Summary of Changes in 2013 COMTRADE Standard:

IEC 60255-24 Edition 2.0 2013-04/ IEEE Std C37.111™ International Standard

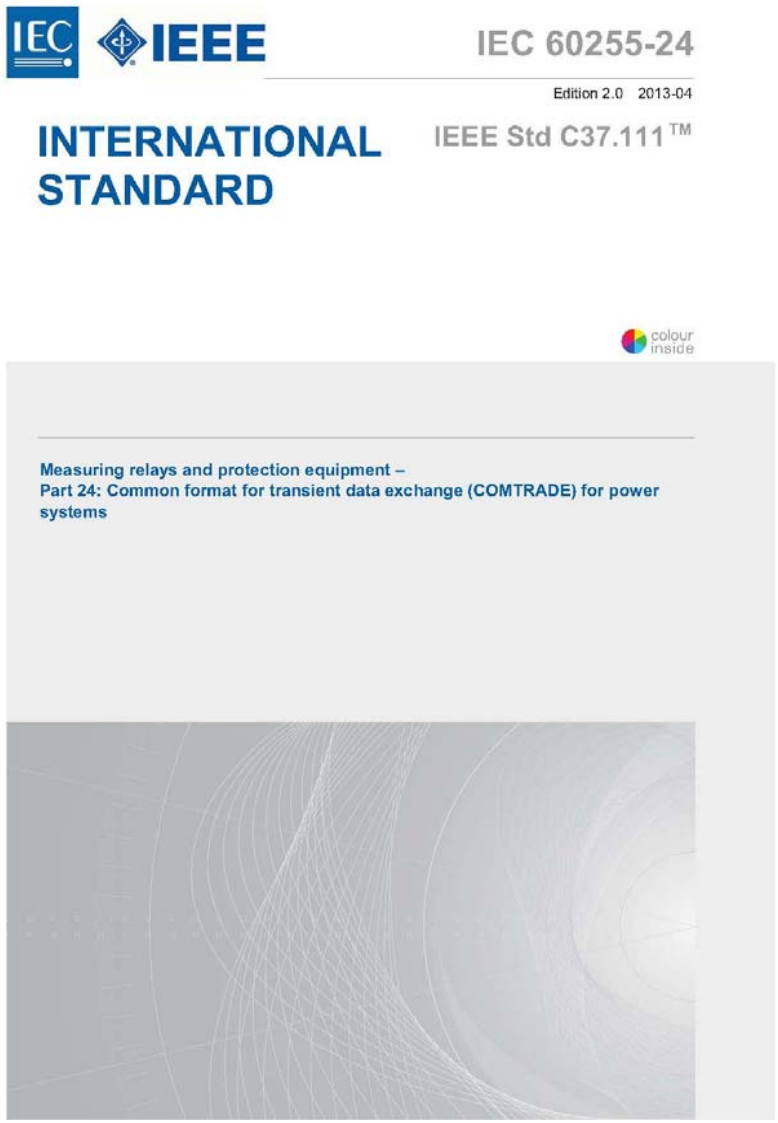
Working Group H4 of the Relaying Communications Subcommittee Power System Relaying Committee

Albuquerque, NM September 12, 2013

Presented By
Ratan Das

IEEE PES Power & Energy Society™

Published on April 30, 2013



IEEE PES Power & Energy Society™

History of COMTRADE Standard

- IEEE C37.111-1991, Approved June 27, 1991
- IEEE C37.111-1999, Approved March 18, 1999
  - IEC 60255-24, Ed 1.0 adopted in 2001
- IEC 60255-24 Ed 2.0/IEEE C37.111-2013, Published on April 30, 2013

What is COMTRADE?

- COM TRA D E: Common format for Transient Data Exchange
- Group of four (.CFG, .DAT, .INF, .HDR) files used for exchanging sampled values between a recording device and a reader
- Common format enabled interoperability
- One of the Smart Grid Standard where interoperability is used for over 20 years

.CFG File in 2013 Standard

station_name, rec_dev_id, rev_year
TT, #A, #D
An, ch_id, ph, ccbm, uu, a, b, skew, min, max, primary, secondary, P or S
Dn, ch_id, ph, ccbm, y
line_freq
nrates
samp, endsamp
start_date, start_time
trigger_date, trigger_time
file_type
timemult
time_code, local_code
tmq_code, leapsec

LEGEND:
rev_year---→ Added in 1999
ch_id ----→ Revised in 2013
time_code -→ New in 2013

IEEE PES Power & Energy Society™

Example: .CFG File in 2013 Standard

```
SMARTSTATION, IED123, 2013
8, 4A, 4D
1, IA , A, Line123, A, 0.113891, 0.056945, 0, -32768, 32767, 933, 1, s
2, IB , B, Line123, A, 0.113891, 0.056945, 0, -32768, 32767, 933, 1, s
3, IC , C, Line123, A, 0.113891, 0.056945, 0, -32768, 32767, 933, 1, s
4, 3I0, N, Line123, A, 0.113891, 0.056945, 0, -32768, 32767, 933, 1, s
1, 51A, A, Line123, 0
2, 51B, B, Line123, 0
3, 51C, C, Line123, 0
4, 51N, N, Line123, 0
60
1
1200, 240
12/01/2011,05:55:30.75011xxxx
12/01/2011,05:55:30.78261yyyy
ASCII
1.00
-5h30, -5h30
B, 3
```

LEGEND:

2013 -----→ Added in 1999

IA --------→ Revised in 2013

-5h30 -----→ New in 2013

IEEE PES Power & Energy Society™

Summary Changes in 2013 COMTRADE

- Four New Fields at the end of Config Section
  - Time Information fields (two) in one line
    - Time Code (time_code), Local Code (local_code)
  - Time Quality fields (two) in another line
    - Time Quality Indicator Code (tmq-code), Leap Second Indicator (leapsec)
- Up to 1 ns of resolution in Time-stamp
- Use of Unicode UTF-8 characters
- New data types: binary32 (using 4 bytes to represent integer numbers) and float32 (using 4 bytes to represent real numbers)

IEEE PES Power & Energy Society™

Summary Changes in 2013 COMTRADE

- Allows single file format (with extension .CFF) in lieu of four separate files
  - Four sections of information corresponding to .CFG, .INF, .HDR, and .DAT
  - DAT section is either in ASCII (or UTF 8) or Binary
- ch_id & skew fields in the Configuration (.CFG) file/section have been designated critical
- Removes a number of obsolete restrictions
  - Storage media , Filename up to 253 characters instead of 8; however up to 64 character filename is recommended

IEEE PES Power & Energy Society™

New Fields in the 2013 CFG Section

Time Information: Time Code (time_code): -5h30

- Time Code field specifies the time difference between local time and UTC (without offset)
- Field has a maximum of 7 formatted characters
- First character is a sign character, followed by up to 5 characters for indicating the time difference (which includes up to 2 digits for the hours followed by the letter “h” followed by 2 digits for the minutes
  - “-5h30” means the time difference is minus 5 hours and 30 minutes

Time difference also reflects whether standard time or daylight saving time was in effect at the time of recording

IEEE PES Power & Energy Society™

New Fields in the 2013 CFG Section

Time Information: Local Code (local_code): -5h30

- Local Code field has the same format as the Time Code field
- Code “x” means such information is not applicable
- In the event that the date and time stamps in the COMTRADE record are set to UTC without offset (meaning Time Code is 0), then the Local Code field can be used to identify the local time zone where the record was captured

New Fields in the 2013 CFG Section

Time Quality Indicator Code (tmq-code): B

- Used to indicate the maximum time error between the recorded time stamps and the time from the synchronizing source (such as a GPS clock)
- Field corresponds to the Time Quality indication code defined in IEEE Std. C37.118
- Field is composed of a single hexadecimal digit. Some examples:
  - '**F**' means clock failure, time is not reliable
  - '**4**' means clock unlocked, time is within 1 microsecond
  - '**0**' means clock locked onto its source (such as a satellite in the case of a GPS Clock)

IEEE PES Power & Energy Society™

New Fields in the 2013 CFG Section

Leap Second Indicator (leapsec): 3

Leap Second Indicator field (leapsec) is used to indicate that a leap second may have been added or deleted during the recording resulting in either two segments of data having the same Second of Century time stamp or having a missing second:

- '**3**' means the time source does not have the capability to address leap seconds
- '**2**' means a leap second was subtracted in the record
- '**1**' means a leap second was added in the record
- '**0**' means record does not contain a leap second adjustment

IEEE PES Power & Energy Society™

Example of .CFF File in 2013 Standard

```
--- file type: CFG ---
SMARTSTATION, IED123, 2013
8, 4A, 4D
1, IA , A, Line123, A, 0.113891, 0.056945, 0, -32768, 32767, 933, 1, s
2, IB , B, Line123, A, 0.113891, 0.056945, 0, -32768, 32767, 933, 1, s
3, IC , C, Line123, A, 0.113891, 0.056945, 0, -32768, 32767, 933, 1, s
4, 3I0, N, Line123, A, 0.113891, 0.056945, 0, -32768, 32767, 933, 1, s
1, 51A, A, Line123, 0
2, 51B, B, Line123, 0
3, 51C, C, Line123, 0
4, 51N, N, Line123, 0
60
1
1200, 240
12/01/2011,05:55:30.75011xxxx
12/01/2011,05:55:30.78261yyyy
BINARY
1.00
-5h30, -5h30
B, 3
--- file type: INF ---
--- file type: HDR ---
--- file type: DAT BINARY: 702 ---
```

Binary data not shown

Future Trends

- Synchrophasors
- User Channels
- XML format for CFG section

Timeline: HTF8, H5d and H4

- HTF 8 Task Force first met in May 2003 to explore COMTRADE Issues and requested to form a WG
- H5d WG was formed in Sept 2003: assignment to prepare a report on the application and use of the C37.111 Standard, and Issues to be addressed
- Last H5d (fourth) meeting was in Sept 2004 and facilitated the re-affirmation of the C37.111-1999
- H4 working group was formed in Jan 2005 with an assignment to revise the C37.111 standard
  - PAR was approved, on June 9, 2005, till Dec. 31, 2009
  - PAR was extended on Nov 2, 2009, till Dec 31, 2011
  - PAR was extended on Dec 7, 2011 till Dec 31, 2012
  - PAR was extended on Feb 1, 2013 till Dec 31, 2014

IEEE PES Power & Energy Society™

WG H4 Activities (25 meetings)

- IEEE C37.111 Draft Standard Timeline:
  - Draft 0 was ready on September 15, 2006
  - Draft 1 was ready on Dec 22, 2006
  - Draft 2 was ready on May 17, 2007
  - Draft 3 was ready on January 4, 2008
  - Draft 4 was ready on May 11, 2008
  - Draft 5 was ready on January 13, 2009
  - Draft 6 was ready on April 20, 2009
  - Draft 7 was ready on September 13, 2009
  - Draft 8 was ready on January 11, 2010
  - Draft 9 was ready on May 12, 2010
- Request from IEEE SA to initiate IEC/IEEE dual logo standard in July 2010

IEEE PES Power & Energy Society™

IEEE Std C37.111/IEC 60255-24 Drafts

- Draft 1 was ready on September 13, 2010
- Draft 2a was ready on September 17, 2010
- Draft 3 was ready on March 31, 2011
- Draft 3b was ready on April 12, 2011
- Draft 3d was ready on May 4, 2011
- Draft 3e was ready on September 6, 2011
- Draft 3f was ready on October 13, 2011
- Draft 3f_rev1 was ready on Jan 20, 2012
- Draft 3f_rev2 was ready on September 28, 2012
- Draft for FDIS was ready on January 31, 2013

IEEE PES Power & Energy Society™

IEEE Std C37.111/IEC 60255-24 Balloting

- Draft 2a ready on September 17, 2010
  - IEEE Ballot Sept 20 – Oct 20, 2010 (81 comments)
  - IEC CD Ballot Oct 18, 2010 - Feb 18, 2011 (68 comments)
- Draft 3f_rev1 ready on Jan 20, 2012
  - IEC CDV Ballot Feb 27 – July 27, 2012 (4 comments)
  - IEEE Ballot Recirculation July 17 – July 27, 2012 (11 comments)
- Draft for FDIS ready on January 31, 2013
  - IEEE SA Board Approval Feb 6, 2013
  - IEC FDIS Jan 31 – March 30, 2013

IEEE PES Power & Energy Society™

IEEE PSRC Working Group Members (38)

IEEE Std C37.111-2013
IEC 60255-24:2013(E)
MEASURING RELAYS AND PROTECTION EQUIPMENT –
Part 24: Common format for transient data exchange (COMTRADE) for power systems

IEEE Participants

At the time this standard was submitted to the IEEE-SA Standards Board for approval, the Working Group for Power System Relaying Committee had the following membership:

Ratan Das, *Chair*
Amir Makki, *Vice Chair*

Mark Adamiak
Eric Allen
Scott Anderson
Alex Apostolov
Greg Bray
Christoph Brunner
Rick Cornelison
Bui Dac-Phuoc
Bill Dickerson
Tony Giuliante
Erich Gunther
Jim Hackett
Randy Hamilton
Juergen Holbach
Jim Ingleson
Bogdan Kasztenny
Mladen Kezunovic
Vahid Madani
Pierre Martin
Peter McLaren
Harish Mehta
Krish Narendra
Om Nayak
Bruce Pickett
Jeffrey Pond
Murari Mohan Saha
Larry Smith
Jian Cheng Tan
Mark Taylor
Stan Thompson
Benton Vandiver
Quintin Verzosa, Jr.
Solveig Ward
Tom Wiedman
Murty Yalla
Dave Zinn

IEEE PES Power & Energy Society™

IEEE Ballot Participants (90)

The following members of the individual balloting committee voted on this standard. Balloters may have voted for approval, disapproval, or abstention.

William Ackerman
Mark Adamiak
Ali Al Awazi
Angela Anuszewski
James Ariza
Roy Ball
Kenneth Behrendt
Hubert Bilodeau
Oscar Bolado
Gustavo Brunello
Arvind K. Chaudhary
He Chun
Stephen Conrad
James Cornelison
Randall Crellin
Robert Damron
Ratan Das
Gary Donner
Michael Dood
Randall Dotson
Neal Dowling
Donald Dunn
Gary Engmann
Fredric Friend
Frank Gerleve
Jeffrey Gilbert
Jalal Gohari
Edwin Goodwin
Stephen Grier
Randall Groves
Roger Hedding
Gary Heuston
Gary Hoffman
C. Huntley
Jim Ingleson
Innocent Kamwa
Piotr Karocki
Yuri Khersonsky
James Kinney
Stanley Klein
Joseph L. Koepfinger
Jim Kulchisky
Chung-Yiu Lam
Greg Luri
Amir Makki
Kenneth Martin
Pierre Martin
Walter McCannon
John McDonald
Kimberly Mosley
Jerry Murphy
R. Murphy
Bruce Muschlitz
Anthony Napikoski
Michael S. Newman
Robert Orndorff
Chris Osterloh
Lorraine Padden
Donald Parker
Jeffrey Pond
Michael Roberts
Charles Rogers
Oleg Roizman
Bob Saint
Steven Sano
Bartien Sayogo
Thomas Schossig
Gil Shultz
Tarlochan Sidhu
Mark Simon
Veselin Skendzic
James Smith
John Spare
Gary Stoedter
Charles Sufana
Michael Swearingen
Richard Taylor
John Tengdin
Michael Thompson
Stan Thompson
Demetrios Tziouvaras
Joe Uchiyama
Eric Udren
Benton Vandiver
Srinivasa Vemuru
John Vergis
Quintin Verzosa, Jr.
Ilia Voloh
John Wang
Thomas Wiedman

IEEE PES Power & Energy Society™

Summary

- History of the COMTRADE Standard
- Summary Changes in 2013 IEC/IEEE COMTRADE standard
- Future Trends

Acknowledgements

- Members of Working Group
- Guests of WG meetings over last 10 years
- Collaborators within IEEE PSRC and IEEE SA
- IEEE PSRC Officers and Standard Coordinators
- All participants of the IEEE balloting body
- All participants of the IEC balloting process
- Editorial Staff of IEC and IEEE

IEEE PES Power & Energy Society™