# On the Application of Serial Port Devices in the Television Broadcast Control System of Fuzhou Radio and Television Station: Postprint

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## Abstract

After one or more serial servers connect to a local area network, they can establish connections with one or more computers, enabling bidirectional transparent data transmission. Their use allows traditional serial devices to integrate into Ethernet-based control networks, enhances centralized device control, and improves equipment utilization rates.

## Full Text

### Brief Discussion on the Application of Serial Port Devices in the Television Broadcast Control System of Fuzhou Radio and Television Station

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**Abstract:** When one or more serial port servers are connected to a local area network, they can establish connections with one or more computers to achieve bidirectional transparent data transmission. This enables traditional serial devices to integrate into Ethernet-centric control networks, enhancing centralized equipment control and improving utilization rates.

**Keywords:** multi-serial-port card; serial port server; data conversion; communication mode; Ethernet

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With advances in electronic information technology, television broadcast control equipment is rapidly evolving toward digitalization, intelligence, and centralization, with inter-device information transmission gradually transitioning from serial communication to Ethernet-based network architectures. Although

IP-based broadcast control represents the future trend, comprehensively considering current technology maturity and the need to improve existing equipment utilization, converting traditional serial devices into Ethernet-accessible equipment that can be controlled via local area networks is undoubtedly the most economical and reliable solution at present [1]. Based on the actual conditions at Fuzhou Radio and Television Station, two primary serial control methods are employed.

## 1. Multi-Serial-Port Card Control Method

To ensure broadcast security with high equipment exclusivity requirements, our department' s broadcast control system employs a method where multi-serial-port cards are installed on primary and backup broadcast workstations, with two control signal paths converging onto a Dalian Jiecheng ECO-422-8 switcher for controlling broadcast-end equipment.

The ECO-422-8 is a switcher specifically designed for RS-232/422 signals, featuring eight switching channels. Each channel has primary and backup RS-232/422 signal inputs and one signal output, supporting computer control via RS-232/422 communication ports. Each primary/backup channel uses relays for switching, with the primary path of each channel supporting power-off bypass functionality. The switcher' s eight channels can be arbitrarily configured into two groups (GPI1 and GPI2) via DIP switches on the rear panel, with each group having dedicated switching control buttons and GPI control interfaces. The front panel AUTO button allows selection of the control method—either local button control or GPI remote control [2]. This makes it suitable for primary/backup broadcast workstation control link switching in broadcast control systems.

Using the news channel (Channel 1) as an example, the broadcast-end control system operates as follows: The primary input signal for each channel of the ECO-422-8 switcher comes from the multi-serial-port card of the primary broadcast workstation, while the backup input signal comes from the multi-serial-port card of the backup broadcast workstation. Six of the switcher' s eight channels are utilized, controlling the primary and backup video servers, primary and backup broadcast matrices, and HDVTR-1 and HDVTR-3 HD Blu-ray recorders. Under normal conditions, the primary broadcast workstation controls one primary video server, one primary sub-control matrix, and HDVTR-1, while the backup broadcast workstation controls the backup video server, backup sub-control matrix, and HDVTR-3. In an emergency where one broadcast workstation fails, operating the GPI1 and GPI2 group buttons in conjunction with the broadcast control software enables either the primary or backup broadcast workstation to independently control all six channels: the primary and backup video servers, primary and backup broadcast matrices, and both HDVTR-1 and HDVTR-3. This allows primary and backup broadcast workstations to serve as mutual backups, significantly enhancing the safety redundancy of the broadcast control system [3].

[Figure 1: see original paper] News Channel Broadcast System Control Diagram

## 2. Serial Port Server Control Method

To ensure interconnectivity between devices with different communication modes, serial port servers must be employed to handle data conversion between different protocols. These devices can parse TCP/IP data packets from Ethernet into serial data streams for delivery to serial devices, and conversely, package serial data streams into TCP/IP packets for upload to Ethernet. By connecting multiple serial devices to Ethernet, serial port servers enable device sharing, improve existing equipment utilization, reduce investment costs, and simplify cabling [4]. After one or more serial port servers are connected to a local area network, they can establish connections with one or more computers to achieve bidirectional transparent data transmission.

The matching between serial port servers and host computers primarily involves two communication modes:

**I. Socket Mode**
Because serial port servers support standard TCP/IP communication formats, any host computer using Socket programming specifications can directly transmit raw data after establishing a TCP/IP connection with the serial port server. The data format is determined by the serial device, enabling completely transparent forwarding.

**II. Real COM Mode**
In this mode, virtual serial port management software on the computer maps the RJ45 Ethernet interface of the serial port server to a standard serial port under the operating system. Applications can then perform send and receive operations as they would with a physical serial port, and the port number (e.g., COM7, COM8, COM9) along with its parameters and occupancy status can be directly viewed through the Device Manager [5].

Fuzhou Radio and Television Station uses the MOXA NPort5630-16 serial port server, which features 16 RJ45 serial connectors and can connect up to 16 serial devices simultaneously. The station employs the virtual serial port communication mode (Real COM Mode) to control serial devices. Specific application methods are described below.

### 2.1 Subtitle System Control

**Control Strategy:** Under normal conditions, the channel' s primary broadcast workstation controls the subtitle machine. Once the primary workstation fails, the backup broadcast workstation automatically takes over control of the subtitle machine.

Due to the large volume of subtitles, graphics, corner animations, and other content that must be broadcast daily across channels—content delivered via the station' s OA system or by dedicated personnel using USB drives or optical

discs—the broadcast control system network and subtitle system control network are maintained as two separate local area networks to prevent computer virus transmission and ensure network security. Communication signals between them are forwarded through serial port servers.

**Workflow:**
(1) During daily broadcast schedule preparation, any entry requiring ticker text or corner graphics must be associated with corresponding content in the subtitle schedule either in advance or temporarily at the broadcast workstation when the schedule airs.
(2) When primary and backup broadcast workstations call up the daily broadcast schedule for preparation, they simultaneously automatically call up the corresponding subtitle schedule on the subtitle machine.
(3) When a broadcast schedule entry requiring subtitles or corner graphics airs, the primary broadcast workstation sends a call command to the subtitle machine.
(4) The IP packet containing this command is routed through the broadcast control system network switch to the serial port server.
(5) The serial port server parses the IP packet and delivers the command to the subtitle machine via the com port used by the channel' s subtitle system, prompting the subtitle machine to broadcast the corresponding subtitle entry.

The subtitle system also supports channel-shared broadcasting functionality. In manual program mode, any subtitle machine can share subtitle information with and control broadcasting on any other channel' s subtitle machine. In this scenario, subtitle information data and control commands travel via IP packets through the subtitle system network switch over Ethernet paths.

[Figure 2: see original paper] Subtitle System Control Diagram

### 2.2 Program Upload Control System

**Control Strategy:** Upload workstations control upload Blu-ray recorders and broadcast video server/upload server capture cards via serial port servers, while controlling the master control matrix via Ethernet to establish channels between Blu-ray recorders and server capture cards. For upload security, once a Blu-ray recorder or server capture card is occupied by a particular upload workstation, it cannot be accessed by other upload workstations until the upload is completed and the device is released.

Fuzhou Radio and Television Station employs a hierarchical storage approach for program materials. Under normal conditions, materials are first uploaded to upload servers serving as secondary storage, then migrated to the broadcast video server of the target channel. In emergency situations, materials can be directly uploaded to the target channel' s broadcast video server to save migration time.

**Workflow:**

(1) Select a Blu-ray recorder and load the appropriate program disc according to the upload schedule entry. Proceed with one of the following two options:

Set the Blu-ray recorder to Local mode, use its control panel to locate the upload start point and reset to zero, then switch to Remote mode, and select the Blu-ray recorder from the signal source channel list in the upload software.

Set the Blu-ray recorder to Remote mode, select it from the signal source channel list in the upload software, and use the upload software' s control panel to remotely operate the Blu-ray recorder for cueing and resetting.

(2) Select the server board card for material capture from the capture device list in the upload software.

(3) Operate the upload software to begin material capture:

The master control matrix establishes a capture channel under control.

The Blu-ray recorder begins playing the program disc.

The video server capture board begins recording.

After capture completes, the system automatically releases the occupied equipment and capture channel.

[Figure 3: see original paper] Upload System Control Diagram

During the SD/HD simulcast transition phase, this control system can simultaneously accommodate both SD and HD equipment, enabling mixed use within the same control system. For example, in the subtitle control system, HD channels control HD subtitle machines while SD channels control SD recorders, all using the same network switch, serial port server, and subtitle database server —eliminating the need for two separate HD/SD control systems. In the upload control system, upload workstations can simultaneously control SD/HD recorders, SD/HD server capture cards, and SD/HD master control matrices, allowing SD materials to be uploaded to SD channel servers and HD materials to HD channel servers to meet the different material requirements of SD and HD channels.

This system architecture has been employed by Fuzhou Radio and Television Station since the digital conversion phase of the SD era. Despite multiple equipment updates through the current HD system, the core architecture remains applicable. Based on over ten years of operational experience, serial port servers not only enable traditional serial devices to integrate into Ethernet-centric control networks—enhancing centralized equipment control, improving utilization rates, and reducing costs—but also demonstrate exceptional stability with long-term, fault-free operation. Operationally, staff interactions with devices at the client end are transparent, eliminating the need to consider communication mode differences between devices and improving usability. From a security perspective, the system solves communication challenges for device control between two independent, non-interconnected local area networks, significantly reducing computer virus transmission risks. In terms of compatibility, the control system enables simultaneous mixed use of HD and SD equipment, allowing HD upgrades to be implemented in batches and phases, which substantially reduces capital investment pressure.

Based on these experiences, this control system offers strong stability, high security and compatibility, low operational costs, and facilitates equipment upgrades and transformation—making it a reliable choice before full IP-based broadcast control system implementation.

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*Note: Figure translations are in progress. See original paper for figures.*