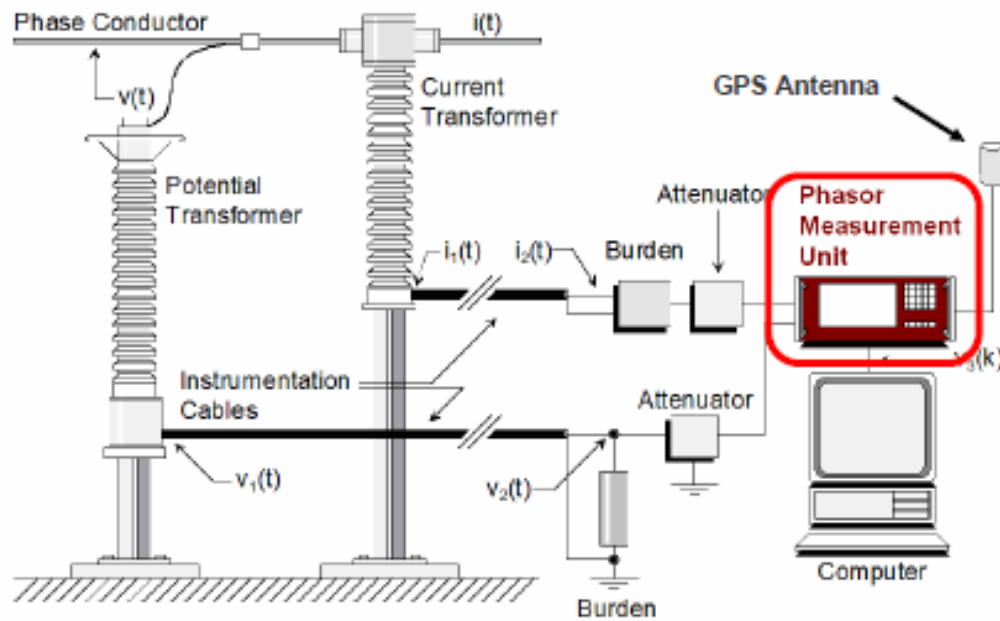# PMU Operation

- Access to Voltage and Current signals via PTs and CTs

- GPS antenna provides the precise time base for sampling and tagging

- Access communication circuits for output.

Typical PMU Installation & Configuration

Some Commercially Available PMUs

Phasor Data Concentrator (PDC)

• A phasor data concentrator collects phasor data from multiple PMUs or other PDCs, aligns the data by time-tag to create a time-synchronized dataset, and passes this dataset on to other information systems.

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What is the goal?

- The **NASPI** community's goal is to enhance the use of networked phasor measurement devices, phasor data-sharing, applications development and integration, and research and analysis.

- The mission of the North American SynchroPhasor Initiative is to improve power system reliability and visibility through wide area measurement and control and visualization.

Synchronized Phasor Measurement System

What is it?

SPMS is our current SCE phasor measurement system.

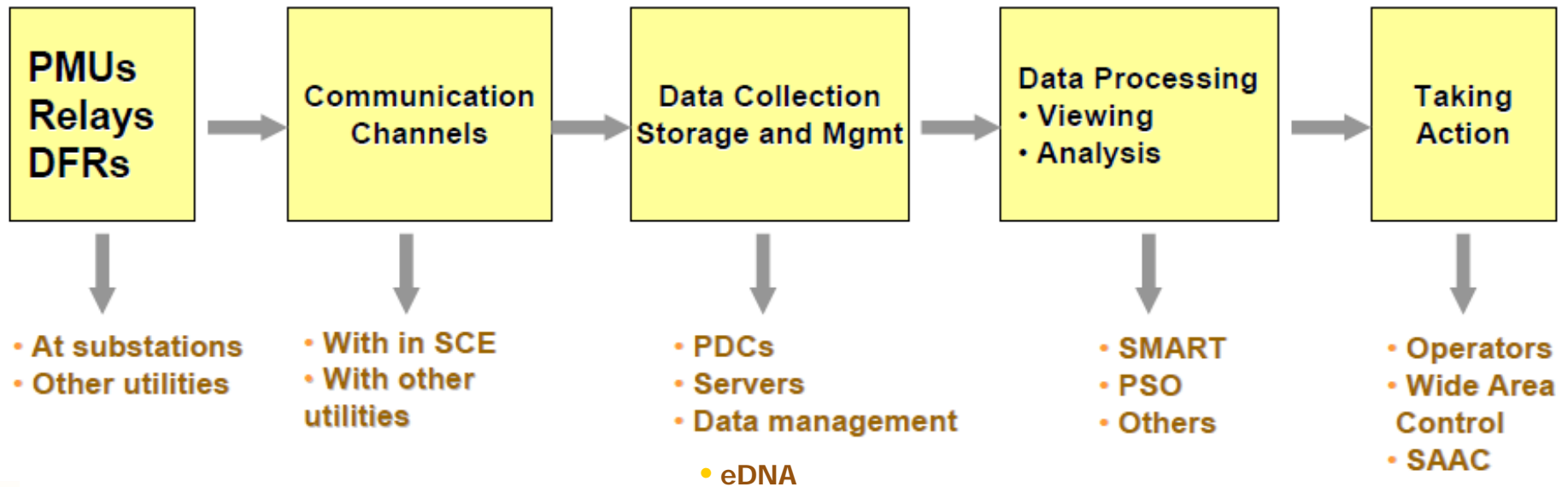Uses BPA PDC Stream Protocol for data streaming between entities

A grid monitoring system – Measures, computes and compares:

- Voltage phasors
- Current phasors
- Phase angles between different electric system points simultaneously (Synchronized Measurements)
- Measurements are at a very high rate (30 or 60 Hz)
- SPMS operates faster than the typical SCADA/EMS systems
- The SPMS system has the capability to capture and store dynamics of the events/disturbances.
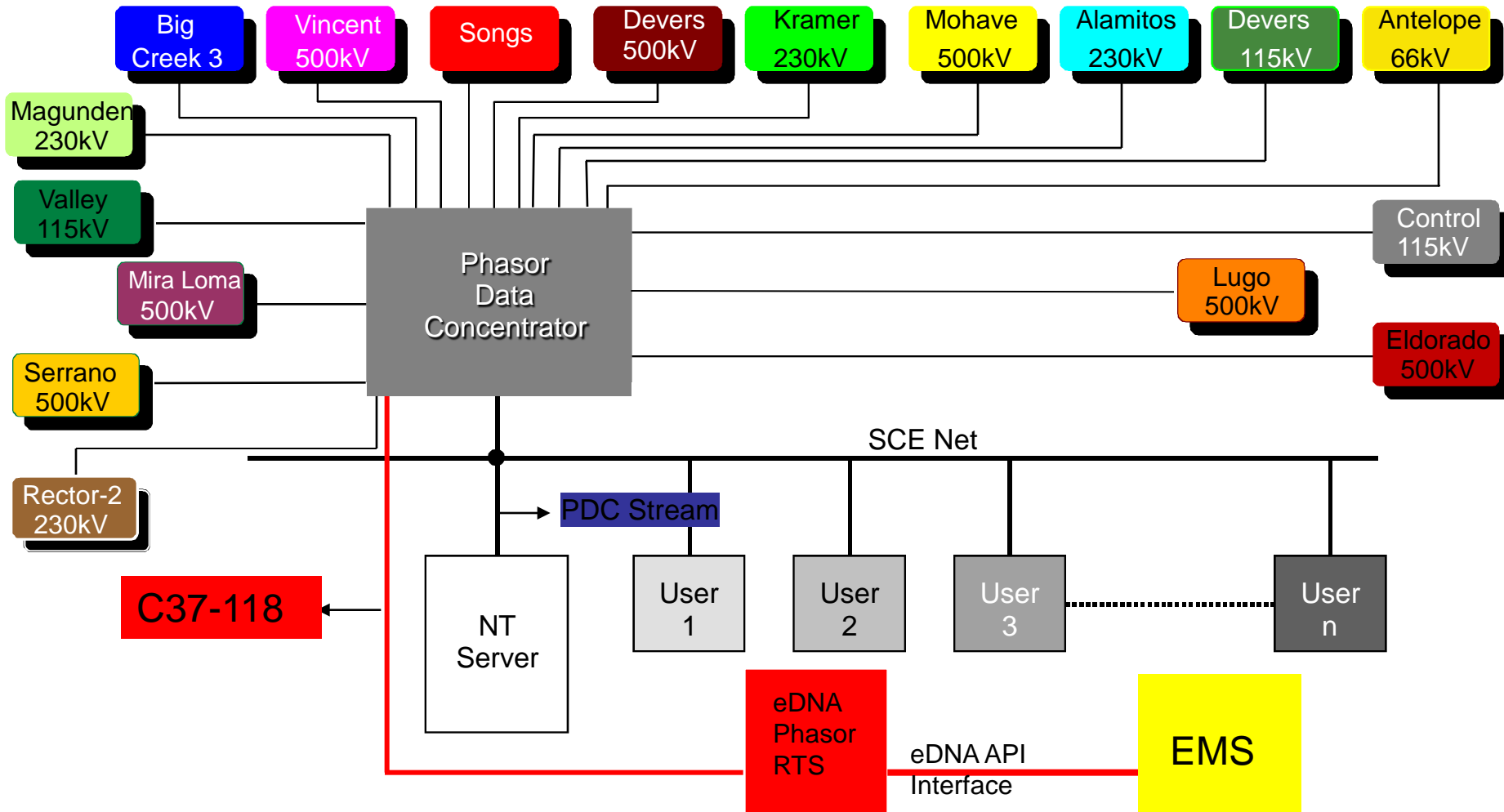
SPMS at SCE

• In- service 20 Phasor Measurement Units in SCE area

• Installed three Phasor Data Concentrators which are now in operation at Grid Control Center at Alhambra.

• Developed Power System Outlook program to view and analyze MW, MVAR, voltage, currents, modal oscillations and their damping.

• Developed SMART® - Synchronized Measurement & Analysis in Real-Time program which was installed at SCE's Grid Control Center in 2007.

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SPMS Technology

| PMUs Relays DFRs	→	Communication Channels	→	Data Collection Storage and Mgmt	→	Data Processing • Viewing • Analysis	→	Taking Action
↓		↓		↓		↓		↓
• At substations • Other utilities		• With in SCE • With other utilities		• PDCs • Servers • Data management • eDNA		• SMART • PSO • Others		• Operators • Wide Area Control • SAAC

Current SCE Phasor Measurement System Network

SPMS Capabilities

• Enable instantaneous assessment of system performance and stability (Situational Awareness) hence avoiding major system disturbances

• Potentially enable determination of Available Transmission Capacity in real-time

• Establishing and monitoring system stress limits

  – Increasing loading if margin is there

  – Reducing loading if the safe limits are exceeded

• Monitoring slowly growing oscillations (widespread outages)

• Monitoring voltage levels at critical locations

File　View　Mode　Playback　Tools　Window　Help
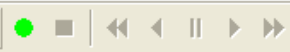
Version 7.3

eDNA Synchrophasor Real-Time System
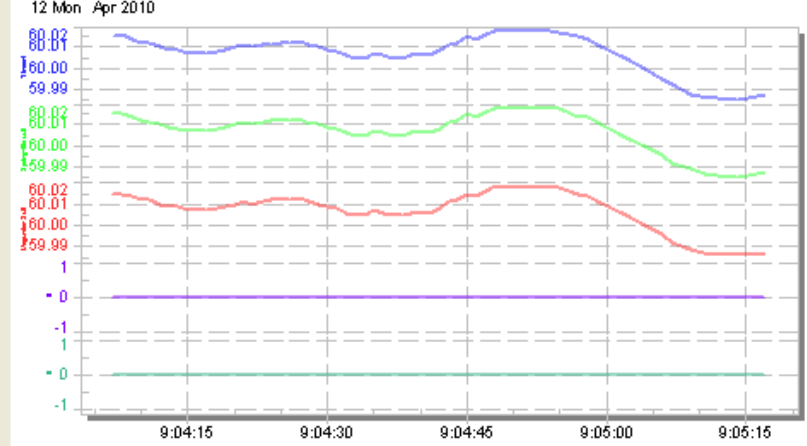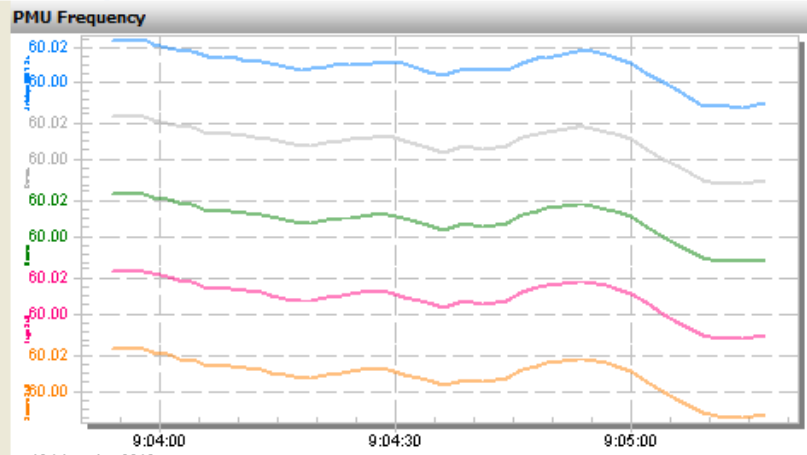# Phasor Measurement Unit Data

SOUTHERN CALIFORNIA
EDISON®

4/12/2010 9:05:17 AM

PDC

PDC

PMU

Alamitos Generat
Antelope 66KV Su
Big Creek 3
Control 115kV Su
Devers
Devers-115 Sub
Eldorado
Grand Coulee
Kramer
Lugo Sub
Magunden Sub
Mira Loma Sub
Mohave Generatin
Rector 230
Rector 66
San Onofre Switc
Serrano Sub
Springville sub
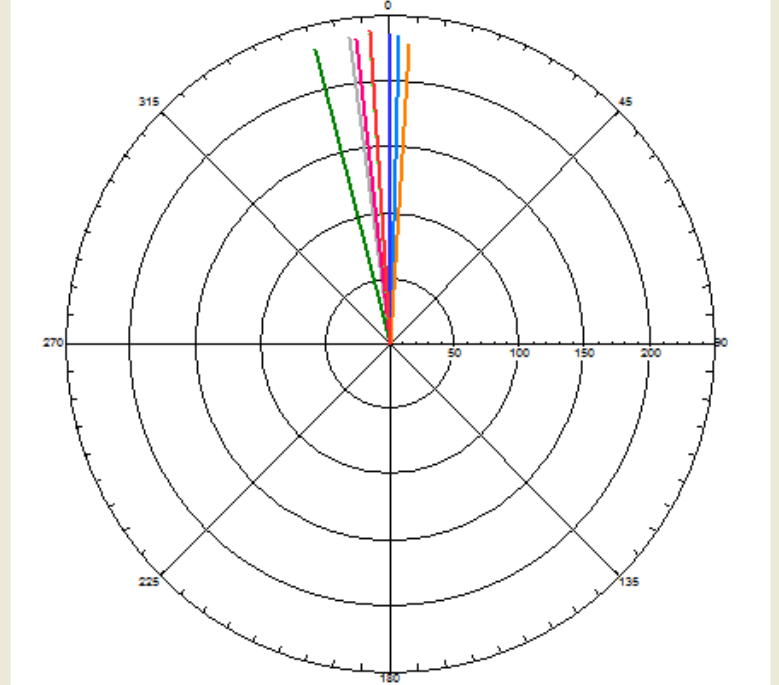Valley Sub
Vestal sub
Vincent

Phasor

Magunden 230 kV

Add Signal

PMU Frequency

12 Mon Apr 2010

12 Mon Apr 2010

| 30 Sec | 1 Min | 5 Min | 10 Min | 15 Min | 30 Min |

Digital Breaker

16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

Dig1:　-4145

Dig2:　0

32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17

Phasor Angle Magnitudes

!Vincent!Vincent 230 kV

Signal Phasor	Magnitude	Angle
!Antelope 66KV Su!Antelope-220KV B	233.45	37.43
!Devers!Devers 230 KV Bu	233.27	28.40
!Kramer!Kramer 230 kV Bu	230.01	21.20
!Lugo Sub!Lugo 230 kV Bus	231.53	29.19
!Serrano Sub!Serrano 230 kV B	227.22	39.43
!Vincent!Vincent 230 kV	233.45	35.67
!Springville sub!SV-MAG1 line vol	234.74	31.73
!Magunden Sub!Magunden 230 kV	237.11	31.87
	N/A	N/A
	N/A	N/A

Remove Signal

Mode: Run

NUM

Wide Area Situational Awareness System (WASAS)

The primary purpose of the WASAS system is to provide system operators with previously unavailable information about the operating status of bulk power system.

This info will allow operators at SCE and across the Western Electricity Coordinating Council (WECC) control area to better manage the region's transmission system and make decisions necessary for preventing catastrophic electric system failures.

Phase 1 from 2010 – 2015
- Provide secure phasor data to the Western Electricity Coordinating Council (WECC) as part of a contractual obligation in a separate DOE stimulus funding (ARRA) agreement

- Implement Software based PDCs and Phasor Gateway functionality to exchange synchrophasor data with WECC and other utilities.

PMU

Existing PMU

DSU/CSU Modems

DFR / PMU

NEW DFR/PMU
AND EPDC

Ethernet

EPDC

16 port Serial to
Ethernet Gateway

Monitoring
Workstations

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