Summary of A/V Bridging Network Requirements

Geoffrey M. Garner (Consultant)
Gmgarner@comcast.net

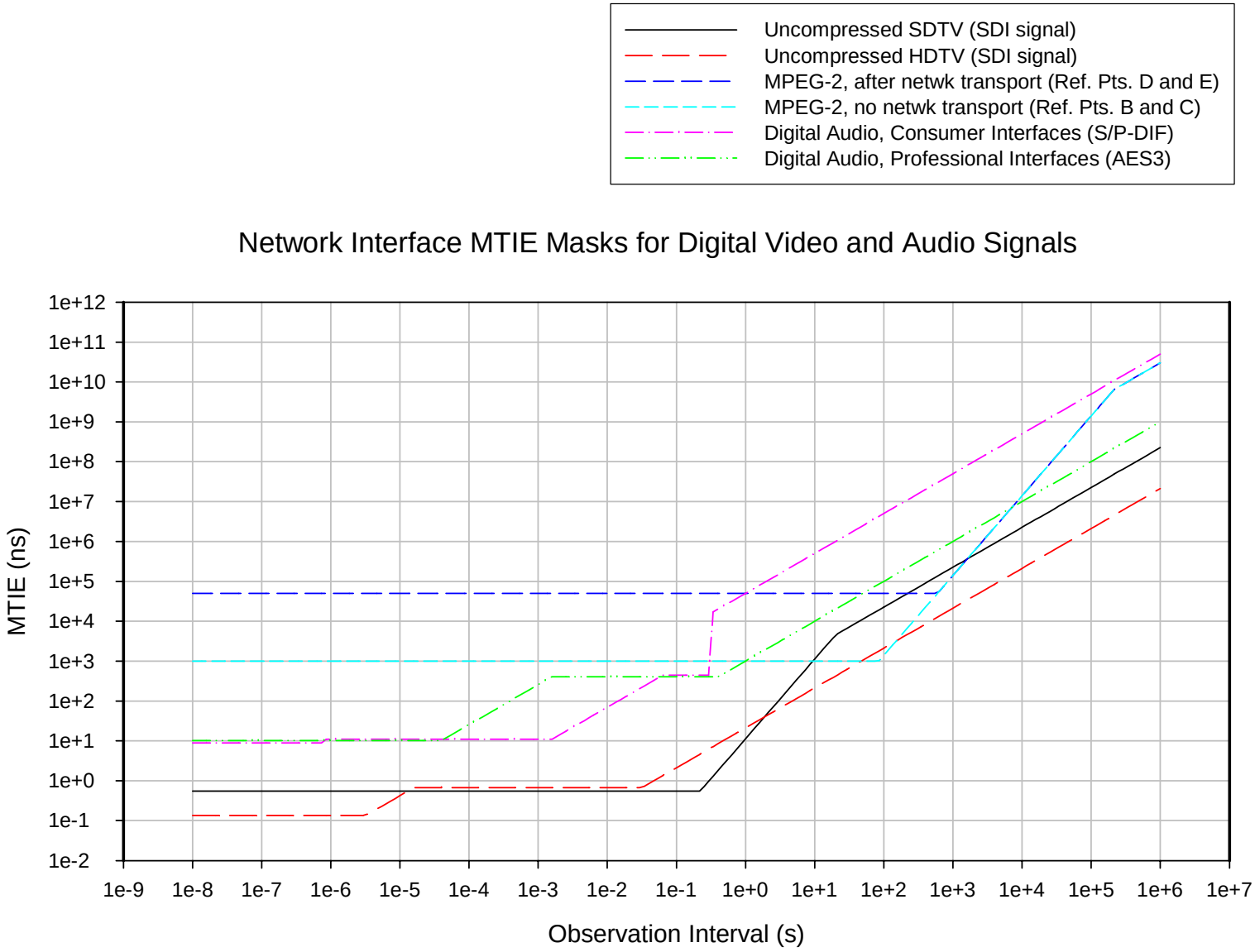
SAMSUNG Electronics

IEEE 802.1 AVB TG / IEEE 1588 Design Meeting
2006.02.21

Summary of Requirements

- Jitter and wander accumulation for time-sensitive applications (uncompressed and compressed digital video; digital audio) at the network egress must be within the respective MTIE masks on slide 3 (derived from the requirements on slide 4; see [3], and background in [1] and [2])
  - Note that the AVB Network gets only an allocation of these requirements for applications that are delivered to the residence via service provider network(s)
  - For applications that contain multiple streams, time synch of the streams (inter-stream synch requirements) must be on the order of several ms, and possibly as stringent as 10 μs (but no more stringent than this); see slide 5 for details [3]
- Requirements must be met for an application whose streams traverse up to 7 hops [4]
  - This is an assumption on the maximum expected network diameter; the total number of bridges in the network may be larger
- Possible maximum latency requirement of 2 ms [4]
  - may be relaxed by several ms depending on implications for bridges and applications (there was discussion of this at the September, 2005 interim meeting)
- Cost of Audio/Video Bridges should be in same ballpark as cost of present consumer-grade Ethernet switches, routers, or wireless access points (or products that combine these functions) [5]
- Minimal or no administration required by users; bridges should be “plug and play” and self-configure (including GM selection)

End-to-End Jitter and Wander Requirements



End-to-End Jitter and Wander Requirements

Requirement	Uncompressed SDTV	Uncompressed HDTV	MPEG-2, with network transport	MPEG-2, no network transport	Digital audio, consumer interface	Digital audio, professional interface
Wide-band jitter (UIpp)	0.2	1.0	50 µs peak-to-peak phase variation requirement (no measurement filter specified)	1000 ns peak-to-peak phase variation requirement (no measurement filter specified)	0.25	0.25
Wide-band jitter meas filt (Hz)	10	10			200	8000
High-band jitter (UIpp)	0.2	0.2			0.2	No requirement
High-band jitter meas filt (kHz)	1	100			400 (approx)	No requirement
Frequency offset (ppm)	±2.79365 (NTSC) ±0.225549 (PAL)	±10	±30	±30	±50 (Level 1) ±1000 (Level 2)	±1 (Grade 1) ±10 (Grade 2)
Frequency drift rate (ppm/s)	0.027937 (NTSC) 0.0225549 (PAL)	No requirement	0.000278	0.000278	No requirement	No requirement

Inter-Stream Synchronization Requirements

- Time synchronization requirements of different audio/video streams for acceptable QoS, for several applications (see [3] and Reference [42] cited in [3])
  - Tightly coupled audio (e.g., audio streams delivered to multiple speakers)
    - ±10 μs (note: there is some question on the validity of this requirement, as this can be exceeded if a listener changes location by several cm)
  - Lip-synch
    - ±80 ms
  - Video animation with accompanying audio
    - ±80 ms
  - Other examples, and detailed description of experiments, given in Reference [42] cited in [3]

Additional Assumptions and Tradeoffs

- AVB bridge will have inexpensive Ethernet clock/oscillator
  - 25 MHz (40 ns granularity) for 100 Mbit/s
  - 125 MHz (8 ns granularity) for 1 Gbit/s
  - Will not be OCXO and extremely likely not TCXO; may be possible to bound noise generation (but bound will be loose)
- AVB bridge will have inexpensive processor, for which timing/synch functions will be a small subset of all its functions
- Low cost requirement implies it will likely not be feasible to have special hardware at the PHY to improve time stamp measurement accuracy
- Low cost requirement implies that a solution should allow any expensive filtering to be done at end device (and therefore have cost associated with the application that needs it); expensive filtering should not be required in the bridges
- Tradeoff between bridge oscillator phase error (due noise generation, temperature changes, granularity, and time stamp measurement error), sync interval, and endpoint filter bandwidth and gain peaking
- Different compensation schemes have different requirements on information that must be exchanged (e.g., both free-running and frequency corrected phases versus just frequency-corrected phases; cumulative and differential information versus only one or the other)

References

1. Geoffrey M. Garner, *Description of ResE Video Applications and Requirements*, Samsung presentation at May, 2005 IEEE 802.3 ResE meeting, Austin, TX, May 16, 2005.
2. Geoffrey M. Garner, *Description of ResE Audio Applications and Requirements*, Samsung presentation at May, 2005 IEEE 802.3 ResE meeting, Austin, TX, May 16, 2005.
3. Geoffrey M. Garner, *End-to-End Jitter and Wander Requirements for ResE Applications*, Samsung presentation at May, 2005 IEEE 802.3 ResE meeting, Austin, TX, May 16, 2005.
4. Michael Johas Teener, *Residential Ethernet Study Group Closing Plenary Report IEEE 802.3*, San Francisco, CA, July 21, 2005
5. *Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks*, Draft 5 Criteria, November 16, 2005.