

Reduced Twisted Pair Gigabit Ethernet EMC & Noise Ad Hoc Report

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RTPGE EMC & Noise Ad Hoc

- Chartered during September 2012 meeting to develop EMC & Noise models and measurements
- Conference calls & meetings held in 11/07/2012, 12/17/2012, 01/25/2013, 3/4/2013, 4/30/2013, 5/8/2013
- Communications via RTPGE/802.3bp reflector. Minutes & contributions were sent to the reflector
- Thanks to those who attended the ad hoc calls

Workplan Summary

- **First Phase (Data Collection as of 5/14/2013)**
 - Ingress modeling
 - Define the noise sources (in-car background noise, alien XTALK, EMC noise, impulse noise, battery noise, etc.)
 - Define the channel transfer function/measurement modeling methodology
 - Egress modeling
 - Block diagram for PHY emissions
 - Define emissions' mask
 - Balance measurements of the proposed RTPGE channels were provided
 - **Need input for connectors**

Workplan Summary (cntd.)

■ **Second Phase**

- Reach consensus on a baseline limit for EM emissions (emissions' mask) and based on that define the Transmit PSD mask
- Build consensus of all discrete noise sources and background noise

■ **Third Phase**

- Develop text for standard

Current Status

- ❑ Differential Channel Impairments
- ❑ EMC Noise & Limit Lines
- ❑ EMC Channel Transfer Function Modeling
- ❑ Alien XTALK
- ❑ In-Car Background Noise
- ❑ Impulse Noise
- ❑ Other Noise sources?

Differential Channel Impairments

- ❑ Insertion Loss (aka channel attenuation) varies as a function of length, frequency and temperature.
- ❑ Return Loss needs to be properly constrained for FDX systems and can have a direct impact on input dynamic range.
- ❑ Both of these impairments can be handled by digital equalization and echo cancellation.
- ❑ Status: Channel Ad-Hoc is making progress for defining the differential parameters.

EMC Modeling & Limit Lines

- ❑ Stefan Buntz (Daimler) proposed DPI technique for component level emission & immunity testing (similar to IEC 62132-4) and provided the limit lines in http://grouper.ieee.org/groups/802/3/RTPGE/public/nov12/buntz_01_1112_rtpge.pdf
- ❑ CISPR 25 also addresses Conducted and Radiated Emissions' measurement techniques. If CISPR 25 is preferred method of testing then, **Limit lines (dBuV vs. frequency [0.1MHz–1GHz])?**
- ❑ ISO 11452-2/4/5 define Radiated Immunity via Antenna, BCI and Strip Line measurement techniques. If they are preferred method of testing then, **Limit lines (dBm vs. frequency [0.1MHz–1GHz])?**

EMC Channel Transfer Function

- ❑ CM-to-CM and CM-to-DM conversion transfer functions must be attained for RTPGE channels in order to compute the input-referred noise for the PHY.
- ❑ Mehmet Tazebay (Broadcom), Richard Mei (Commscope), Thomas Muller (Rosenberger) made proposals for method and techniques for attaining these transfer functions
http://www.ieee802.org/3/bp/public/jan13/tazebay_3bp_01a_0113.pdf
http://www.ieee802.org/3/bp/public/jan13/mei_3bp_01_0113.pdf
http://www.ieee802.org/3/bp/public/jan13/mueller_3bp_01_0113.pdf
- ❑ In principle, 3-port network analyzer measurements can be used to analyze these transfer functions.

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http://www.ieee802.org/3/bp/public/jan13/mueller_3bp_01_0113.pdf
- ❑ In principle, 3-port network analyzer measurements can be used to analyze these transfer functions.

Alien XTALK modeling

- ❑ Kirsten Matheus (BMW) proposed a few select cable bundle topologies based on use cases agreed-upon by participating OEMs:
http://www.ieee802.org/3/bp/public/jan13/matheus_3bp_02_0113.pdf
- ❑ Several measurements were made based on the presented topologies (Mei et al, Commscope) using CAT6A-based 1- and 2-pair cables
http://www.ieee802.org/3/bp/public/jan13/mei_3bp_01_0113.pdf
- ❑ Preliminary results indicate that alien XTALK is within the limit lines for the select cables. . More test results are expected with the final channel parameters.

In-Car Background Noise

- ❑ Stefan Buntz (Daimler) provided a direct measurement technique and results for BG in the car http://www.ieee802.org/3/bp/public/mar13/buntz_3bp_01_0313.pdf
- ❑ The background noise was measured as common mode noise (dBuV versus frequency [0.1MHz-1GHz]).
- ❑ The EMC channel transfer functions dictate the input-referred common mode and differential mode noise observed by the PHY.

In-Car Impulse Noise

- ❑ ISO 7637-2 lists tests for transient immunity testing (pulses 1-5) for supply lines
 - Is RTPGE with PoE expected to pass these immunity pulses?
 - Are there additional requirements in excess of ISO 7637-2?
 - What criteria is considered passing for this test?
 - Class A requires a BW of the pulse within the PSD of RTPGE!
- ❑ ISO 7637-3 lists tests for transient immunity testing for signal lines.
 - Is RTPGE MDI expected to pass these immunity transient test pulses?
 - Are there additional requirements in excess of ISO 7637-3?
 - What criteria is considered passing for this test? Is it different from the ISO 7637-3 standard?
- ❑ Thomas Hogenmuller (Bosch) made a contribution showing empirical, simulation and emulation results for in-car impulse noise. This work extensively provides information for the impulse-noise model. The mathematical parameters will be provided by Mr. Hogenmuller.
http://ieee802.org/3/bp/public/may13/hogenmueller_3bp_01_0513.pdf

Other Noise Sources

- ❑ Battery Noise, PoDL considerations and etc.
- ❑ A contribution was made by Yair Darshan (Microsemi) which discussed the noise sources over a single data & power pair
http://ieee802.org/3/bp/public/may13/darshan_3bp_01_0513.pdf
- ❑ What else are we missing?