



ENTERGY SYNCHROPHASOR ARCHITECTURE

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GPA SYNCHROPHASOR USER'S GROUP

ARCHITECTURE OVERVIEW

■ Field Devices

- 48 SEL-351A PMUs
- 21 SEL-2488 and SEL-2407 GPS Clocks
- 42 SEL-3355 Substation Computers (openHistorian)
- 116 DFRs

■ Data Streams

- 400+ Circuits monitored (transmission lines, transformers, and POIs to IBRs)
 - ABC+ Voltages (magnitudes and angles)
 - ABC+ Currents (magnitudes and angles)
 - Frequency per device – NOTE: Frequencies for individual circuits may be needed to monitor frequency instability and grid inertia

■ Data Centers

- 16 Data Servers (openHistorian)
- Data mapping (Lat/Long, Nomenclature, Pairing voltage and current)
 - JSON Device Configuration Files shared among Data Servers
- Bulk calculations (MW, MVAR, MVA, Time Synch, Voltage Balance Across Phases, etc.)
- Raw data from all devices taking 3GB/hour of storage (Close to 80GB per day without any calculations) @ 30 samples per second

DEVICE/TAG NOMENCLATURE

PMU (Single Circuit)

- **Device Acronym**

ENT_fromSub_toSub_**P**_E**N**I**8**

- **Example:** ENT_TUL_LSU_P_ENN6

DFR (Multiple Circuits)

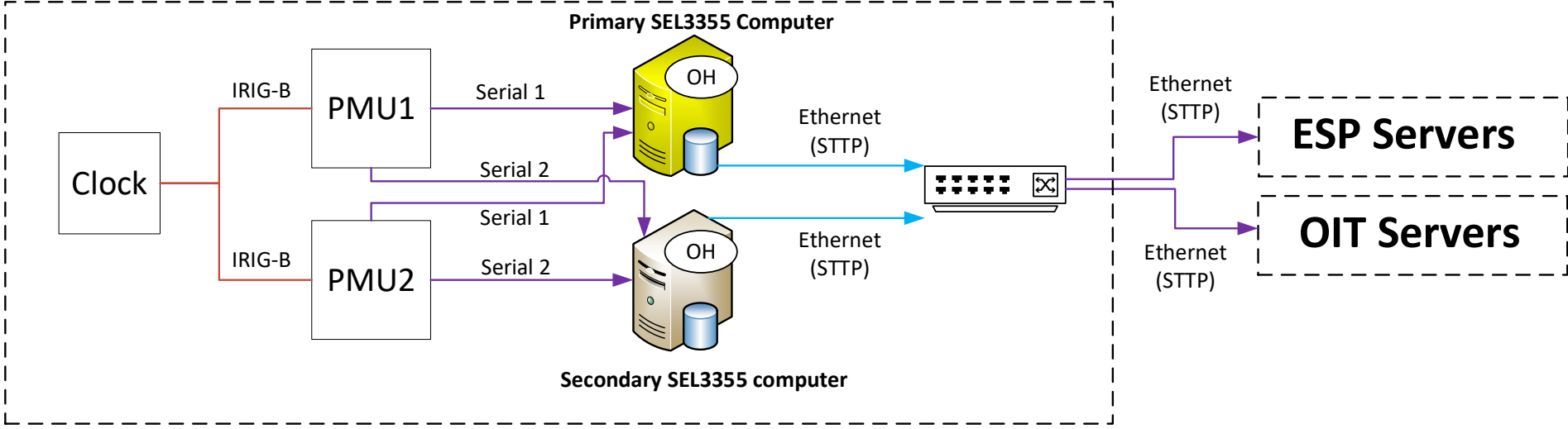
- **Device Acronym**

ENT_Sub_**1**_D_E**N**I**8**

- **Example:** ENT_FQ_3_D_NPI4

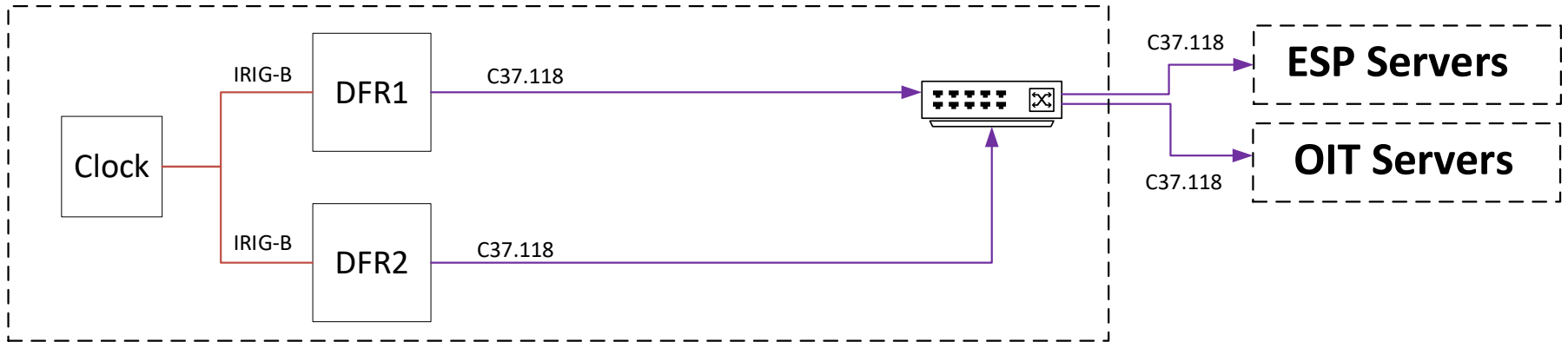
- 1** Number of DFR(s) at the same substation
- P/D** PMU, DFR
- E/N** Electronic Security Perimeter (ESP), Non-ESP
- P/N** NERC PRC-002-RI, Non-PRC002
- I/N** Inverter-Based Resource (IBR), Non-IBR
- 2...8** 69kV, 115kV, 138kV, 161kV, 230kV, 345kV, 500kV

PMU Distributed Architecture



	TAG LABEL	
Bulk Calculation	MW_1	
	MW_A	
	MW_B	
	MW_C	
	MW_3	
	MVAR_3	
	MVA_3	
	VMAG_DEV_VA	
	VMAG_DEV_VB	
	VMAG_DEV_VC	
	VMAG_DEV_XP	
	VANG_DIFF_BA	
	VANG_DIFF_CA	
	VANG_DIFF_1A	
	IMAG_RATIO_NA	
	IMAG_DEV_XP	
IANG_DIFF_BA		
IANG_DIFF_CA		
IANG_DIFF_1A		
FREQ_DIFF_NOM		
FREQ_DIFF_AVG		
TIME_SYNC		
TIME_DIFF		
PMU Raw Data	V0_MAG	Sequence Components
	V0_ANG	
	V1_MAG	
	V1_ANG	
	V2_MAG	
	V2_ANG	
	I0_MAG	
	I0_ANG	
	I1_MAG	
	I1_ANG	
	I2_MAG	
	I2_ANG	

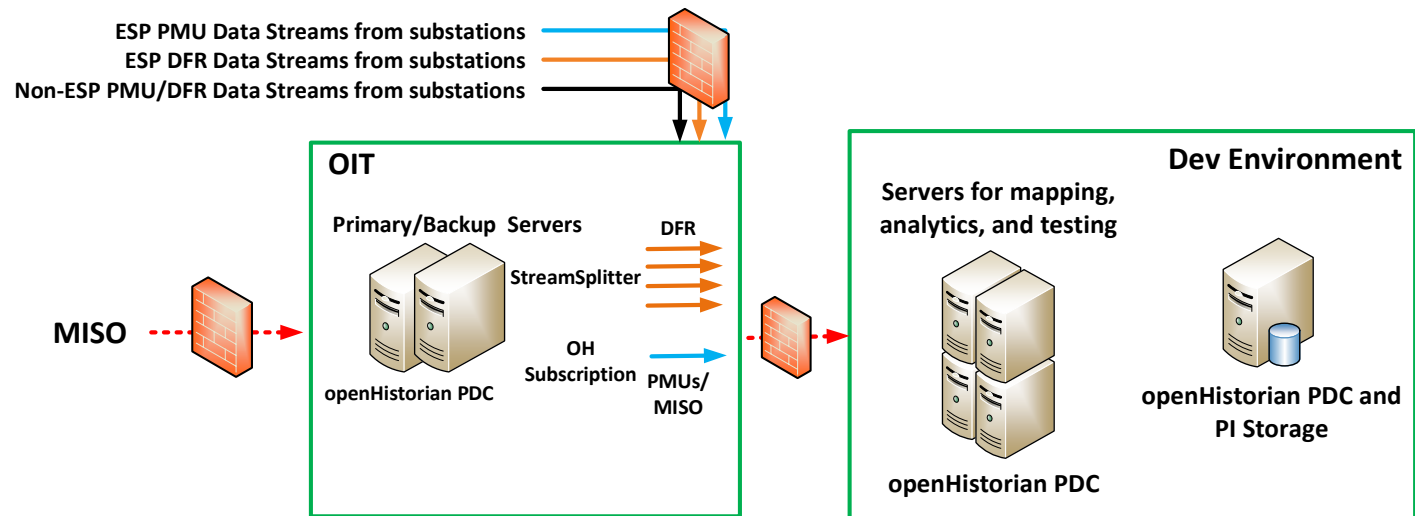
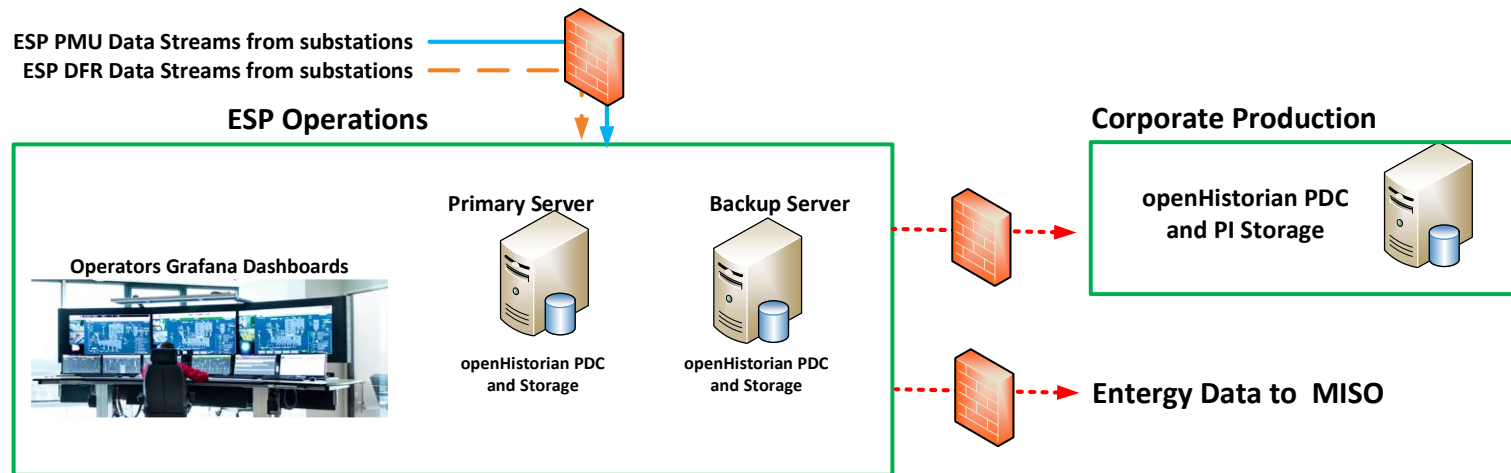
DFR Architecture



		TAG LABEL	
DFR	Raw Data	Frequency	VA_MAG
		VA_MAG	VA_ANG
		VA_ANG	VB_MAG
		VB_MAG	VB_ANG
		VB_ANG	VC_MAG
		VC_MAG	VC_ANG
		VC_ANG	V1_MAG
		V1_MAG	V1_ANG
		V1_ANG	IA_MAG
		IA_MAG	IA_ANG
		IA_ANG	IB_MAG
		IB_MAG	IB_ANG
		IB_ANG	IC_MAG
		IC_MAG	IC_ANG
		IC_ANG	I1_MAG
		I1_MAG	I1_ANG
		I1_ANG	

		MW_1
		MW_A
		MW_B
		MW_C
		MW_3
		MVAR_3
		MVA_3
		VMAG_DEV_VA
		VMAG_DEV_VB
VM,	VM,	VMAG_DEV_VC
VM,	VM,	VMAG_DEV_XP
VM,	VM,	VANG_DIFF_BA
VM,	VM,	VANG_DIFF_CA
VM,	VA,	VANG_DIFF_1A
VA,	VA,	IMAG_RATIO_NA
VA,	VA,	IMAG_DEV_XP
VA,	IMA,	IANG_DIFF_BA
IMA,	IM,	IANG_DIFF_CA
IM,	IAN,	IANG_DIFF_1A
IAN,	IAN,	FREQ_DIFF_NOM
IAN,	IAN,	FREQ_DIFF_AVG
IAN,	FREQ,	TIME_SYNC
FREQ,	FREQ,	TIME_DIFF
FRE,	TI,	V0_MAG
T,	T,	V0_ANG
		V1_MAG
		V1_ANG
		V2_MAG
		V2_ANG
		I0_MAG
		I0_ANG
		I1_MAG
		I1_ANG
		I2_MAG
		I2_ANG
		I2_MAG
		I2_ANG
		I2_ANG

WHOLE SYSTEM ARCHITECTURE





ขอบคุณครับ
(KORB-KHUN-KRUB)

GOODNIGHT
FROM
BANGKOK