TSCC Spring 2018
Chair Report

April 10, 2018 (Starting at 5:30pm)
Oxford Inn & Suites, Lancaster CA
(Same week as RCC Meeting: Edwards AFB)
TSCC Membership

- **Academia (1)**
  - Dr. Michael Marcellin

- **Government (4)**
  - Mark Bender
  - Albert Gabaldon
  - Myron Moodie
  - Tab Wilcox

- **Industry (8)**
  - Scott Brierley
  - Brad Fleury
  - Philip Ellerbrock
  - Wayne Klein
  - Steve Nicolo
  - Sergio Penna
  - Joe Sulewski
  - Gilles Freud

- **Ex-Officios**
  - Clifford Aggen (IFT Rep)

- **Members Emeritus**
  - Lee Eccles
  - Merv MacMedan
  - Erwin (Terry) Straehley
Agenda

- **17:30**  Call to Order  S. Nicolo
- **17:40**  Attendance and determination of Quorum  W. Klein
- **17:45**  Review and Approve Agenda  S. Nicolo
- Review of new members and alternate proposals
- Vote on members
- **17:50**  Officer Reports
  - Chair  S. Nicolo
  - Secretary-Treasurer  W. Klein
  - Approval and review of last Minutes
- Financial Status
- Action Item Review  S. Nicolo
Agenda (Continued)

18:10 Committee Reports

- Nominating Committee  S. Nicolo
  - New nominations/follow-up on members
  - Changes since Last meeting
- Radio Frequency  S. Brierley
- RF Vendor Working Group (Update)  J. Pappas
- Data Multiplex  B. Fleury
- Networking and Protocols  S. Nicolo
- RCC TGG Network SC Report on 218  Shawn Perry
- Transducers
  - Coding/Data Compression
  - Recorder / Reproducer
  - ETSC Report

Need New Chair
Need New Chair
M. Buckley
G. Freaud
Agenda (Continued)

- **19:00** Website status  B. Baggerman
- **19:10** Old Business  S. Nicolo
- **19:20** New Business  S. Nicolo
  - Subcommittee Discussion
  - Discuss and decide on Fall Meeting (ITC)
  - ITC Standards Paper Award
  - TSCC Future activities
- **20:00** Adjourn  All
## Subcommittee Discussions

<table>
<thead>
<tr>
<th>Subcommittee</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominating Committee</td>
<td>Chair TBD</td>
</tr>
<tr>
<td>• Needs Chair</td>
<td></td>
</tr>
<tr>
<td>Radio Frequency</td>
<td>S. Brierley</td>
</tr>
<tr>
<td>• No Actions Proposed</td>
<td></td>
</tr>
<tr>
<td>Networking and Protocols</td>
<td>S. Nicolo (NEW)</td>
</tr>
<tr>
<td>• No Actions Proposed</td>
<td></td>
</tr>
<tr>
<td>Transducers</td>
<td>Chair TBD</td>
</tr>
<tr>
<td>• Discuss need for this Sub Committee</td>
<td></td>
</tr>
<tr>
<td>Coding/Data Compression</td>
<td>Chair TBD</td>
</tr>
<tr>
<td>• Discuss need for this Sub Committee</td>
<td></td>
</tr>
<tr>
<td>Recorder / Reproducer</td>
<td>M. Buckley</td>
</tr>
<tr>
<td>• No Actions Proposed</td>
<td></td>
</tr>
<tr>
<td>ETSC Report</td>
<td>G. Freaud</td>
</tr>
<tr>
<td>• No Actions Proposed</td>
<td></td>
</tr>
</tbody>
</table>
Sub Committees

- Sub Committee Group Proposal
  - For Now Propose Suspension of Reporting
    - Transducer Subcommittee
    - Coding and Compression Subcommittee
  - Start New Subcommittee
    - IA (Information Assurance).. Cyber Security
<table>
<thead>
<tr>
<th>Last</th>
<th>First</th>
<th>Association</th>
<th>Member/alternate</th>
<th>Expires</th>
<th>Office</th>
<th>Committee</th>
<th>Last</th>
<th>First</th>
<th>Committee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bender</td>
<td>Mark</td>
<td>Government</td>
<td>Aerospace Corp</td>
<td>2019</td>
<td>member</td>
<td>radio Freq</td>
<td>McNatt</td>
<td>William</td>
<td>radiofreq</td>
</tr>
<tr>
<td>Brierley</td>
<td>Scott</td>
<td>Industry</td>
<td>ULA</td>
<td>2021</td>
<td>Chair</td>
<td>radio Freq/transd</td>
<td>McNatt</td>
<td>William</td>
<td>radiofreq</td>
</tr>
<tr>
<td>Ellerbrock</td>
<td>Philip</td>
<td>Industry</td>
<td>Boeing</td>
<td>2023</td>
<td>member</td>
<td>Data multiplex / RF</td>
<td>Rob</td>
<td>Trepa</td>
<td>Edge</td>
</tr>
<tr>
<td>Fleury</td>
<td>Brad</td>
<td>Industry</td>
<td>Edge Consulting</td>
<td>2020</td>
<td>Chair</td>
<td>R &amp; R</td>
<td>Mayer</td>
<td>Gerhard</td>
<td>data multi, Net</td>
</tr>
<tr>
<td>Gabaldon</td>
<td>Albert</td>
<td>government</td>
<td>China Lake</td>
<td>2021</td>
<td>member</td>
<td>Network&amp;Protocol</td>
<td>Creusere</td>
<td>Charles</td>
<td></td>
</tr>
<tr>
<td>Gilles</td>
<td>Freud</td>
<td>Industry</td>
<td>Airbus</td>
<td>2021</td>
<td>member</td>
<td>Network&amp;Protocol</td>
<td>Abbott</td>
<td>Ben</td>
<td>N&amp;P</td>
</tr>
<tr>
<td>Klein</td>
<td>Wayne</td>
<td>Industry</td>
<td>Apogee Labs</td>
<td>2017</td>
<td>Treasurer</td>
<td>Network&amp;Protocol</td>
<td>Dehme</td>
<td>Chris</td>
<td>rec/rep, datamult,Net</td>
</tr>
<tr>
<td>Marcellin</td>
<td>Dr. Michael</td>
<td>academic</td>
<td>Univ of AZ</td>
<td>2019</td>
<td>member</td>
<td>Network&amp;Protocol</td>
<td>Wilcox</td>
<td>Tab</td>
<td>YPG</td>
</tr>
<tr>
<td>Moodie</td>
<td>Myron</td>
<td>Government</td>
<td>GDP Space/Ampex</td>
<td>2015</td>
<td>Chair TSCC</td>
<td>Network&amp;Protocol</td>
<td>Nicol</td>
<td>Steve</td>
<td>Industry</td>
</tr>
<tr>
<td>Nicolo</td>
<td>Steve</td>
<td>Industry</td>
<td>GDP Space/Ampex</td>
<td>2015</td>
<td>Chair TSCC</td>
<td>Network&amp;Protocol</td>
<td>Wen</td>
<td>Malcolm</td>
<td>radiofreq</td>
</tr>
<tr>
<td>Penna</td>
<td>Sergio</td>
<td>Industry</td>
<td>Embraer</td>
<td>2019</td>
<td>member</td>
<td>Network&amp;Protocol</td>
<td>Leonardo</td>
<td>de Queiroz</td>
<td></td>
</tr>
<tr>
<td>Sulewski</td>
<td>Joe</td>
<td>Industry</td>
<td>L-3</td>
<td>2018</td>
<td>member</td>
<td>Data Multiplex R &amp; R</td>
<td>Dehme</td>
<td>Chris</td>
<td>rec/rep, datamult,Net</td>
</tr>
<tr>
<td>Wilcox</td>
<td>Tab</td>
<td>government</td>
<td>YPG</td>
<td>2021</td>
<td>member</td>
<td>data comp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggen</td>
<td>Cliff</td>
<td>IFT</td>
<td>IFT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eccles</td>
<td>Lee</td>
<td>Emeritus</td>
<td>Boeing</td>
<td></td>
<td>member</td>
<td>data comp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MacMedan</td>
<td>Merv</td>
<td>Emeritus</td>
<td>Boeing</td>
<td></td>
<td>member</td>
<td>data multiplex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Straehley</td>
<td>Erwin</td>
<td>Emeritus</td>
<td>Boeing</td>
<td></td>
<td>member</td>
<td>data multiplex</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Open Actions

- Resolve/Update Attendance History Document (Treasurer will then take ownership)
- Need TSCC Co Chair
- Need 3 new members
“TSCC Spring 2018
Treasurer Report”

April 10, 2018 (Starting at 5:30pm)
Oxford Inn & Suites, Lancaster CA
(Same week as RCC Meeting: Edwards AFB)
Treasurer Report
for the Period 10/22/17 thru 4/10/18

- **INCOME**
  - None $ 0.00

- **EXPENDITURES** $ (398.17)
  - Domain Name Renewal (3 years) $ (89.96)
    - Jan 3, 2018 through January 2, 2021
  - 2017 Award Plaques $ (308.21)

- Net Increase (Decrease) in Cash $ (398.17)

- Beginning Cash Balance $ 2717.65

- Ending Cash Balance $ 2319.48
TELEMETERING STANDARDS COORDINATION COMMITTEE

SPONSORED BY
INTERNATIONAL FOUNDATION FOR TELEMETERING

TSCC Spring 2018
Nominating
Subcommittee Report

April 10, 2018 (Starting at 5:30pm)
Oxford Inn & Suites, Lancaster CA
(Same week as RCC Meeting: Edwards AFB)
Nominating Sub-Committee Membership

- Current Nominating Subcommittee Membership
  - **CHAIR TBD**  
    - NEED NEW CHAIR
  - Scott Brierley - United Launch Alliance
  - Wayne Klein – Apogee Labs
  - Stephen Nicolo – GDP Space Systems
Sub-Committee Focus

- The nominating sub-committee shall propose TSCC members and officers for approval by the membership.

- Prospective TSCC members and officers can be nominated by the TSCC membership or by a nominating subcommittee.

- All nominations must be approved by a membership vote.
TSCC Membership Rules

- The TSCC shall have 16 members.
- Adequate representation shall always exist from the diverse groups constituting the telemetry community.
- Representatives of government and commercial entities shall each constitute a minimum of one-third (1/3) of the regular TSCC Membership.
- The remaining one-third (1/3) may include, but is not limited to those in commercial, governmental, and academic organizations.
- Membership by representatives of non-US entities shall not exceed 25% of the total regular membership.
TSCC Membership Terms

- TSCC Membership Terms are for five years
  - Terms are staggered so that the terms of 20% (rounded to the nearest integer) of the regular membership end each year
  - Members may be re-nominated for additional terms by the nominating sub-committee.

- Expirations – Fall 2018:
  - Joe Suleski
Membership Changes

- Voting on Members:
  - Fall 2017 Voting
    - Wayne Klein (Term was up Fall 2017—MUST VOTE)
    - For Member Terms voting will occur at next meeting (Fall 2018)
      - Joe Sulewski (Term is up Fall 2018)
  - Voting on Alternates:
    - None

- Alternates still needed for:
  - Mark Bender
  - Albert Gabaldon
  - Tab Wilcox

- Retiring members:
  - None
TSCC Membership

- Academia (1)
  - Dr. Michael Marcellin

- Government (4)
  - Mark Bender
  - Albert Gabaldon
  - Myron Moodie
  - Tab Wilcox

- Industry (8)
  - Scott Brierley
  - Brad Fleury
  - Philip Ellerbrock
  - Wayne Klein
  - Steve Nicolo
  - Sergio Penna
  - Joe Sulewski
  - Gilles Freud

- Ex-Officios
  - Clifford Aggen (IFT Rep)

- Members Emeritus
  - Lee Eccles
  - Merv MacMedan
  - Erwin (Terry) Straehley
Future Membership Slots

- We have 13 full members. Need 2 Government and 1 Academia or Industry to maintain our approx 33% split between industry, academic and government.

- Possible Government Nominees:
  - Kevin Bossoletti > Said no but recommended **Brian Platt**
  - Jack Salisbury
  - Scott Kujiraoka
Members Emeritus

- Lee Eccles (ret., formerly Boeing) was voted in as Member Emeritus in Fall 2017 Meeting
TSCC Officers

- Officers shall serve for a two year term of office
  - The term of office shall begin at the start of the TSCC Year in even calendar years
  - Traditionally the Vice-Chair succeeds to the Chair's position to fulfill a two year term as Chair
  - The Secretary-Treasurer may be re-elected
  - Officer Terms up December 31, 2018

- Current Officers:
  - Chair – Steve Nicolo
  - Vice-Chair - Vacant!!!!!!!!!
  - Secretary-Treasurer – Wayne Klein

- Subcommittee Chairs
  - All positions full
Open Actions

- Three open positions to be filled (2 Government & 1 Acadamia or Industry)
- Need TSCC Vice-chair
- Committees
  - Subcommittee Chairs
    - Nominating Committee Chair Needed
    - Transducer Committee (Need Chair if we are keeping this committee)
    - Coding and Compression (Need Chair if we are keeping this committee)
  - Alternates still needed for:
    - Mark Bender
    - Albert Gabaldon
    - Tab Wilcox
TSCC Spring 2018 RF COMMITTEE

April 10, 2018 (Starting at 5:30pm)
Oxford Inn & Suites, Lancaster CA
(Same week as RCC Meeting: Edwards AFB)
Sub Committee Membership

- Scott Brierley, Chairman

Members:

- Johnny Pappas
- Mark Bender
- Mark Dapore
- Brad Fleury
- Lloyd Lautzenhisier
- Bill McNatt
- Rich Siegal
- Brad Oney
- James Carwell
Sub-Committee Focus

- RF Subcommittee reviews standards dealing with the Radio Frequency (RF) telemetry link
- Current standards
  - RCC IRIG-106
  - RCC IRIG-118
  - RCC RF Handbook
  - CCSDS-401
  - CCSDS-411
  - SGLS
  - STDN
  - 1451.5
Significant Activity

- RF Vendors Working Group meeting was held after the fall TSCC meeting
- Reviewed TG-153 (RCC-118, Vol 2, Ch 8) LDPC Test TEST PROCEDURES FOR HARDWARE IMPLEMENTING LOW DENSITY PARITY CHECK CODES
Committee Members

- Brad Fleury – Director Edge Consulting and Sales
- Alternate – Rob Trepa, Director Edge Consulting and Sales
Sub-Committee Standards

- **Current standards**
  - IRIG-106 -17
  - Telemetry App’s Handbook.
    - TMATS use cases, complete but updates are made as needed
    - RCC XML handbook for IHAL and DDML XML
Sub Committee Membership

Jon Morgan – RCC lead EAFB
Joe Sulewski – L-3 Communications
Joe Merritt – RT Logic
Jack Sheldon
Erwin Straehley
Duane Wheaton
Sub-Committee Focus

- Minimal activity since Fall meeting
- Name change from Data Multiplex to Telemetry Processing
- No new Pink Sheets circulating for IRIG 106
- “Chapter 7” recording impacts to TMATS and recording largely implemented in 106-15
Open Actions

- Support RCC ongoing efforts:
  - TMATS Handbook releases
  - IRIG standards
- Support RCC – TG Datamultiplex telecons and RCC meetings.
TELEMETERING STANDARDS COORDINATION COMMITTEE

SPONSORED BY
INTERNATIONAL FOUNDATION FOR TELEMETERING

TSCC Fall 2017
Networks Subcommittee Report
Sub Committee Membership

- Steve Nicolo, Chair – GDP Space Systems, Ground Telemetry  **(NEW CHAIR)**
  - Ben Abbot, Southwest Research Institute
  - Myron Moodie, Southwest Research Institute
  - Wayne Klein, Apogee Labs
  - Fil Macias, White Sands Missile Range
  - William Malatesta, NAVAIR
  - Steve Nicolo, GDP Space Systems
  - Hyong Yi, Curtiss-Wright Controls, Avionics and Electronics
  - Robert Weaver, Apogee Labs
  - Chris Dehmelt, L3 Telemetry – East
  - Joe Sulewski, L3 Telemetry
  - Malcolm Weir, Ampex
  - Sergio Penna, Embraer
  - Dave Buckley, Curtiss-Wright Controls
Sub-Committee Focus 1

Standards Activity:

- iNET Suite:
  - IRIG 106 Chapters 21-28 Pink sheets released (formerly known as the iNET standards)
Sub-Committee Focus II

- Standards Activity:
  - IRIG106-Ch7
  - IP over PCM

- Standards Activity:
  - IEEE1588 (PTPv3)
  - TMoIP (RCC 218) - Review and comments submitted
Open Actions

- Review subcommittee members
TELEMETERING STANDARDS COORDINATION COMMITTEE

SPONSORED BY INTERNATIONAL FOUNDATION FOR TELEMETERING

“TSCC Spring 2018 Recorder & Reproducer Committee Report

April 10, 2018 (Starting at 5:30pm)
Oxford Inn & Suites, Lancaster CA
(Same week as RCC Meeting: Edwards AFB)
Sub Committee Membership

- Mark Buckley (Telspan Data), Chairman
- Albert Gabaldon, Alternate Chairman

- Bob Baggerman (Zodiac)
- Balázs Bagó (Zodiac)
- Paul Carrion (Calculex)
- Chris Dehmelt (L-3 Comm Telemetry East)
- Justin Denning
- Paul Ferrill (ATAC)
- Tim Gatton (Aerogear Telemetry)
- Dan Green (Zodiac)
- Bill Harrison (Smartronic)
- Eric Lamphear (Telspan Data)
- Jake Layer (Smartronic)
- Mike Lockard (EMC Corp)
- Hung Mach (Boeing)
- Doug Novak (USAF Tyndall AFB)
- Johnny Pappas (Zodiac)
- Christian Rueck (Databus Tools)
- Bela Szabo (RT Logic)
- Rob Trepa (Edge Consulting)
- Malcolm Weir (Ampex)
- Craig Wierzbicki (TTC)
- Rick Williams (SDS)
Sub-Committee Focus

- **Data Recorders, Ground and Airborne**
- **Standards in Place**
  - [IRIG 106-17](http://www.wsmr.army.mil/RCCsite/Pages/Publications.aspx) Telemetry Standards Chapters 6, 10, & 11
Significant Activity

- RCC Telemetry Group Recorder & Reproducer Committee
  - IRIG 106-17 Chapters 6/9/10/11 Published
- STANAG 4575, AEDP-6 Ratification
  - Released Ed 4 to NSA for ratification and subsequent release to member nations for promulgation.
Significant Activity
RCC Document 106-19 Chapter 10

- TSCC R&R will continue with its formal roll in pink sheet reviews
- TSCC R&R to take a “less formal” roll in CR reviews & recommendations
Significant Activity
RCC Document 106-17 Chapter 10

- **2019 Working RCC TG R&R CR’s**
  - CR-RR-17-000 Documents new CR numbering
  - CR-RR-17-001 (Formally CR-092) New Packet Header
  - CR-RR-17-002 (Formally CR-096) MDL Data Type
  - CR-RR-17-003 (Formally CR-097) Fix Video Formats
  - CR-RR-17-004 Distribution Statement
  - CR-RR-17-005 Document PN types (PN11, PN15)
  - CR-RR-17-006 Christian Rueck, via TSCC, comments
  - CR-RR-17-007 New CH6 Appendix (CoAP/JASON)
  - CR-RR-17-008 New CH29 HDLC for Ethernet Telemetry
  - CR-RR-17-009 **Proposed** New Ethernet/FC Formats
  - CR-RR-17-010 **Proposed** Update CH9 S-Group
  - CR-RR-18-011 **Proposed** PCM Format 2 (DQM/DQE)
Open Actions

- **TSCC** –
  - Review Ethernet payload identification related to range needs
  - TSCC Web site to be updated for public document access and storage
  - **Validator**
    - The RCC has requested the TSCC to develop a recorder validation tool (Chapter 10 Validator)
      - Software/hardware definition, procedure
      - Would include maintaining a “Golden File” of data. Any issues of TSCC maintaining files with ITF? Would be maintained on webpage.
      - We have a volunteer to lead the effort...
      - At least two versions exist...
IRIG 218 TMoIP
Update Status

ITC 2017
(updated 4/6/18)
Shawn T. Perry
NAWCAD Pax River
RCC TTG Chairman
TMoIP Origin

- Developed as Ranges transitioned from ATM to IP
- Goal of providing simple transport of SST
- Based on standards such as pseudowire
- 218-10 mentions future growth possibilities (RTP, IPv6)
- Great success so far for Range implementations
  - Distributed flight testing at contractor sites
  - Opens door for Range interconnectivity for LVC
- Ambiguities led to interoperability difficulties
  - Vendors developed proprietary variations
Changing Paradigm

- New requirements emerged
  - Test articles lacking Ch4 time
  - TMoIP not just for muxes anymore
  - Software decons, best source, receivers, IP decryptors
  - PCM and DQE frame payload shaping
- Vendors and Ranges reached out to RCC TG
- RCC TG reached out to RCC TTG
- RCC TTG posted RFI on 218 growth requests
TMoIP Models
RFI Results

- Timestamp top priority
  - RTP vs Control Word expansion
  - Format requests varied (UTC vs TAI)
  - Nanosecond resolution
- Unused Control Word bits
- Payload shaping
  - PCM and DQE frames with bit sync status
- Improved interoperability
  - Ability to auto-adjust to bit rate changes and user selected parameters (minimal latency)
TTG 218-18 Goals

- Identify valid requirements
- Maintain 218-10 functionality
- Maintain vendor proprietary variants
- Make update painless to implement on deployed hardware
- Create process for continual improvement
<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
<th>Length</th>
<th>P/C/F (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet Dest Addr</td>
<td>Identifies station(s) to receive frame</td>
<td>6</td>
<td>P</td>
</tr>
<tr>
<td>Ethernet Src Addr</td>
<td>Identifies station that originated frame</td>
<td>6</td>
<td>C</td>
</tr>
<tr>
<td>802.1Q Length/Type</td>
<td>Virtual LAN (VLAN) tag length/type</td>
<td>2</td>
<td>F = 0x8100</td>
</tr>
<tr>
<td>VLAN Tag Ctrl Info</td>
<td>Bit Description</td>
<td>2</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>0 - 2 User Priority Field</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 Canonical Format Indicator (CFI)</td>
<td></td>
<td>F = 0</td>
</tr>
<tr>
<td></td>
<td>4 - 15 VLAN Identifier (VID)</td>
<td></td>
<td>P</td>
</tr>
<tr>
<td>Length/Type</td>
<td></td>
<td>2</td>
<td>F = 0x0800</td>
</tr>
<tr>
<td>IP Header</td>
<td>Byte Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 Bytes Total</td>
<td>0 Version + IP header length</td>
<td>1</td>
<td>F = 0x45</td>
</tr>
<tr>
<td></td>
<td>1 TOS</td>
<td>1</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>2 - 3 Total length of IP packet</td>
<td>2</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>4 - 5 16 bit ID</td>
<td>2</td>
<td>C/F</td>
</tr>
<tr>
<td></td>
<td>6 - 7 Flags + Fragment Offset</td>
<td>2</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td>8 TTL</td>
<td>1</td>
<td>F/P</td>
</tr>
<tr>
<td></td>
<td>9 Protocol (UDP)</td>
<td>1</td>
<td>F = 0x11</td>
</tr>
<tr>
<td></td>
<td>10 - 11 IP Header checksum</td>
<td>2</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>12 - 15 Source IP address</td>
<td>4</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>18 - 19 Destination IP address</td>
<td>4</td>
<td>P</td>
</tr>
<tr>
<td>UDP Header</td>
<td>Byte Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Bytes Total</td>
<td>0 - 1 Source Port</td>
<td>2</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>2 - 3 Destination Port</td>
<td>2</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>4 - 5 UDP Length</td>
<td>2</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>6 - 7 UDP Checksum</td>
<td>2</td>
<td>C</td>
</tr>
<tr>
<td>Payload</td>
<td>TMoIP Control Word</td>
<td>4 (or 12)</td>
<td>C</td>
</tr>
<tr>
<td>Ethernet FCS</td>
<td>Ethernet Frame Check Sequence</td>
<td>4</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>TMoIP Raw Packet Data</td>
<td>Var</td>
<td>C</td>
</tr>
</tbody>
</table>

(1) P = Programmable by user  
C = Calculated or placed in packet without user intervention  
F = Fixed  
Var = Variable
# TMoIP Control Word

## TABLE 3-3. TMoIP CONTROL WORD

<table>
<thead>
<tr>
<th>Field</th>
<th>Bits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VER</td>
<td>4</td>
<td>Version identifier</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“0000” indicates 218-10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“0001” is reserved for proprietary modified 218 formats</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“0010” indicates 218-18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“0011” through “1111” reserved for future versions</td>
</tr>
<tr>
<td>VDB</td>
<td>12</td>
<td>Version Defined Bits</td>
</tr>
<tr>
<td>SEQ NUMBER</td>
<td>16</td>
<td>Sequence Number</td>
</tr>
</tbody>
</table>

**Notes**

- 218-10 remains unchanged.
- 218-P version was added to maintain functionality of several proprietary modified 218-10 variants in use.
- 218-18 version removes the unused alarm bits, adds the ability to designate that a payload is sized to a PCM or DQE frame, adds bit sync status for PCM frame aligned payloads, and adds a 64-bit timestamp.
### TABLE 3-3.1. TMoIP 218-10 CONTROL WORD

<table>
<thead>
<tr>
<th>Field</th>
<th>Bits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VER</td>
<td>4</td>
<td>Version identifier</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“0000” indicates 218-10</td>
</tr>
<tr>
<td>L</td>
<td>1</td>
<td>Local Defect Alarm, indicates local circuit fault in the TM stream</td>
</tr>
<tr>
<td>R</td>
<td>1</td>
<td>Remote Defect Alarm, indicates remote circuit fault in the TM stream</td>
</tr>
<tr>
<td>M</td>
<td>2</td>
<td>Local Defect Alarm Modifier</td>
</tr>
<tr>
<td>RES</td>
<td>2</td>
<td>Reserved</td>
</tr>
<tr>
<td>LEN</td>
<td>6</td>
<td>If non-zero, LEN indicates TMoIP Payload Length, defined as the TMoIP Control Word + Raw Packet Payload</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If zero, LEN indicates TMoIP Payload Length greater than 63 bytes. In this case the TMoIP payload length is determined via length fields in lower protocol layers.</td>
</tr>
<tr>
<td>SEQ NUMBER</td>
<td>16</td>
<td>Sequence Number</td>
</tr>
</tbody>
</table>

#### Notes

- **Req**: The TMoIP raw packet size shall be user configurable.
- **Opt**: The TMoIP raw payload size may be auto-configurable, based on user priorities (e.g. stream/delay characteristics).
- **Req**: The minimum TMoIP raw packet size = 1 byte.

**Notes:**

- a. To limit the effects of Ethernet fragmentation, the final Layer 2/3/4/6 packet size should be less than the Ethernet Maximum Transmission Unit (MTU).
- b. Padding may be required to meet the minimum Ethernet MTU size.
### TABLE 3-3.2. TMoIP 218-P CONTROL WORD

<table>
<thead>
<tr>
<th>Field</th>
<th>Bits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VER</td>
<td>4</td>
<td>Version identifier &quot;0001&quot; indicates Proprietary variants of 218-10</td>
</tr>
<tr>
<td>PDB</td>
<td>12</td>
<td>Proprietary Defined Bits</td>
</tr>
<tr>
<td>SEQ NUMBER</td>
<td>16</td>
<td>Sequence Number</td>
</tr>
</tbody>
</table>

**Notes**

This version allows vendors who created modified versions of 218-10 to maintain functionality. Due to variances in implementation, not recommended in mixed vendor environments.
<table>
<thead>
<tr>
<th>Field</th>
<th>Bits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VER</td>
<td>4</td>
<td>Version identifier &quot;0010&quot; indicates 218-18</td>
</tr>
<tr>
<td>PLD</td>
<td>2</td>
<td>Payload type &quot;00&quot; indicates no frame alignment &quot;01&quot; indicates PCM frame aligned &quot;10&quot; indicates DQE frame aligned &quot;11&quot; Reserved</td>
</tr>
<tr>
<td>FSS</td>
<td>2</td>
<td>Frame Sync Status (used for PLD = &quot;01&quot; only) &quot;00&quot; indicates Search &quot;01&quot; indicates Check &quot;10&quot; indicates Lock &quot;11&quot; indicates Flywheel</td>
</tr>
<tr>
<td>RES</td>
<td>2</td>
<td>Reserved</td>
</tr>
<tr>
<td>LEN</td>
<td>6</td>
<td>If non-zero, LEN indicates TMoIP Payload Length, defined as the TMoIP Control Word + Raw Packet Payload If zero, LEN indicates TMoIP Payload Length greater than 63 bytes. In this case the TMoIP payload length is determined via length fields in lower protocol layers.</td>
</tr>
<tr>
<td>SEQ NUMBER</td>
<td>16</td>
<td>Sequence Number</td>
</tr>
<tr>
<td>TIMESTAMP</td>
<td>64</td>
<td>64-bit timestamp – NTP format 32 bit seconds field 32 bit fractional seconds field Prime epoch 00:00 01 Jan 1900 UTC</td>
</tr>
</tbody>
</table>

**Notes:**
- Req The TMoIP raw packet size shall be user configurable.
- Req The TMoIP raw payload size shall be auto-configurable, based on user priorities (e.g. stream/delay characteristics).
- Req The minimum TMoIP raw packet size = 1 byte.

**Notes:**
- a. To limit the effects of Ethernet fragmentation, the final Layer 2/3/4/6 packet size should be less than the Ethernet Maximum Transmission Unit (MTU).
- b. Padding may be required to meet the minimum Ethernet MTU size.
IRIG vs NTP vs PTP

- **IRIG**
  - >64 bits and can’t achieve 1 ns resolution
- **NTP**
  - Most likely implemented time source (minimal effort)
  - 64 bits with 233 ps resolution
- **PTP 1588**
  - Questions concerning 1588 profiles which affect format
  - Greatest implementation impact to vendors
  - Greater long-term use potential, but immature now
Conclusions

- Successful vendor interoperability test at ITC
  - Few test cases with interoperability issues
  - Vendors identified “bugs” and work-arounds
- Didn’t break 218-10 or proprietary methods
- Should be backward compatible with existing HW
- New features
  - 64-bit 233 ps resolution timestamp
  - Payload shaping for minor frames and DQE
  - Bit sync status information metadata