White Paper

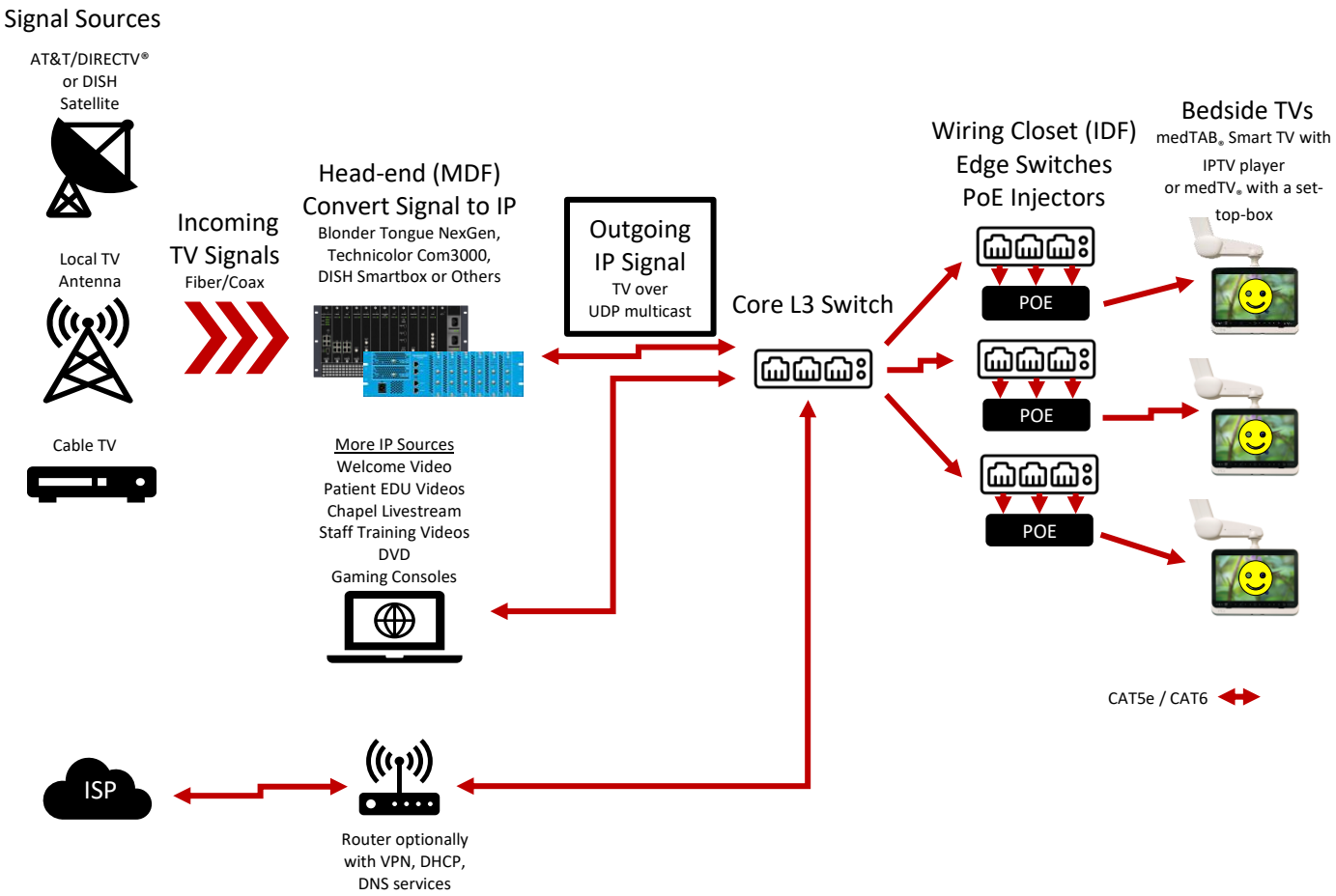
DESIGNING IPTV INFRASTRUCTURE FOR PDI TV AND TAB

PDI-WP-5

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 something like the following.



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 either a roof mounted satellite dish, a cable company coax or optical fiber. In some cases, a roof mounted off air antenna is also used as an input.
- PDI TVs are compatible with the following stream formats over ethernet
    - Transport layer: UDP (with or without RTP)
    - Network layer: IP, IGMP
    - Video Encoding: MPEG-2 and AVC / MPEG-4 Part 10
    - DRM Encryption: None, ProIdiom-M (including the Dish Network variant) or AES-128
    - Encapsulation: MPEG-2 single program (SPTS) or multiprogram (MPTS) stream

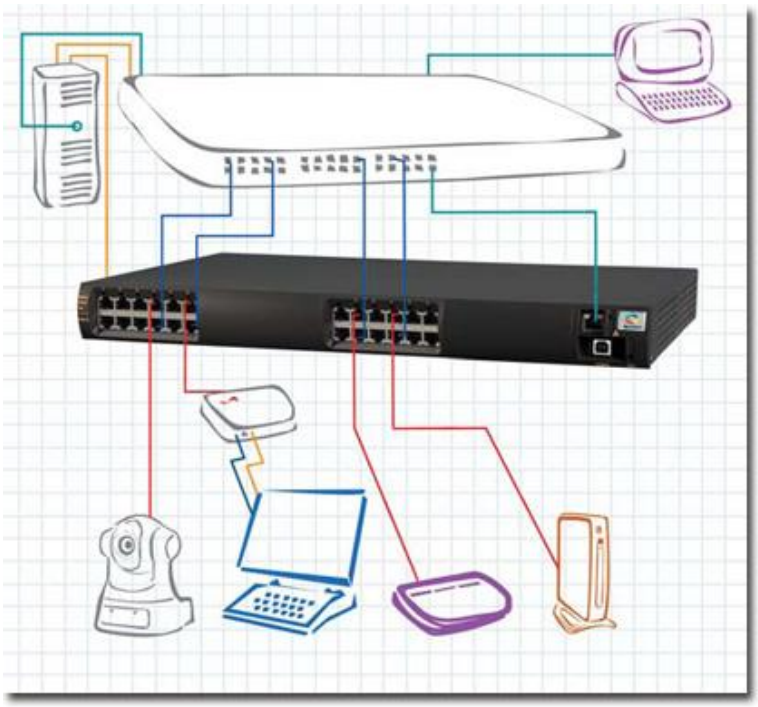
Switch Gear

- 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 your 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.
    - 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 only required when the headend transcoder uses Source Specific Multicast.
    - Each switch must have **IGMP snooping** turned on.
    - The core (or only) switch connected to the headend transcoder must also support **IGMP querying** and must be configured as the **IGMP Querier**.
- 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 UP. In some cases the TV may never obtain an IP address due to DHCP request throttling. PDI recommends disabling STP on switch access ports.
    - For storm control use broadcast rate limiting and/or loopback detection instead. If you must use STP, you may set the TV to high power standby so it never disconnects from the switch.
- 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 offers minimum 60W per port using all 4 pairs for power delivery. The industry uses several different identifiers for 60W per port, including the following:
    - IEEE 802.3bt type 3
    - PoE++
    - Ultra PoE (UPoE)
    - Cisco Universal PoE+ (UPOE+)
- Power sourcing equipment typically has a total power output less than needed to power all ports at the full 60W each. PDI TVs need 60W to meet peak demand, but on average use about half that. So a minimum recommended total power output is 30W x # of ports leading to a TV. As example, a 24 port PoE inserter must have at least a 24x30=720W total power output.
- PDi recommends the following PoE midspan power inserters which have been tested and UL listed with our 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. The PoE inserter will be positioned near the ethernet switch, with short cables connected to the switch (shown as blue lines), and longer cables running to each PDI device (shown as red lines).



Ethernet Cables

- CAT5e supports 1Gbps speed with PoE power up to 328 feet (100m) between the network switch and each endpoint device. The 328 ft (100m) limit includes the combined length of cable before and after the PoE midspan power inserter.
- CAT5e cable usually uses 24AWG wires, but more expensive versions can use 23 or 22 AWG. The lower AWG numbers are better because they are thicker and allow for slightly less PoE power loss over long cable runs. This saves electricity costs and causes less self-heating of bundles of cables as they travel from the power inserter to the powered devices.
- 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 ft (100m) is not long enough, connecting switches via fiber allows distances of 1km or more allowing for access to multiple floors across the entire campus.
- Always follow the local electrical code and category cabling best practices.
    - Use plenum cable when crossing firewalls, crossing floors, or wiring through ventilation shafts.
    - Use shielded cable when running alongside electrical power wires or other sources of electrical noise.

IP Addressing

- Each TV channel from the head end 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 TV's must have a unicast host address assigned either by DHCP or static. The TV will not listen for multicast packets without a unicast address assigned to the TV.
- For IPTV channel assignment, PDi recommends using administratively scoped multicast address space as defined in RFC 2365. However, PDI TVs may use any multicast address range.
- The following IP addressing scheme is used by PDi TV's by default. It is recommended to follow this when creating your custom lineup so that troubleshooting is easier.
    - The available channel number range is 1 through 9999.
    - The multicast range is 239.255.0.1 through 239.255.99.99 and the default port is 1234.
    - The last octet of the IP address represents the lower 2 digits of the channel number.
    - The 3rd octet of the IP address represents the hundreds and thousands digits of the channel number.
    - Examples of default channel numbers:

      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: 1234