Local and Wide Area Cross-Triggering of TESLA Disturbance Recording Systems

Introduction

We describe the operation of cross-triggering communication between all TESLA recorders at a local substation, as well as communication of TESLA recorders between substations. Disturbance ("swing") recordings are important to understand power system network disturbances. Swing recordings are slow speed recordings (1 sample per cycle, at power frequency 50 or 60Hz) of RMS values.

At the local substation level, there are 2 methods for cross-triggering between the recorders at same location: hard-wired or co-operative mode.

Hard-Wired Cross-Trigger Mode
(Within a substation)

This method of "cross-triggering" requires the user to hard-wire TESLA output contact #4 from one recorder to another recorder's digital external input. Contact #4 is operated by the DSP and has a very high-speed pick-up used for high-speed cross-triggering between TESLA recorders at the station. It is suggested to use the very last external input (EI#32 for a TESLA 18/32, EI#64 for a TESLA36/64), in order to standardize on the cross-triggering inputs, although the user can choose other inputs if desired.

If cross-triggering more than 3 recorders at a station, then a blocking diode matrix must be wired to each recorder in order to prevent a recorder from cross-triggering back on itself. If a recorder is cross-triggered back on itself, it will NOT create its record for that event. See diagram "Station C" connections for cross-triggering of 6 recorders.

Cooperative Cross-Trigger Mode
(Within a substation)

This method of "cross-triggering" makes use of the Ethernet connections to the TESLA fault recorders and the station's LAN switch or router.

In the TESLA User's Manual, it describes how to setup a group of recorders (up to 4 individual records) to configure them into Cooperative Mode. This system will configure the recorders in a "Master-Slave" relationship. In other words, one recorder in the group is the "Master" recorder, and all the other recorders in the group become the "Slave" recorders. In effect, all recorders in a "Cooperative Mode" group act as one recorder. For example, a cooperative group with a maximum of 4 recorders, would act as a single recorder with 144 (36 x4) analog channels and 256 (64 x4) digital external input (EI) channels.

In this mode of operation, all cross-triggering is accomplished via the Ethernet (LAN) communication from the Master recorder to the Slave recorders. It is not required to hard wire the cross-trigger system (as shown in Station "C" of the large "Local & Wide Area Cross Triggering" diagram).

Wide Area Monitoring (WAM) Cross-Triggering Mode
(between recorders at multiple locations)

For this method, the user will install "TESLA Central Station Server" software on a computer that will act as Central Station Database Server. This software will provide automatic poling to automatically retrieve records from all the system TESLA recorders. This software will also perform automatic cross-triggering to all recorders installed at each station.

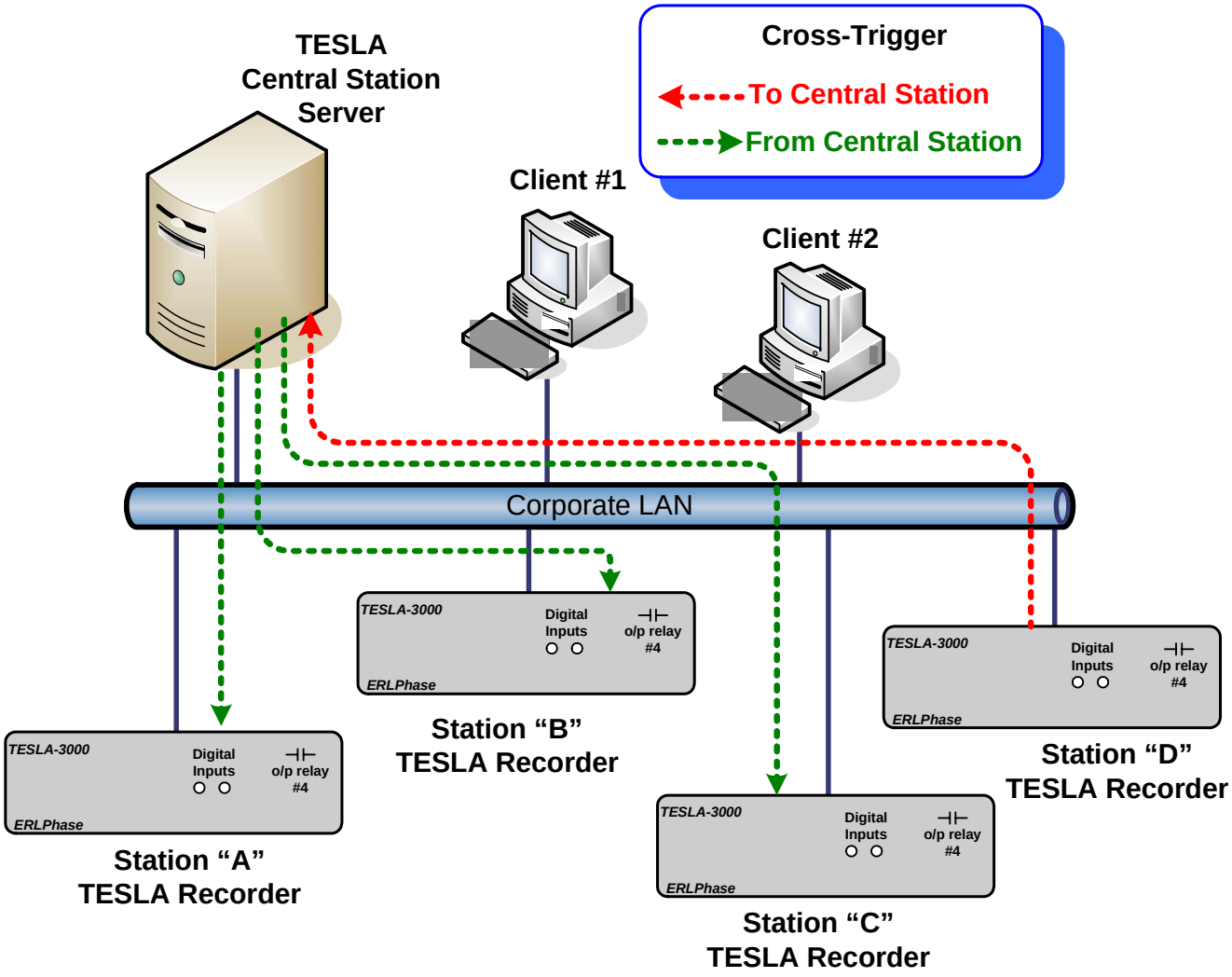

Figure 1. Cross-Triggering From Station to Station

In the above example, if the TESLA Recorder at Station "D" detects a swing fault at 9:00pm, it will create a swing record. At this time, it will notify TESLA Central Station Server (red arrow) that it detected a swing fault condition at 9:00pm. Central Station will then notify recorders at stations "A", "B" and "C" to go to their swing recording memory buffer at time 9:00pm and create the swing record for 9:00pm (green arrows). Then, at a user-defined polling time, automatically retrieve the records from recorders at Stations "A", "B", "C" and "D".

If the user has no Ethernet connections, then they can use phone modem communication connections.

Local & Wide Area X-Trigger TESLA Recording System

RECORD BASE CENTRAL STATION SERVER

Client #1

Client #2

Client #3

Corporate LAN

Firewall

Firewall

Firewall

Station "A"

Cooperative X-Trigger Mode

Station LAN switch

TESLA-3000 — Digital Input #32 — o/p relay #4

GEN. #1 — ERLPhase

GEN. #2 — ERLPhase

GEN. #3 — ERLPhase

Station "B"

Cooperative X-Trigger Mode

Station LAN switch

TESLA-3000 — Digital Input #32 — o/p relay #4

GEN. #1 — ERLPhase

GEN. #2 — ERLPhase

GEN. #3 — ERLPhase

GEN. #3 — ERLPhase

Station "C"

Hard wired X-trigger Mode

LAN Connections

Station LAN switch

TESLA-3000 — Digital Input #32 — o/p relay #4 — +VE — −VE

GEN. #1 — ERLPhase

GEN. #2 — ERLPhase

GEN. #3 — ERLPhase

GEN. #4 — ERLPhase

GEN. #5 — ERLPhase

GEN. #6 — ERLPhase

Blocking Diodes 1500 p.i.v. rating

By James J. Wood – 05/01/2010