Timing Considerations in Event Reconstruction

Personal status report on
PSRC Working Group I11

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Report of I11

- Formed by IEEE PSRC (Power System Relay Committee; Subcommittee I
- This is an upper case letter "I."
- Latest Draft at this address:
  - *http://www.pes-psrc.org/i/I11.html*

History Lesson

- When I first stared in this,
  - *Paper oscillographs*
  - *No one looked at our records but us.*
  - *We had about 10 times as many protection engineers for the same amount of transmission.*
  - *We explained some very interesting events with unsynchronized and sparse data.*

Things are different now.

- If your company is involved an a really "big one;"
- You will not have within your own company the resources to figure it all out.
- You will probably be asked to send in every record you have. (and a lot of system data, as well.)
- The remainder of your work will go on just as before the incident.

Why are there so many standards?

- Blackout of 2003 analysis essentially just ended.
- This was the best analysis ever done of such a complex event.
- NERC PRC-002 and PRC-003 say set certain standards, direct Regions to set many others for themselves.
- NPCC as an example now has a Criteria and 3 guidelines. The guidelines preceded the PRCs; the criteria followed PRCs.

NERC Project 2007-11

- A draft SAR to revise PRC-002 and 018 was posted for the period 3/22 to 4/20
- Project Team 2007-11 will revise the SAR and seek approval.
- A Standards drafting team will then be formed work on a revision.
- This team will examine the Regional document which have been prepared.
- Important for team to decide which matters should be in NERC Standard and which should be left to the Regions.

What is the goal anyway?

- To have an appearance of having "tough" demanding standards?
- To actually enable a disturbance team to reconstruct a disturbance? This in turn implies:
  - *Simulation*
  - *Narrative*

I11 Report

- Could be essentially completed at the May 15-17 Meet in Nashville.
- If this were accoplished, the final version would probably appear in the website: http://www.pes-psrc.org/i/I11.html between May and September.
- The remaining slides are titled similarly to sections of the report, and thus are representative of report contents.

Time Scale

- Think of it as the "Ticks."
- There really is no choice of time scales, the only reasonably choice is UTC.
- Meaning of the word "coordinated."
- The remain other time scales, for example UT1, TAI.
- It is proving to be very hard to get people to separate a related discussion, which is time zone.

UTC

- Universal Coordinated Time (Scale)
- Characteristics of UTC are invariant second, and the occasional need for leap seconds.
- Most of comments, discussion and disagreement on this sections has in fact to do with time zone, which is a separate question.
- I would agree if necessary to leave this second out of the I11 report.

GPS

- GPS Time Scale is deriviative of USNO which is derivative of NIST.
- I suggest no one ever refer to GPS Time, a potential for confusion.
- The Time Scale supplied of of a GPS clock can be considered to be UTC, accurate enough for the purpose.

GPS Clocks

- Previous to around 2002, the "high accuracy" option was offered.
- After around 2002, the high accuracy option "standard."
- The output of Modern GPS clocks or older ones with the option can be considered to be essential perfect for the purpose.

Time Zone Offsets

- For local convenience, the general public time is usually offset from "raw" UTC.
- Time keeping in field which transcend time zone boundaries simply use "raw" UTC.
- Power industry should do the same.

Timing of System Events

- Record Inititation Time (trigger time)
- Fault Inception Time
- Current Zero Time – So far the group has adopted the NPCC convention that the time to be reported is the time of current zero in the last phase to interrupt.
- Fault Clearaing Time

Event Inputs

- Reliable sensing of a change in contact status takes time. Contact deblunce function introduces a delay. Obviously any auxiliary relay introduces delay. So far groups has arrived at a great range of possible delays from less than a ms to many ms.

Delay and Distortion in DME Inputs

- CCVTs are though to be significant sources of errors.
- CTs thought to be much better.
- Other burdens have capacitance inserted to meet transient withstand specs.

Delay in Recorders

- Based on 2 actual events, this can be up to several ms.
- First even cap. Bank fault.
- Second event line fault.

Network Protocol Accuracy

- Network synchronization can be as good or better than IRIG-B if the engineering is good.

Local IED Internal Clock

- Can be synchronized very closedly to incoming IRIG-B or network protocal.
- Runs 'free' is incoming synchronizing interruptued.

IRIG-B

- Suppose we have a substation IRIG-B wiring network that has too much wiring is not carefully done, has too many devices.
- IRIG-B driver has it limits.
- Result would be that some devices on the network would miss some of the synchronizing pulses.
- If devices miss pulses they continue on their own clocks.
- I believe we have a gap to cover here. Not all DME devices make this know via alarm of make this apparent to the used.

IRIG-B Accuracy

- We have arrived at a statement in the report that indicates the accuracy of a wired IRIG-B network should be better that 1 ms.