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Session : Foundational Blocks for Smart Grids

BANDWIDTH ADEQUACY, DATA COMPRESSION AND EVOLVING WAMS APPLICATIONS FOR INDIAN GRID

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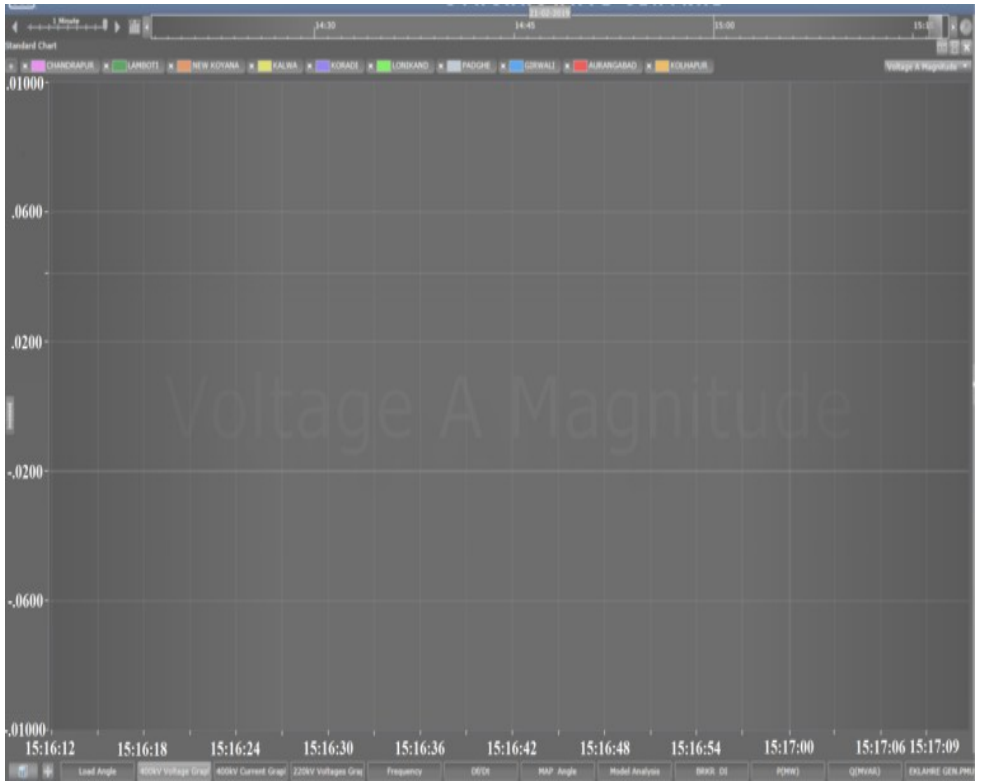
INTRODUCTION

- Challenges of Data Transfer in SMARTGRID
- Case study-1: Tentative Bandwidth Requirement of A Typical 400kV substation in MAHATRANSCO Grid
- Significance of Data Compression and Its Applications in Electrical Power Utilities
- Case study-2: Application of Data Compression Technique to PMU Data
- Case Study-3: Synchrophasor System for Disturbance Analysis

Bandwidth Adequacy and Data Transfer Challenges



Screen shot for Visualization with NO VOLTAGE DATA on synchrophasor system from 400kV Lonikand substation.

- **BIG DATA : The data of 15,000 samples** for 7 power system parameters from 8-Phasor Measurement Units (PMUs) in the state of Maharashtra spanning duration of 10 minutes comes out to be **8,40,000 Samples** and generation of around **1.5GB of Data per Day**.

- With Increase in Number of PMUs the **data volume would increase**, ALONG WITH BANDWIDTH REQUIREMENT TO TRANSFER THE DATA.

Tentative Bandwidth Requirement of Various Applications at 400kV Dhule Substation in MAHATRANSCO Grid

Bandwidth for RTU data Communication	**414.46Kbps**
Bandwidth for ERP data Communication	**824Kbps**
Bandwidth for ABT data Communication	**5.33 Kbps**
Bandwidth for VOIP data Communication	**87.2Kbps**
Bandwidth for WAMS data communication	**128.0**
Total Bandwidth Requirement	**1479.53 Kbps (1.47Mbps)**

Case Study-2: Data Compression With PMU Data

$$Compression\ Ratio\ (CR) = \frac{Original\ Data}{Compressed\ Data}$$

Results for Data Compression with Principal Component Analysis

Data compression Technique Used	Original Data size (MB)	Compressed Data Size (MB)	Compression Ratio (CR in %)	Compression in Data Achieved (%)
PCA with PRINCIPAL	8.38	1.449	5.783	**82.70**

Case Study-3: WAMS for Disturbance Analysis

The Disturbance pertains to bursting of **R-phase CT** of 3 x 200MVA, 400/220kV ICT-4 at 400kV Padghe substation in MAHATRANSCO Grid.

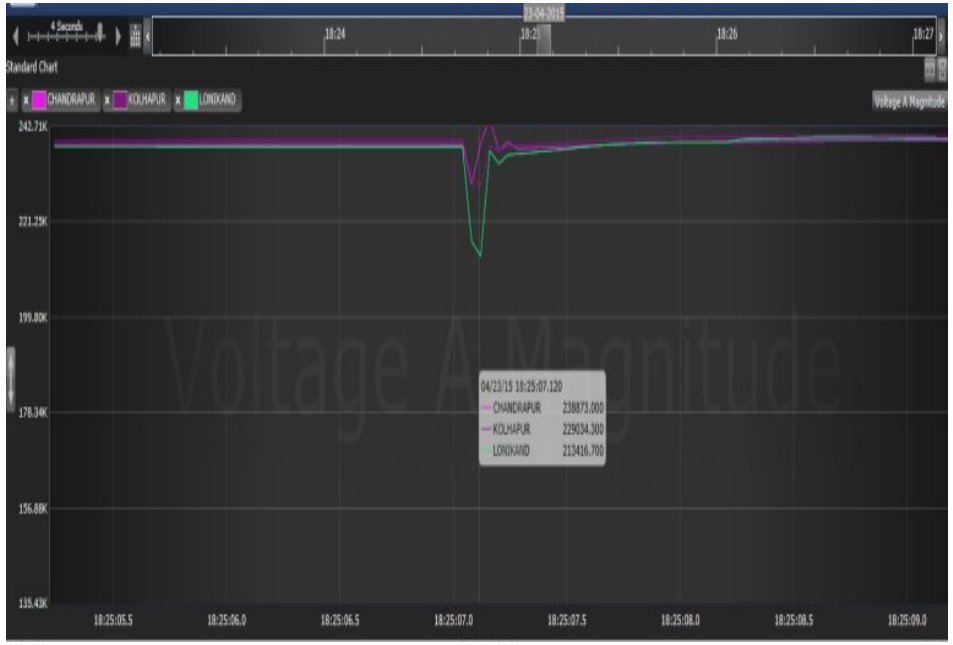
Sr. No.	Voltages [Ph.-G] in kV observed			
		400 kV Lonikand	400 kV Kolhapur	400 kV Chandrapur
1)	V_A	238	240	239
2)	V_B	243	242	243
3)	V_C	240	240	241

Voltages as indicated by Synchrophasor systems in MAHATRANSCO during NORMAL CONDITION.

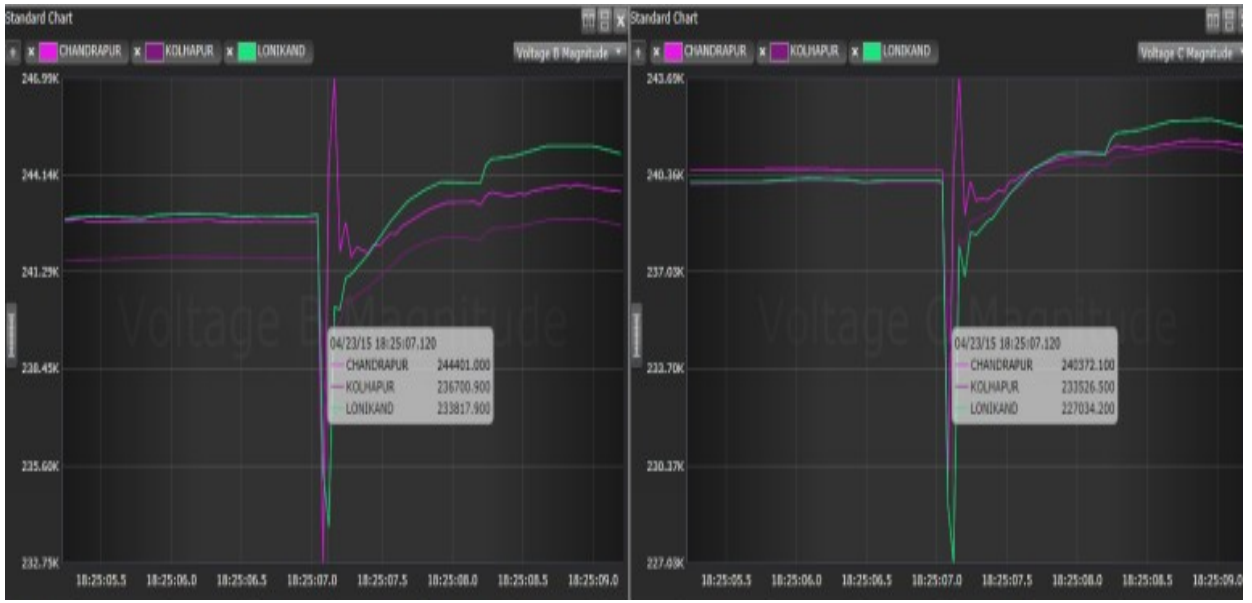
Sr. No.	Voltages [Ph.-G] in kV observed at the Instance of Voltage Dip [Approximately]			
		400 kV Lonikand	400 kV Kolhapur	400 kV Chandrapur
1)	V_A	**213**	229	239
2)	V_B	234	237	244
3)	V_C	227	234	240

Voltages as indicated by Synchrophasor systems in MAHATRANSCO during DISTURBANCE CONDITION.

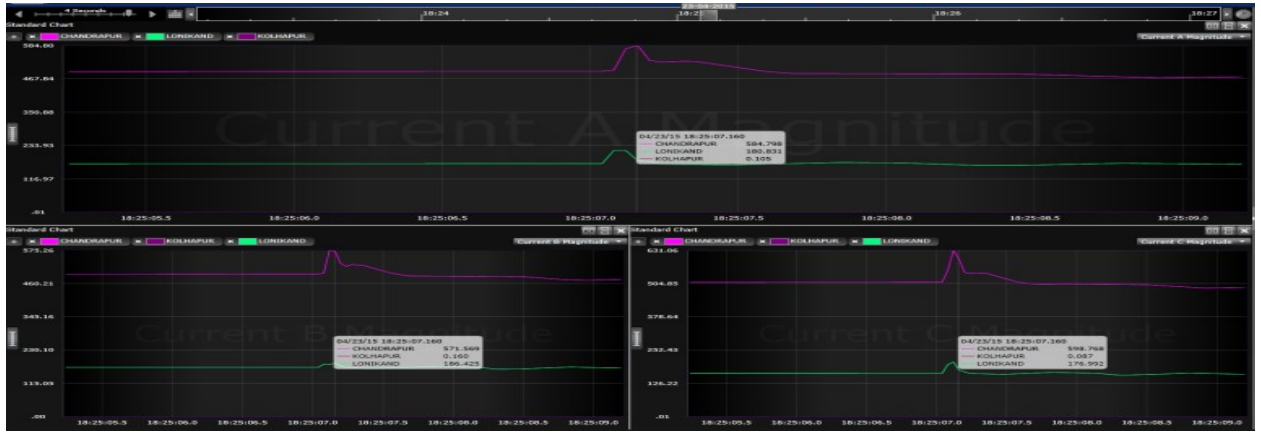
Case Study-3: WAMS for Disturbance Analysis



A-ph. Voltage during disturbance as indicated by WAMS



B-ph. and C-Ph. Voltages at the dip as indicated by Synchrophasor systems in MAHATRANSCO during Disturbance



A ph., B-ph. and C-Ph. Currents as indicated by synchrophasor systems in MAHATRANSCO during disturbance

KEY TAKEAWAYS

- Highlights Challenges of **BIG DATA** generated in **SMARTGRID**, **Importance of Bandwidth Adequacy for Various power system applications with practical data**.

- Demonstrates **Significance of Data Compression** and Its use in **Compressing Data** from SMARTGRID device like that, **from PMUs**.

- Utilization of Wide Area Measurement Systems **(WAMS)** Synchrophasor System for **Grid Monitoring and Disturbance Analysis.**

THANK YOU