Technical Brief

ACU communications explained

Introduction

There are several means by which you can connect a TDSi Access Control Unit (ACU) to a computer running Ultragard 2000. In any given situation, some will be unsuitable but you will still be left with a choice.

Each method has different costs and benefits associated with it, and this document aims to discuss these in order to allow you to make the best choice.

To help build a general understanding of the subject, we start by explaining the principles used by Ultragard 2000 Communications.

Ultragard Communication Principles

As you will see later, more than one ACU can be connected to a single communication port on a computer. This means that there must be a means of preventing two or more ACUs transmitting at the same time, because if data collision occurred there would be no means of unscrambling the result.

TDSi's solution to the problem is that an ACU never transmits unless it is asked to – this is sometimes called "polling". This is the opposite of the situation when an ACU is to be connected to a "dumb" printer that cannot ask for data and where the ACU must transmit event data immediately the event occurs. (This explains the existence of the menu option in the Communications menu – Immediate or Polled).

Polling for Events

Most of the time, Ultragard 2000 is transmitting requests for event data to ACUs. Each time Ultragard transmits a request, it addresses just one ACU by including the ACUs Unit Number at the beginning of the command. If an ACU has recorded one or more events then the ACU responds by transmitting the oldest untransmitted event; otherwise it responds with a "null" response. Either way, When Ultragard has received the response it moves on to the next ACU, and so on until it starts again with the original ACU.

A single communication port can send about 5 requests per second. You can improve system performance by using more than one communications port and sharing the ACUs across the ports (the Windows operating system permits up to 9 ports).

You can see this polling taking place:

- By looking at the front-panel LEDs on an RS485 converter (if one is in use) – you will see a rapid and continuous flickering of both Transmit and Receive LEDs if all is well, because every transmission from Ultragard should result in a response from an ACU.
- Alternatively, by looking at the LEDs inside the ACU, you will see continuous flickering of the Receive LED but only an occasional response from the Transmit LED. That is because the ACU sees every command that Ultragard transmits but only responds to commands that include its own unit number.

The rhythm of the LEDs rarely changes when only polling requests are being sent – any break in the rhythm is usually short (less than 0.5s).

Sending Programming Commands

When a user makes a change to data in the Ultragard 2000 database, this will usually result in the need to send programming information to one or more ACUs. A single change to the data in the Ultragard 2000 database can result in one or many commands being sent to each ACU.

Programming commands are sent in between Polling requests and you can see the rhythm of the LEDs change when this is happening, as the ACU has to process a command before it can respond (remember that Ultragard will not send the next command until it has) and the length of the delay is variable depending on the nature of the command.

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RS232

RS232 connection is only suitable for connecting two devices together; i.e. a PC to a single ACU. As most computers already have an RS232 port spare, this is the lowest-cost option, but it is limited to 15m (50ft) of cable. So if you have more than one ACU, or require more than 15m of cable, you need to use another method.

RS485

RS485 allows 32 devices to be connected on 1200m of cable. Usually, this requires an RS232-RS485 converter to be plugged into the RS232 port of the computer and these are widely available in various forms. TDSi supply a Westermo MA-45, which is mains powered, uses opto-isolated circuitry and provides information on status via front-panel LEDs. Cheaper alternatives without these features are available from various sources. PCI cards that provide direct RS485 connection are available for fitting into the PC.

If more than 1200m of cable or more than 31 ACUs are needed, line-drivers can be used to boost signal strength.

Note that an RS485 network must not be installed as a “star” or “multi-drop” configuration. The cable must loop in and out of the ACU, although the ACU plays no part in driving or delivering the signal to the next ACU.

The PC can sit anywhere on the RS485 network – it does not need to be at one end. It is perfectly acceptable for example for the PC to be in the middle, with 600m of cable headed off in one direction and 600m of cable headed off in another direction. There is no concept of balancing loads either: you could have 30 ACUs on one of the legs and one ACU on the other.

Modem

Connection via modem is suitable for use with remote sites where no local administration and monitoring is required.

The central computer will connect to the remote site whenever there are commands and card numbers to be sent, and will also connect on a regular basis to collect event data.

The access control units on the remote site will connect to the PC whenever there is an alarm to report. However, if two ACUs try to dial out simultaneously then they will both fail due to collision of data. Ideally, only one ACU should be connected to a modem if alarm dial-back is required. Otherwise, multiple ACUs can be connected via an RS485 bus to a RS485/RS232 converter that is connected to the RS232 port on the modem.

TDSi experienced some problems when testing ISDN modems. It is likely that these problems have been solved as part of the work required by the implementation of TCP/IP communications in Ultragard 2000 v2.3, but we cannot warrant this.

USB

Some computers these days are supplied without RS232 communication ports. While adding a PCI card with one or more RS232 ports is relatively straightforward and inexpensive, it is clearly simpler to plug in a USB-RS232 converter. TDSi has tested a multi-port device (one USB port to 4 RS232 ports) and discovered that this method of “sharing” resources caused problems.

We have not tested single-port devices although the multi-port device mentioned worked perfectly when only one port was in use. We have not tested two one-port devices plugged into the same computer – this may also introduce problems through the effects of “sharing” resources.

Structured cabling (CatV, TCP/IP, Ethernet etc.)

Putting in new cable is time consuming and costly. In some cases it can be impossible (in listed buildings, across roads etc). TDSi supports two methods for using an existing network – whether it is a local area (LAN) or wide area network (WAN) – provided the network permits TCP/IP traffic:

1. By installing a pc to act as a "communications server"
2. By installing an Ethernet-to-serial adaptor

Communications server

This simply requires installing the Ultragard 2000 communications software on a PC, and connecting the PC anywhere on the network. This PC then provides all of the other options for connection to ACUs.

There will be issues to be dealt with, such as ensuring that the PC with the database has a static IP address and that the communications server can "see" this PC across the network regardless of routeing issues and sub-net masks. The client's IT Administrator may be nervous about allowing "foreign" traffic and may be concerned that load on the network may increase to unacceptable levels. TDSi has many such installations with no problems.

The communications PC can be an unattended machine with no keyboard mouse or PC. Provided it is set to auto-login, the communications software will start automatically after a power failure. If the database PC becomes unavailable, communications will stop until it becomes available again.

It may be that the same PC is required for use by an administrator, in which case this becomes a "no-cost" option.

Ethernet-to-serial adaptor

Ethernet to serial adaptors are becoming more popular and more common as a solution to the problem of installing dedicated cabling. Sometimes these are installed in pairs – one at the PC, one at the remote end. Sometimes only one device is used, at the remote end, and an application is run on the PC that creates a virtual communications port and re-routes data for that port to an IP address.

Many manufacturers claim that these devices are "transparent" – i.e. that the devices at each end of the link behave just as if there was a direct connection. This is not always the case – the devices may not be tolerant to the variable delays that can occur in a network with variable loading. Only devices that have been tested and approved should be considered.

TDSi has implemented a solution using a single device with com-port re-direction. Up to 9 such devices can be addressed by each pc in the Ultragard system, without utilising any "real" communication port hardware. Each device can have up to 31 ACUs connected as they support RS485. So not only has the cost of dedicated cabling been eliminated, but also the cost of an RS232-RS485 converter.

Radio modem, Fibre optics, Line Drivers, X25 etc.

In theory, any method of communications link may be employed provided that it is "transparent" to the Ultragard software and to the ACUs. This means that the various aspects of the protocol must be unaltered by the communications link:

- A data packet must be received exactly as transmitted. The TDSi protocol uses packed BCD encoding with error checking. This can result in characters that are reserved for special use in a conventional 7- or 8-bit ASCII character set – these must be transmitted exactly as they are received
- Delays must not be introduced by the communications link – Ultragard expects responses within a fixed time and will treat an ACU as off-line if responses are delayed.
- Inter-character delays must not be introduced
- Multiple packets must arrive in the same order as they were transmitted

Due to the wide variety of possible communication links, and the large number of manufacturers of such equipment, TDSi cannot recommend, test or warrant any particular method or manufacturer beyond those listed in this document.