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DATA COMM FOR BUSINESS

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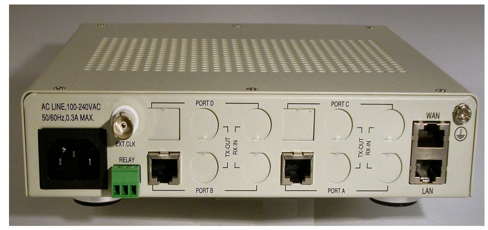
IP-6700 T1/E1 over Ethernet Applications Note

Front View of IP-6700 showing SMP Port



Rear view showing 2 - T1 Ports

The IP-6700 transports T1 or E1 over Ethernet. The T1 or E1 TDM data is encapsulated in UDP packets. Each packet is made up of **bundles** and **cells**.

A **bundle** is a grouping of consecutive DS-0 channels, i.e channels 1 through 24, or 16 to 20, etc.

Cells contain 48 bytes and are used to transmit the bundled DS-0 information over Ethernet.

The number of cells per bundle determines the size of the IP packet. Each cell is 48 bytes, or octets. This is discussed in the IP-6700 manual Section 8.2. With 48 byte cells, the maximum number of cells per bundle is 30 (30 x 48 = 1440 bytes of payload). For any bundle, the number of cells can range from 1 to 30. With 1 cell per bundle, the total packet size is 94. For each additional cell per bundle, the packet size increases by 48 bytes. The maximum packet size is therefor 1486 bytes.

With small cells, that is, few cells in the bundle, the packets are small, the number of packets per second is higher, and the total data rate goes up. The data rate increases because with small cells, the overhead of the IP header is a larger percentage of the data. With just one cell in the bundle, the IP overhead is 46/94, or 49%. With 30 cells in the bundle, the IP overhead is 46/1486, or just 3%.

If the IP-6700 is used with a router that is limited in the number of packets per second that it can handle, then more cells in the bundle is desired. More cells in the bundle results in fewer, larger packets.

The table below shows the relationship of bundles, cells, packets, packet size and full duplex (both directions combined) data rates.

DS-0's/Bundle	Cells in Bundle	Packets/Second	Packet Size	M Bits/Sec
1	1	340	94	0.256
2	1	682	94	0.512
2	2	340	142	0.388
4	4	341	238	0.650
24	1	8192	94	6.161
24	24	341	1198	3.272

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IP Addresses:
The **Unit** address should be a different address than the Bundle IP address. The Unit address is used for SNMP and Telnet access, and both are transported via TCP/IP. The T1/E1 information is sent using UDP. The Unit address is set after logging in ("O" to Log In), then entering "S" for System Setup.

The Ethernet Port in the screen below is the Lan Port.

```
LOOP IP6700              === System Setup (SYSTEM) ===      15:07:22 10/03/2006
ARROW KEYS: CURSOR MOVE, TAB: ROLL OPTIONS
Time/Date       :15:07:26 10/03/2006  Ethernet Port:ENABLE   Lan Port: Data_only
IP Addr.:010.002.003.055 Subnet Mask:255.255.000.000 Gateway IP:000.000.000.000
Community:(Get)public           Community(Set)public       Wan Port: WAN_only
```

The **Bundle** IP Setup is accessed by entering "T" on the main menu to access the Time Slot IP Assignment. The Bundle IP Address setup is accessed by entering "V". The address is set on the screen shown below, using a different IP address than the Unit address. This Source address is used for transporting T1/E1.

```
LOOP IP6700               === Bundle IP Setup ===          15:54:38 11/03/2006
ARROW KEYS: CURSOR MOVE, Please Input: nnn.nnn.nnn.nnn, BACKSPACE to edit

Src. IP Address :000.000.000.000
Subnet Mask     :000.000.000.000
Gatway IP       :000.000.000.000
```

Timing/Clocking:
The clock setup is accessed from the main menu with the "K" Clock Source Setup selection. The choices for clocking are Internal, External, Port X (Bundle X) or Port X (Line). The **Internal** clock is a clock internal to the IP-6700. **External** clock comes in via the BNC connector on the rear of the IP-7600. The **Port X (Bundle X)** clock comes from data received over the Ethernet from a remote IP-6700. The **Port X (Line)** clock comes from the T1/E1 line plugged into the IP-6700. Each T1/E1 port can be clocked separately, as required.

If connecting to a phone company line, where the phone company should be the controlling master clock, the IP-6700 plugged into the phone line should be set to Port X (Line) and the the far end IP-6700 should be set to Port X (Bundle X).

If an IP-6700 T1/E1 port connects private, non-telco devices, the clock source could be the IP-6700 at one end, or the external T1 device (such as a PBX). Only one device can be the master clock for a port. If the master clock is external to an IP-6700, the IP-6700 clock must be PortX(BundleX, or PortX(Line). The IP-6700 that is wired to the master clock device must be set to PortX(Line) clock.

```
E1 Port A          === System Setup (CLOCK-Normal Mode) ===13:57:00 12/06/2005
ARROW KEYS: CURSOR MOVE, TAB: ROLL OPTIONS


Master_Clk Source : INTERNAL
Second_Clk Source : INTERNAL
Current Clock     : MASTER_CLK
Clk_Recover_Mode  : MANUAL
Clock Status      : NORMAL
```

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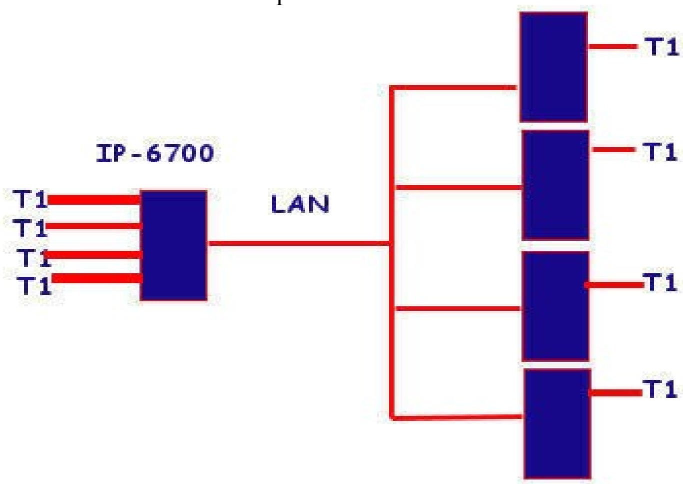
Point-to-Point or Point-to-Multipoint Applications:
The IP-6700 can be used point-to-point, or can be used from a single point to multiple end points. Each bundle in an IP-6700 can have its own unique destination IP-6700.



Jitter, Delay and Buffering:
The IP-6700 has a receive buffer to handle the jitter delay that characterizes IP packet transmission. The jitter buffer can be up to 512 milliseconds in size. The jitter buffer size and jitter delay are both expressed in milliseconds. The delay and size are set on a per-bundle basis. On the bundle setup page, the numbers entered are 0.5 milliseconds in value.

The variable packet delay that can be handled by the IP-6700 is approximately ¼ second. If packets arrive out of order, the IP-6700 can correctly re-order the packets if they are within the jitter buffer size/time. If packets are lost in transmission, the IP-6700 will fill in the missing packet. The packet fill in may be invisible for voice or data traffic. It depends on what was in a missing packet.

The jitter size value must be larger than the jitter delay. The difference between the jitter size and jitter value must be larger than the time to process an incoming packet. The size and delay cannot be equal. At 10BaseT data rates, the largest IP-6700 packet will take at least 2 milliseconds to receive, not counting internal processing.

As delay increases for voice traffic, the need for voice echo cancellation increases. But if size and delay are too small, they may be smaller than the typical jitter on the IP network, resulting in lost packets. If the IP-6700 is used on a link with other traffic, and the traffic is bursty, it may be necessary to experiment to get the optimum values for jitter size and jitter delay.