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**Forestry and grassland internet of things - Technical
requirements for video based on wireless sensor network**

林草物联网 面向视频的无线传感器网络技术要求

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3 Terms and definitions

The terms defined in GB/T 30269.2-2013 apply together with two terms given here. The forestry and grassland internet of things (3.1) is a system that exchanges information and communicates between things by means of sensing equipment and agreed protocols, in forest, grassland, wetland, desertified and sandified environments, so as to identify, locate, track, monitor and manage intelligently; the definition is taken with modification from LY/T 2413.2-2015, 3.1.1. A wireless bridge (3.2) uses wireless transmission to build a communication bridge between two or more networks.

4 Abbreviations

The abbreviations listed are 4G and 5G for the fourth and fifth generation mobile communication technologies, ACK, DVR, FTP, HTTPS, IP for the internet protocol address, IPC for inter process communication, LTE, NVR, ONVIF, RAID, RTCP, RTP, RTSP, SDK, SNMP, TFTP, USB and WSN for wireless sensor network. IPC is expanded here as inter process communication, whereas the body of the document uses IPC for the network camera that an NVR connects to; the two uses are printed as they stand.

5 System architecture

The architecture of the wireless sensor network for forestry and grassland video applications is shown in Figure 1 and is divided into a WSN sensing layer, a WSN bearer layer and a WSN application service layer. The sensing layer is made up mainly of

acquisition equipment, including audio and video acquisition equipment and dual spectrum thermal imaging equipment supporting a wireless bridge. The bearer layer is the underlying support network that carries the captured video images up to the application service layer, and uses three transmission routes: the operator network, the wireless bridge and other networks, the last of which may include local area networks and wireless local area networks.

The application service layer is made up mainly of storage equipment, decoding equipment and display equipment. A monitoring centre generally has a large screen display system, a conference speech system, a data storage system, a power and environment system, a fire protection system and a network system as its main parts. The key equipment of the video oriented wireless sensor network is the acquisition equipment, the network transmission equipment, the storage equipment and the decoding and display equipment.

6.2 Acquisition equipment

6.1 The equipment for information exchange, transmission and control of the video surveillance networking system shall meet GB/T 28181-2022. 6.2.1 Audio and video acquisition equipment shall support 2G, 3G, 4G and 5G networks, and shall meet the following: an enclosure protection degree of IP65 or better to GB/T 4208-2017; normal operation at a supply voltage within $\pm 20\%$ of the rated voltage; a low illumination performance of 0.001 lx or less in colour and 0.0001 lx or less in black and white; normal operation at an ambient temperature of $-40\text{ }^{\circ}\text{C}$ to $60\text{ }^{\circ}\text{C}$; a packet loss tolerance of 10 %, the preview image staying good and free of stutter in a network environment with 10 % packet loss.

6.2.1 continues: when the network link is broken for whatever reason, the equipment shall detect the recovery of the network by itself and reconnect automatically, information being stored to the local memory card while the network is down and uploaded automatically once it is back; it shall support HTTPS, shall carry no published vulnerability and shall not put user authentication information in clear text in the communication messages; the remote terminal protocol Telnet, FTP and TFTP services shall be off by default, as shall unused services and ports; and abnormal data packets shall be recognized and handled so that they cannot affect the service capability of the sample system. The main stream shall be no lower than 1080P with a frame rate of no less than 25 frames per second; in the printed list the words on image resolution run on from the end of the item about abnormal data packets, and the two are translated here as they stand.

6.2.2 Front end dual spectrum thermal imaging equipment supporting a wireless bridge shall meet the following: an enclosure protection degree of IP65 or better to GB/T 4208-2017; normal operation at a supply voltage of 90 % to 110 % of the rated voltage, which is the same tolerance that 6.2.1 states as $\pm 20\%$ for the audio and video equipment; a low illumination performance of 0.001 lx or less in colour and 0.0001 lx or less in black

and white; a wiper function that can be switched on manually or automatically; normal operation at an ambient temperature of -40 °C to 60 °C; a packet loss tolerance of 10 %; and, if the network drops while the equipment is working, storage of the captured pictures and recorded files on the internal SD card of the equipment and their upload to a designated FTP server once the network is back.

6.3 Network transmission equipment

6.3.1 The operator network means mainly the 2G, 3G, 4G and 5G mobile communication networks through which signal coverage of the forest area is obtained. The mobile communication network shall reach a coverage radius of more than 30 km, an uplink rate of not less than 10 Mbit/s reaching 50 Mbit/s, a downlink rate of not less than 50 Mbit/s reaching 100 Mbit/s, and a single sector of a base station shall support concurrent access of not fewer than 10 front end acquisition devices and a concurrent access number of not fewer than 50.

6.3.2 A wireless bridge may be networked in three ways, point to point, point to multipoint and relay, shown in Figures 2, 3 and 4; the legend of Figure 3 names the wireless bridge, the network cable and the optical fibre. For stable video transmission the wireless bridge shall meet an enclosure protection degree of IP65 or better to GB/T 4208-2017; a point to point transmission rate of more than 200 Mbit/s at 5 km for a 5 km bridge, at 10 km for a 10 km bridge and at 20 km for a 20 km bridge; automatic ACK timeout adjustment matched to the distance; time division multiple access, which resolves the hidden node problem and improves point to multipoint network performance; virtual local area network division, which isolates service from management and service from service; support for 10 MHz, 20 MHz, 40 MHz and 80 MHz channels; SNMP management; and power over Ethernet.

6.3.3 Where local area network transmission is supported it shall meet GB/T 15629.3, and where wireless local area network transmission is supported it shall meet GB/T 15629.1103-2006. Other short range transmission shall meet GB/T 43957-2024, GB/T 15629.15-2010 and other relevant requirements.

6.4 Storage equipment

6.4.1 Distributed storage equipment covers NVRs and DVRs. The requirements run from compatible access, an NVR taking network cameras, network dome cameras and network video servers and accepting third party cameras by reference to ONVIF and GB/T 28181-2022 while a DVR takes analogue cameras and analogue dome cameras, through independent local or remote adjustment of resolution, frame rate, bit rate and video quality on each channel, multi picture preview with adjustable layout and order and an automatic tour with settable period, scheduled, motion detection and alarm recording modes, break resume upload on the NVR, fast retrieval by channel number, recording type and start and end time, single and multiple channel playback with fast, slow and single frame play and

local electronic zoom, backup over USB and to NAS network storage with batch backup after retrieval and clip backup during playback, and disk management showing disk temperature, vibration and link stability with detailed status for the last seven days.

6.4.1 continues with a condensed playback function that marks intelligent event recordings on the event axis and plays recordings without intelligent events in fast mode and those with them at normal speed; thermal analysis with fire point, temperature measurement and temperature difference alarm linkage when a camera with a thermal imaging function is connected; online upgrade through a browser or client software; user management with per user permissions; restoration of factory settings and restart, the configuration before an abnormal power loss or a restart being kept; logging of the user name, IP address and access time of recent visitors, of parameter settings, alarm logs, disk formatting, recording downloads and playback; audio and video decoding on both NVR and DVR; and transport and storage container formats for the audio and video coded streams meeting Clauses 5 and 6 of GB/T 28181-2022.

6.4.1 ends with the security items: the network protocol used shall support authenticated login or authenticated access; management and control access shall pass user name and password authentication; the authentication process shall resist brute force, the access IP being locked after a number of consecutive failed remote logins and the account being locked after a number of consecutive failed local logins, users already logged in being unaffected during the lock; HTTPS encryption shall be supported, with creation of a private certificate, creation of a private certificate request and upload of a signed certificate, network login and configuration passing over the encrypted channel; AES and similar stream encryption algorithms shall be supported, so that an intercepted live stream cannot be decoded without the key; sensitive signalling exchanges shall be encrypted in the network; and the equipment shall have a firewall able to resist ICMP flooding, half open connection attacks and other attacks.

6.4.2.1 The central video storage system shall use direct storage of the video stream data, which reduces the transmission routing and avoids the single point of failure risk that damage to a server file system brings; shall support iSCSI storage and the RTP, RTCP, RTSP, UDP, HTTP, NTP and SNMP network protocols; shall meet GB/T 28181-2022 so that front end equipment of different makes stays compatible; and shall hold data for a period of not less than 90 days. Table 1 has two columns and sets the technical indicators of the central storage equipment against their requirements, covering the chassis architecture, the processors, the cache, the operating system, the disk interfaces, the RAID levels, the network interfaces, the USB and other ports, the power supply redundancy, the working and storage temperature and humidity, and a 3C certificate.

6.4.2.2 Cloud storage equipment shall support a clustered and virtualized architecture that presents a single interface to the outside, and real time load balancing with a random and discrete data writing scheme so that data does not become unreadable when a device fails.