PDi Communication Systems, Inc

WHITEPAPER

Designing IPTV Infrastructure for PDi® medTV® and medTAB®

PDi-WP-5

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Overview

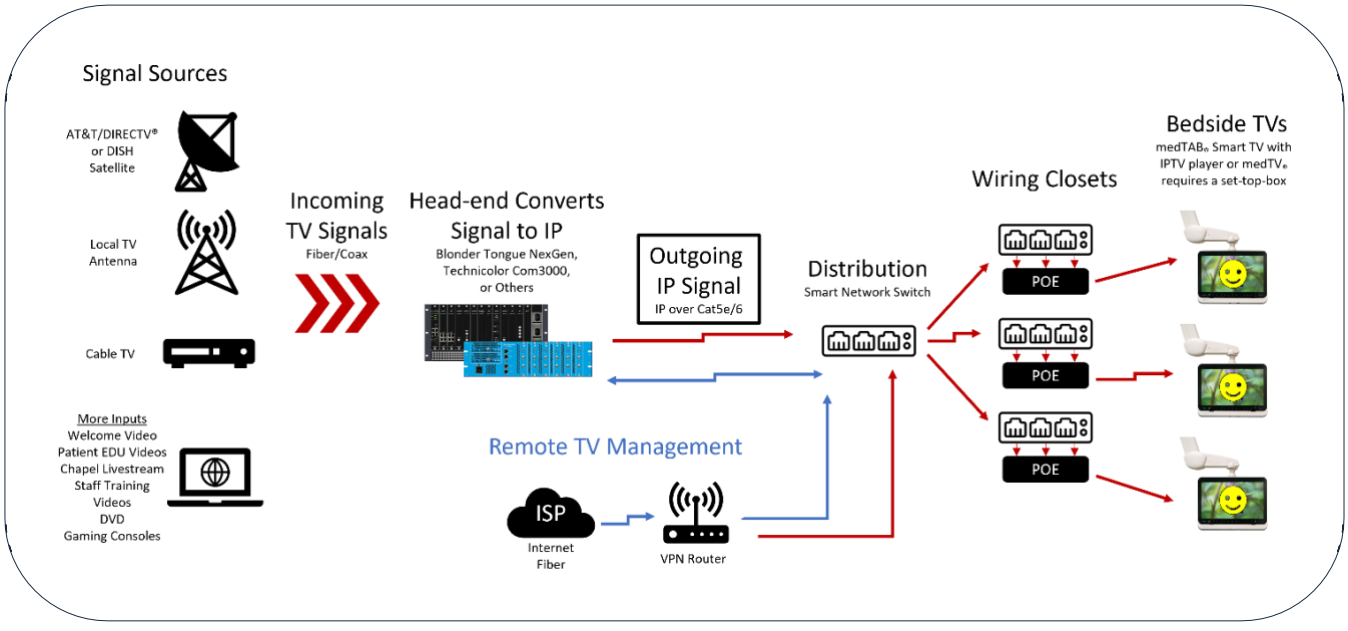
IPTV (internet protocol television) is the next evolution of on-premises television distribution in healthcare facilities. Compared to traditional RF distribution using coaxial cable, IPTV uses standard computer network infrastructure for lower maintenance, longer distances and added services.

PDi Communication Systems, Inc. is the leader in IPTV solutions for healthcare.

PDi offers everything you need From Head End to Bed End® including installation.

This document will help you plan for the network infrastructure needed to support IPTV distribution from an in-house headend to each PDi endpoint.

A complete system will look like the following.



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Signal Source

- The IPTV channel source is typically a rack-mounted transcoder in the facility's headend room or MDF.
- Transcoders compatible with PDi TVs include, but are not limited to:
  - ATX UCrypt
  - Blonder Tongue NexGen
  - DirecTV COM3000
  - Dish SMARTBOX 2
- The transcoder input is usually a roof-mounted satellite dish, a cable-company coaxial cable, or optical fiber. In some cases, a roof-mounted off-air antenna is also used.
- PDi TVs are compatible with the following stream formats over Ethernet:
- Transport layer: UDP, with or without RTP
- Network layer: IP and IGMP
- Video encoding: MPEG-2 and AVC (H.264/MPEG-4 Part 10)
- DRM encryption: Pro:Idiom-M, including the DISH Network variant, and AES-128
- Encapsulation: MPEG-2 single-program (SPTS) and multiprogram (MPTS) streams

Switch Gear

- A small facility may only need a single switch to support the IPTV broadcast and a limited number of TVs, but there is no limit to the number of switches that can be cascaded to support all the organization's TVs.
- Determine the port count of each switch by considering the following.
  - Each PDi TV requires one home run cable to a switch port. Most PDi models connect to the switch at 100 Mbps speed. You may use 1 Gbps switch ports, as that is the typical configuration.
  - You will need at least one 1Gbps switch port for the IPTV channels coming from the transcoder to the core (or only) switch. With a large number of IPTV channels (more than 50) some transcoders will exceed 1 Gbps output. They will require more than one 1 Gbps switch port or may require a 10 Gbps CAT6 or optical connection.
    - If you are providing internet services, the core (or only) switch will need another port for connection to a router.
    - Another port may be needed on the core (or only) switch for a DNS server if you are providing internet but don't already have DNS available via the router or public host.
    - Another port may be needed to attach a DHCP server if it is not already available via the router or switch.
    - If using PoE power, each PoE power inserter chassis may have a management port that will consume one switch port per PoE chassis.

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- If you are interconnecting switches, each switch will require at least one 1Gbps port for the trunk. A way to estimate the interconnect bandwidth is to multiply 20 Mbps by the lesser of:
  - the number of TV's connected downstream of the interconnection,
  - the total number of IPTV channels available
- Consider any remaining equipment that will need to connect to the switch to determine the switch size.

- All switches must support IGMP and it must be configured properly.
  - Each switch must support IGMP snooping. **IGMPv2 or higher is preferred**. IGMPv3 support is required only when the headend transcoder uses Source Specific Multicast.
  - Each switch must have **IGMP snooping** turned on for the VLAN supporting IPTV.
  - The core (or only) switch connected to the headend transcoder must also support **IGMP querying** and must be configured as the **IGMP Querier** on the VLAN supporting IPTV.
- Switch port congestion must be considered for quality of IPTV delivery.
  - Headend transcoders typically use UDP or RTP (over UDP) transmission protocols.
  - UDP has no packet retransmission capability, so any network congestion can result in dropped packets and missing/corrupted video frames.
  - Care must be taken in the network design to avoid port congestion, especially microbursts (100% utilization for a fraction of one second), which can cause intermittent missing/corrupted video.
  - Non-video traffic, going to PC's and other devices, that passes through switch trunks (connections between switches) can result in microburst congestion.
  - Another source of congestion is having too many video streams on one ethernet trunk (from the transcoder or between switches). Most video streams are variable bit rate, so the combined bit rate of all streams can have large peaks.

    A good rule of thumb is to assume each IPTV channel uses **20 Mbps.**
  - Tips to minimize congestion:
    - Apply QoS on switch ports to prioritize video traffic.
    - Use link aggregation or 10Gbit ports for trunk lines between switches to free up bandwidth.
    - Enable ethernet flow control on all switch ports facing a PDi TV. This allows the TV to send pause frames if its buffer becomes temporarily saturated.
- **Limit the use of Spanning Tree Protocol (STP).**
  - STP can create a long blocking period each time the TV is turned on and its link becomes active. In some cases, the TV may never obtain an IP address because of DHCP request throttling. PDi recommends disabling STP on switch access ports.
  - For storm control, use broadcast rate limiting and/or loopback detection instead. If STP must be used, set the TV to high-power standby so it never disconnects from the switch.

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PDi recommends the **Alcatel-Lucent OmniSwitch 6360** series managed switches for their superior IGMP performance, technical support, and lifetime warranty.

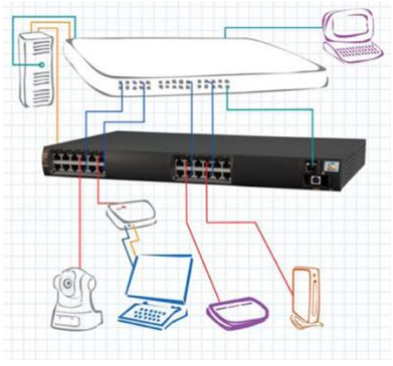
PoE Network Power

- Some PDi models are powered over ethernet (called PoE).
- There are many levels of PoE power. To power PDi devices, use only UL-listed power-sourcing equipment that provides a minimum of 60 W per port using all four pairs. Industry identifiers include IEEE 802.3bt Type 3, PoE++, Ultra PoE (UPoE), and Cisco Universal PoE+ (UPoE+).
- Power-sourcing equipment typically has a total power output below the amount needed to power every port at the full 60 W. PDi TVs need 60 W for peak demand but average about half that amount. The minimum recommended total output is **30 W × the number of ports connected to a TV.** For example, a 24-port injector serving 24 PDi TVs must provide at least 720 W total output.

PDi recommends the following PoE midspan power inserters, which have been tested and UL listed with PDi products:

- 1 port - Microchip Microsemi PD-9601G/AC
- 6 port - Microchip Microsemi PD-9506G/ACDC/M
- 12 port - Microchip Microsemi PD-9512GC/AC or PD-9612GC/AC
- 24 port - Microchip Microsemi PD-9524GC/AC or PD-9624GC/AC

- 2 midspan port connectors (**Data In** port and **Data/Power Out** port) are used for each powered device.
- The following diagram shows a 12-port PoE midspan power inserter. Position the PoE inserter near the Ethernet switch, with short cables connected to the switch (blue lines) and longer cables running to each PDi device (red lines).



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Ethernet Cables

CAT5e supports 1 Gbps speed with PoE power up to 328 feet (100 m) between the network switch and each endpoint device.

The limit includes the combined cable length before and after the PoE midspan power inserter.

- CAT5e cable usually uses 24 AWG wires, but more expensive versions may use 23 or 22 AWG. Lower AWG numbers indicate thicker conductors, which slightly reduce PoE power loss on long runs, save electricity, and reduce self-heating in cable bundles.
- Using CAT6 or CAT6A is generally unnecessary but may be desirable for future needs such as higher speeds and/or higher PoE power delivery.
- When 328 feet (100 m) is not long enough, connecting switches by fiber supports distances of 1 km or more and can provide access across multiple floors or an entire campus.
- Always follow local electrical code and category-cabling best practices.
  - Use plenum cable when crossing firewalls or floors, or when routing through ventilation shafts.
  - Use shielded cable when running alongside electrical power wiring or other sources of electrical noise.

IP Addressing

- Each TV channel from the headend transcoder must be assigned a unique IP multicast socket (address and port).
- TV channels may be single-program (SPTS) or multiprogram (MPTS) transport streams.
- PDi TVs must have a unicast host address assigned by DHCP or statically. A TV will not listen for multicast packets until it has a unicast address.
- For IPTV channel assignment, PDi recommends administratively scoped multicast address space as defined in RFC 2365; however, PDi TVs may use any multicast address range.
- If Source Specific Multicast is used, use the 232.0.0.0/8 CIDR range for compatibility with most network equipment.

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The following addressing scheme is used by PDi TVs by default and is recommended for easier troubleshooting:

- Available channel numbers: 1 through 9999.
- Multicast range: 239.255.0.1 through 239.255.99.99; default port: 1234.
- The last octet represents the lower two digits of the channel number.
- The third octet represents the hundreds and thousands digits.

Examples of default channel numbers are shown below.

- TV channel 1 is on udp://239.255.00.01:1234
- TV channel 105 is on udp://239.255.01.05:1234

- TV channel 500 is on udp://239.255.05.00:1234
- TV channel 9999 is on udp://239.255.99.99:123

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