edit the code and debug to ensure that it can run without error. The specified value can be output through the correctly run code. Verify whether the code and environment are correct. The program can correctly input the specified video given by the Test Project. Through the program, the lane lines in the specified video can be identified and marked with green color blocks.

Competition module	Main knowledge and technical points	Task requirements	Marks
ICV configuration	Load the development environment and dependencies	Fill in the value of the specified variable in the configuration environment code;	3
		The code block works correctly and outputs success;	1
	Run the edit code and debug it	Fill in the value of the specified variable in the algorithm code;	3
		The code block works correctly and outputs success;	2
Code and environment correctness	The code block works correctly and outputs success;	3	

Task 2: Intelligent network connection debugging (25 marks)

1. Task background

An ICV of a new automobile manufacturing enterprise has completed lab code development and configuration. There is a need to fully verify its new energy intelligent vehicle self-driving technology in the core area of a pilot city's economic development zone, within the scope of ICV infrastructure of several intersections.

2. Task requirements

Competitors are required to connect the configured ICV to the dedicated 5G network in the workshop, and complete automatic driving on the designated sand table. The ICV must be able to identify all traffic lights and other road facilities as well as obstacles. After successful identification, the program can frame the identification of traffic lights or obstacles and display the corresponding names. The image must be transmitted to a designated large screen through the dedicated 5G network. Specific task objectives are as follows:

Device	Task item	Task requirements
5G ICV	5G access network	Successfully install the driver for the 5G network card;
	5G equipment configuration and data configuration	Correctly input AP instructions to query network card status, module receiving signal status, module registration network, whether the module is connected to the data network, whether the module is connected to the 5G network, query the registration data network type, set access point information, query whether the setting is successful, check RNDIS configuration, check whether IP is obtained;
	5G network debugging	Correctly input AP instructions to query and set the current USB mode, set 5G band, set 5G base station code, set automatic connection command;
	5G network optimization	Successfully connect to 5G network, by which data can be uploaded and received;
	Load the lane line recognition environment	Correctly load lane line recognition environment;
	Edit code gaps	Fill in all code gaps
	Run the code correctly	The code runs correctly and outputs the specified results;
	Identify the images by code	The code can recognize the lane lines in the images;
	Obtain the recognized image	Correct display the image in the system;
	Connect the lane line program to the 5G network	The program connects correctly to 5G network;
	Obtain upload and download data feedback from 5G network debugging	In 5G network environment, the ICV can upload data and obtain data;
	Upload images correctly	In 5G network environment, images can be uploaded successfully;
	Get upload feedback	The terminal can obtain the images transmitted by the ICV through 5G network;
	Verify whether the overall process and files are correct	The whole process of 5G-based upload and download can run correctly;
	Load the target detection environment	Be able to correctly load the target detection environment and output the specified value;
	Edit the target detection code	Fill in all code gaps;
	Run the target detection code correctly	The code runs;

Identify image	The code can identify the object in the image and output the correct result;
Upload images and identify results correctly	Be able to upload images through 5G network;
The vehicle can correctly identify the lane line	Be able to recognize and mark lane line areas;
The vehicle can run correctly on the track	The ICV can run correctly in the sand table specified track area, and does not press the line or run out of the track;
The vehicle can correctly recognize the traffic lights and obstacles	The ICV can recognize traffic lights and obstacles and mark them, printing the correct category;
The vehicle responds correctly to traffic lights and obstacles	The vehicle can run normally when it recognizes the green light, and stop correctly when it recognizes the red light and obstacles;