EEE transition time constraints

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Outline

- Application considerations
- Protocol considerations
- Conclusions

Application – IP phone

VoIP phone w/ 3 port switch

1. VoIP traffic low, link between phone and switch operates at 100 Mbps
2. Application on PC initiates data transfer
3. Link between phone and wiring closet switch transitions from 100 Mbps to 1000 Mbps
4. Transition time must be less than 10 ms to avoid audible disruption of phone call
5. Application on PC finishes data transfer
6. Link between phone and wiring closet switch transitions back to 100 Mbps
7. Transition time must be less than 10 ms to avoid audible disruption of phone call

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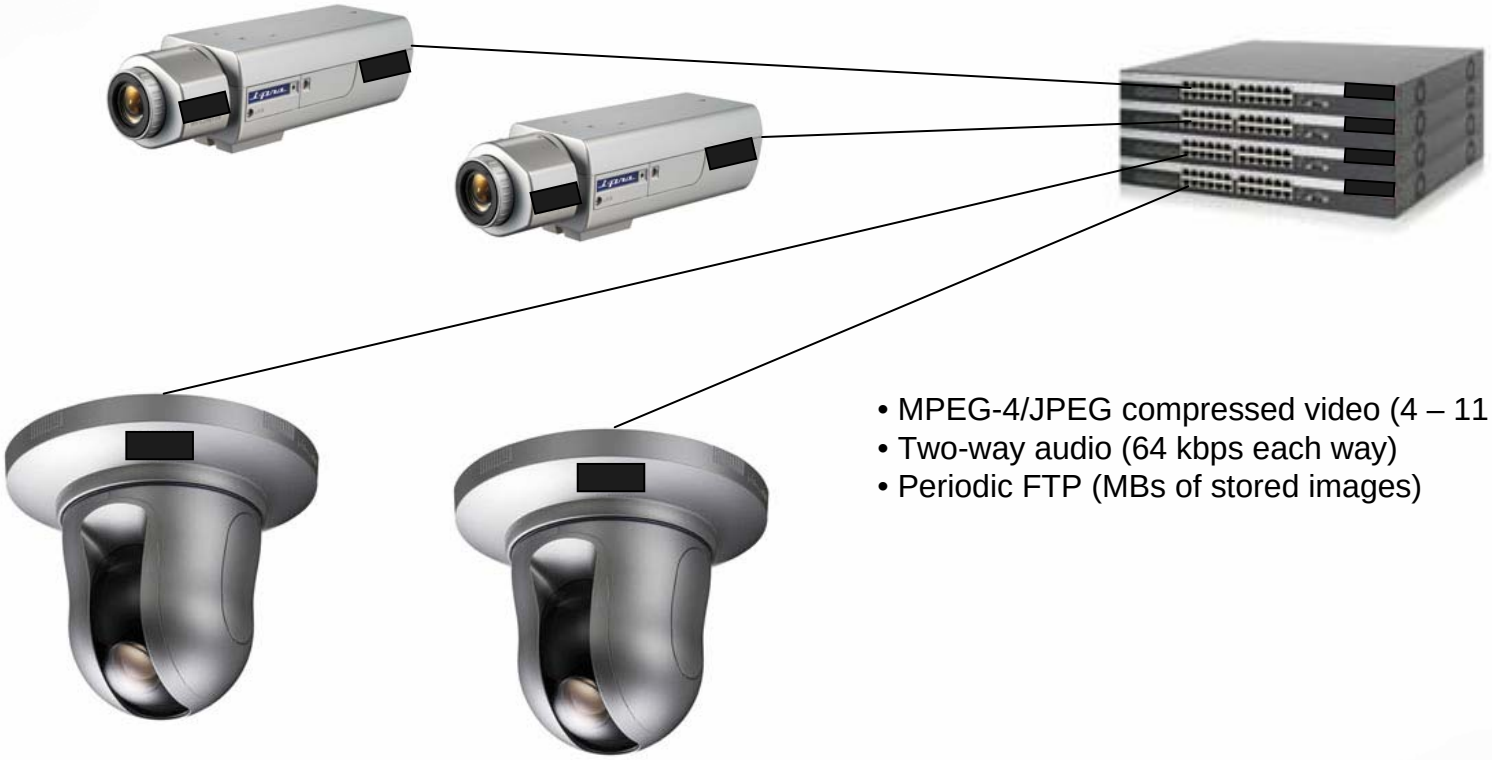
Application – surveillance camera



- MPEG-4/JPEG compressed video (4 – 11 Mbps)
- Two-way audio (64 kbps each way)
- Periodic FTP (MBs of stored images)

1. Cameras send MPEG-4 video to server and display consoles at 30 fps, ~4 Mbps
2. Cameras periodically send JPEG still images to server using FTP
3. When FTP session initiates, link will transition from 10 Mbps to 100 Mbps (possibly 1000 Mbps in the future)
4. Transition time must be less than ~15 ms to prevent frame loss

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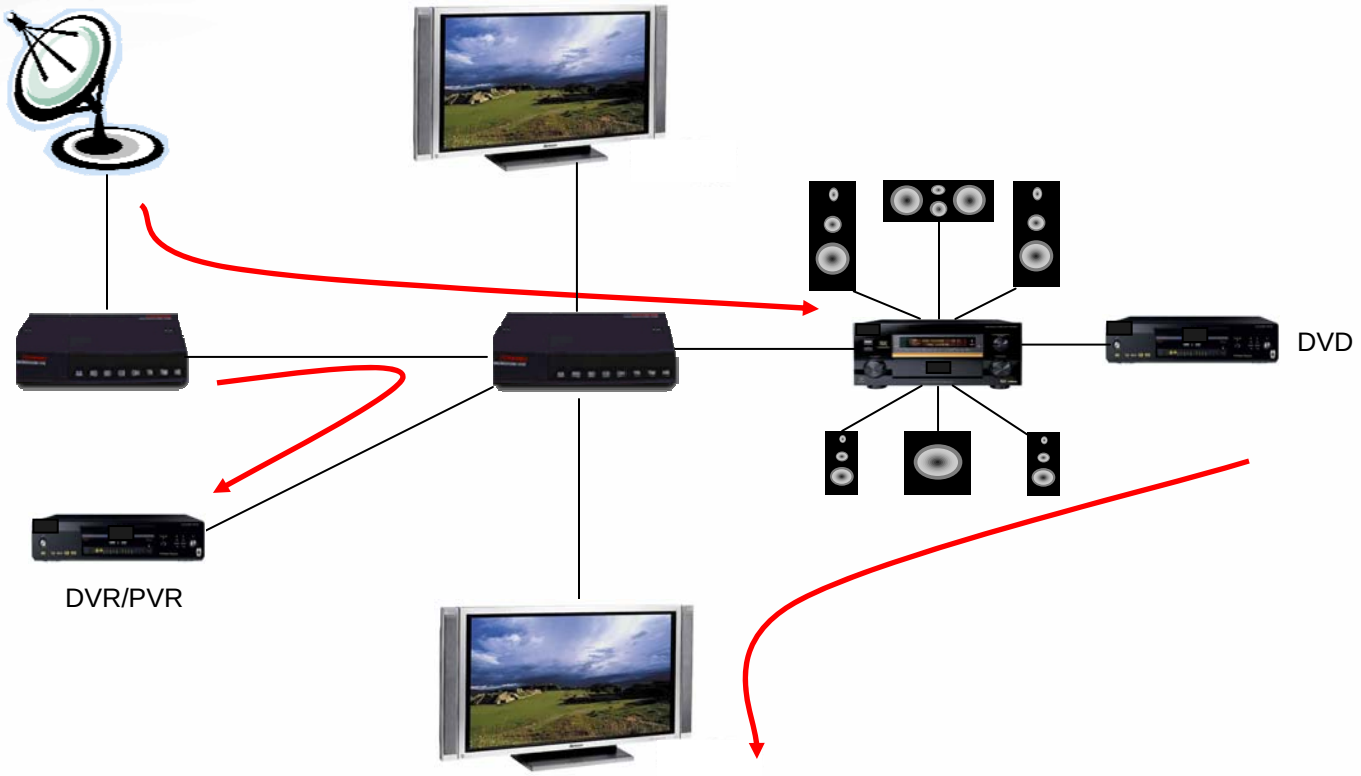
Application - EAV home network



1. Listening to satellite radio on EAV receiver, link between receiver and switch operating at 10 Mbps
2. Start playing DVD on a screen in another room
3. Link between receiver and switch must transition from 10 Mbps to 100 or 1000 Mbps
4. Transition time must be less than 10 ms to avoid audible disruption
5. DVR/PVR set to record “Survivor” from satellite receiver at 8:00 pm on Thursday
6. Link between satellite receiver and AVB switch must transition from 10 Mbps to 100 or 1000 Mbps
7. Transition time must be less than 10 ms to avoid audible disruption

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Application – file transfer

- Assume that a file transfer will invoke a transition from low power to higher bandwidth operation
  - depends on the control policy
- Depending on the transition time and file size, the transition time may be a significant fraction of the transfer time
  - The transition to higher bandwidth might actually increase the file transfer time

File size (MB)	Transfer Time @ 10 Mbps (ms)	Transfer Time @ 100 Mbps (ms)	Transfer Time @ 1000 Mbps (ms)	Transfer Time @ 10000 Mbps (ms)
0.01	8	0.8	0.08	0.008
0.1	80	8	0.8	0.08
1	800	80	8	0.8
10	8000	800	80	8

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Protocol considerations - TCP

- If link downtime is 1 ms or longer, then the entire TCP window may have been sent during the link downtime with the whole end of a window being dropped.
- This means that the connection will be idle until the retransmission time out triggers retransmission.
  - RFC 2988 says that minimum RTO should be 1 sec (to prevent unnecessary retransmissions if the partner gets busy and is slow in sending acks)
  - It isn't uncommon for systems to use a somewhat smaller minimum, e.g. 200 ms
- Once retransmission starts, it progresses more slowly than the original transmission in order to avoid further drops
- In most cases, the transmitter either will send one segment per ack until retransmission completes (i.e. window size is one segment) and then begin slow start (window increases by one segment per ack) or will enter slow start behavior starting with a window size of one from the beginning of retransmission.
- Either way the transmit rate will be lower than it was before the dropped segments until the window has expanded.

Protocol considerations - TCP

- Increased traffic load causes a transmitter to initiate link speed increase
- Speed change takes link down for x ms - during this time buffers overflow and packets are dropped
- TCP exhausts window and stops transmitting
- Link comes up, but traffic load is currently low due to stalled transmitters
- RTO expires and retransmission begins - traffic load is still low until retransmission completes and window size rises
- If the transmitter interprets the reduced traffic as an indication that it can drop back to the lower speed than the link may thrash between the two speeds

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Conclusions

- Applications require sub 10 ms transition time
- Switch buffer overflow is likely if transition time is greater than 1 ms
  - This will degrade TCP performance
- Recommend that the EEE SG retain the goal of achieving a transition time of less than or equal to 1 ms