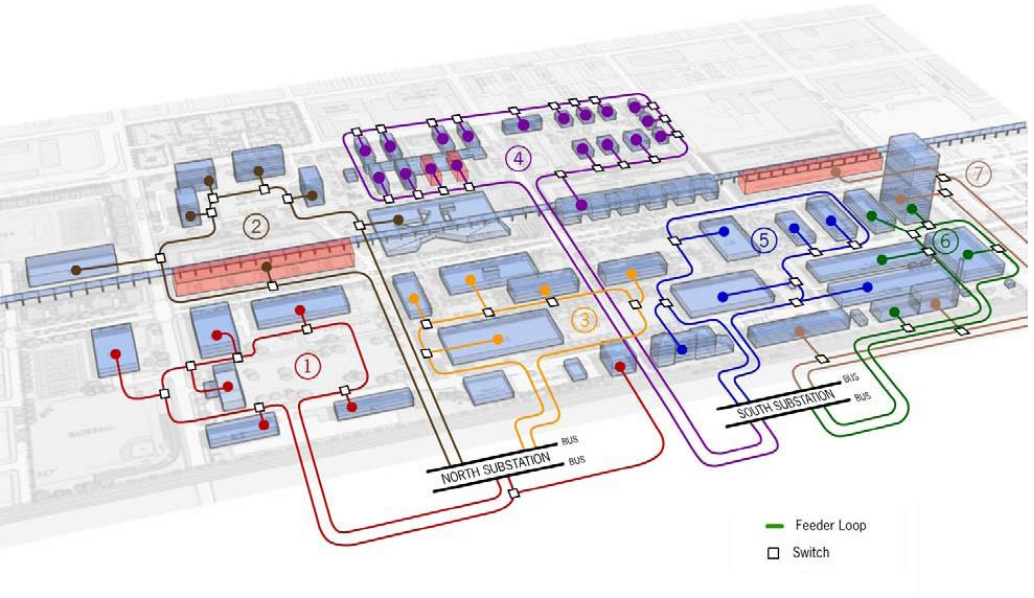
한국전기연구원
KOREA ELECTROTECHNOLOGY RESEARCH INSTITUTE

High Reliability Distribution System:



Local area monitoring system for Microgrid

Smart Power Facility Research Center

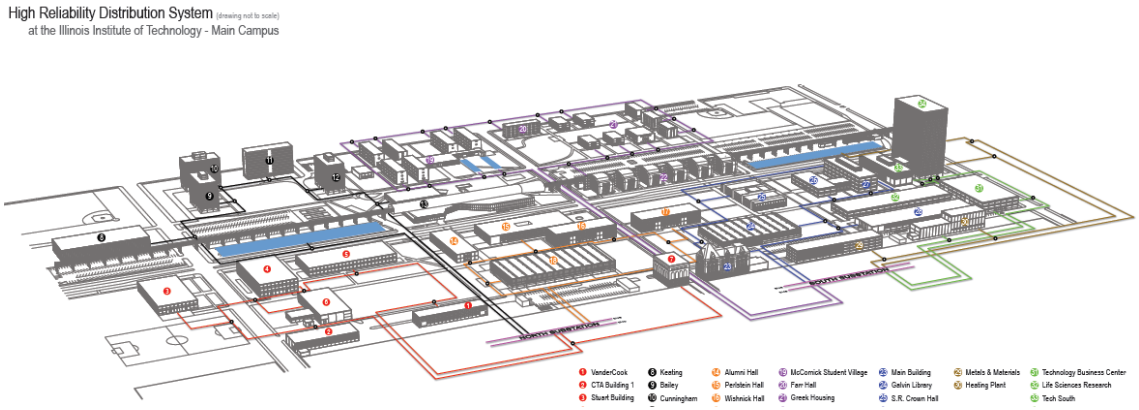
KERI

Time Schedule

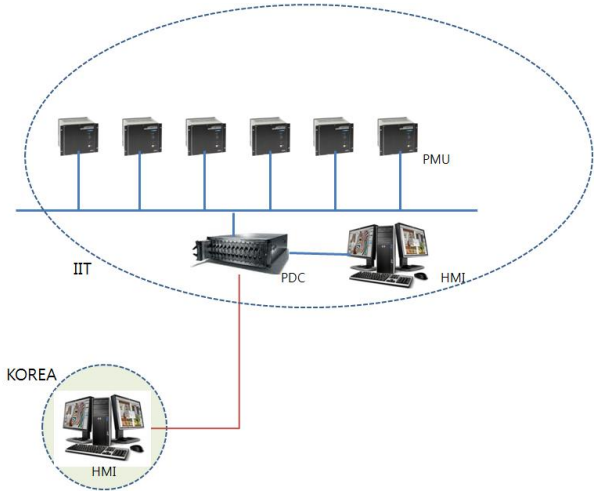
	Activity	presentation
1	Project Overview	KERI
2	Summary of 1st year R&D	
3	Discussion on 2nd year R&D contents	IIT
		KERI
4	Discussion on Microgrid Workshop	IIT
5	Wrap up	

Basic Concepts

Campus Microgrid
Illinois Institute of Technology



Smart PMU



- PMU Demonstration for microgrid application
- LAMS for Campus Microgrid field test
- Enlarge PMU application field & Enhance microgrid technology

Project Overview(KERI &IIT)

Title : Local area monitoring system for Microgrid

Total Project Period	From 01-12-2010 until 30-11-2013 (36 months)			
Agreement	Year 1	Year 2	Year 3	Sum
Project Period	01-12-2010 ~ 30-11-2011	01-12-2011 ~ 30-11-2012	01-12-2012 ~ 30-11-2013	01-12-2010 ~ 30-11-2013
Korean Lead Organization	$378,333	$250,000	$254,167	$882,500
Non-Korean Participating Organization	$125,000	$125,000 +$300,000	$125,000	$375,000 +$300,000
Korean Principal Investigator	Name Dea-Kyeong Kim Position/Title Director			
Non-Korean Principal Investigator	Name Alexander J. Flueck Position/Title Associate Professor, Electrical/Computer Engineering, Illinois Institute of Technology			

Final Goal & Scope

Final Goal	Development of LAMS for Microgrid
Scope	➢Development of LAMS for Microgrid ➢Development of Smart PMU for Microgrid ➢Demonstration of LAMS for Microgrid

Scope & Contents

Scope	Contents
Development of LAMS for Microgrid	➢ Development of LAMS for microgrid ➢ Analyze characteristics of load and develop accurate load model for closed loop feeder
Development of Smart PMU for Microgrid	➢ Implementation of bidirectional information transfer and self-diagnostic function for PMU ➢ Development of island detection function for PMU and its field test for microgrid
Demonstration of LAMS for Microgrid	➢ Demonstration of LAMS for microgrid ➢ LAMS field test and operation

Goal and Scope(Year 1)

Goal	Analysis of grid and Design of LAMS

Scope	Contents
Deploy of PMU and Data Collection	➢ Analyze IIT grid and its environment ➢ Decide PMU installation position ➢ manufacturing PMU ➢ PMU and monitoring system installation ➢ Development of data gathering program(HMI) ➢ Data collection and analysis
Design of LAMS	➢ Requirement analysis and functional design of LAMS ➢ Design of LAMS

Goal and Scope(Year 2)

Goal	Development of LAMS for Microgrid

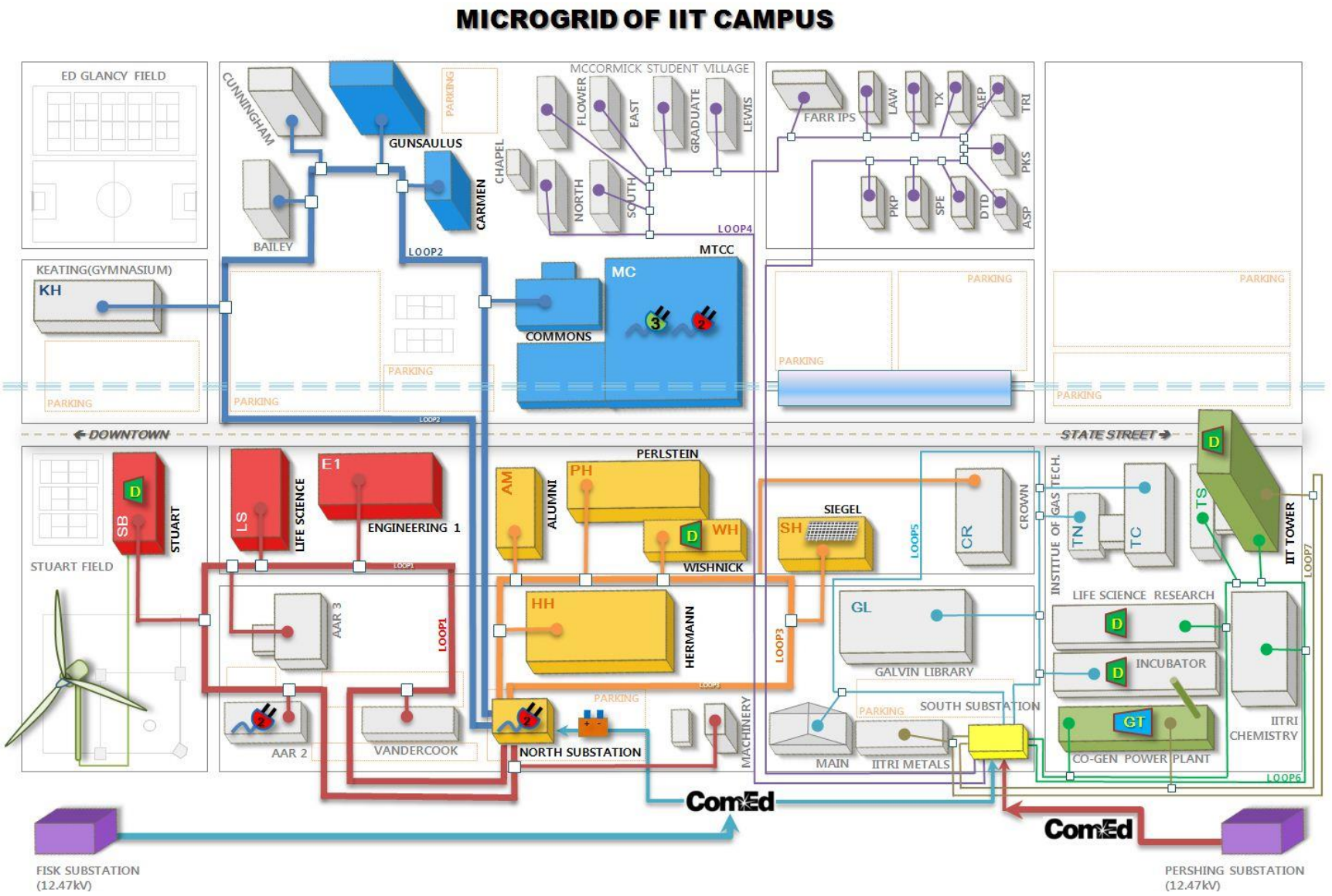
Scope	Contents
S/W Development of LAMS	➢ S/W Development of LAMS system for IIT microgrid
Analyze characteristic load patterns and Develop accurate load model	➢ Analyze the characteristic load patterns for each closed-loop feeder ➢ Perform seasonal shutdown/startup tests ➢ Develop accurate load models for each building and each closed-loop feeder under study
Development of HMI and PDC custumizing	➢ Development of HMI ➢ PDC custumizing and interface
Design of Smart PMU for Microgrid	➢ Extract design parameters for smart PMU ➢ Design of smart PMU for microgrid

Goal and Scope(Year 3)

Goal	Demonstration of LAMS and Smart PMU

Scope	Contents
Field Test for LAMS	➢ Field test of LAMS for microgrid ➢ Test and refine PMU load characterization application ➢Improve load models for buildings and closed-loop feeders
Development of Smart PMU for Microgrid	➢ Implementation of bidirectional information transfer and self-diagnostic function for PMU ➢ Development of island detection function for PMU and its field test for microgrid

Installation Site Selection



Channel Design for Site Installation

	IIT BUILDINGS	PMU		ANALOG			DIGITAL	MODULES						Remark
		Device	Type	PT	CT	SPARE		PT8	CT8	PTx/CTx		AI	DI	
1	*ENGINEERING 1*	1	24/16	12	12	0	16	1	1	1	PT4/CT4	*3*	*1*	*set 1*
2	*LIFE SCIENCE*	1	24/16	9	9	6	16	1	1	1	PT1/CT7	*3*	*1*	*set 1*
3	*STUART*	1	32/16	13	13	6	16	1	2	1	PT5/CT3	*4*	*1*	*set 1*
4	*GUNSAULUS*	1	8/16	3	3	2	16	0	0	1	PT3/CT5	*1*	*1*	*set 2*
5	*MTCC & COMMONS*	1	24/16	9	9	6	16	1	1	1	PT1/CT7	*3*	*1*	*set 1*
6	*HERMANN*	1	24/16	9	9	6	16	1	1	1	PT1/CT7	*3*	*1*	*set 1*
7	*WISHNICK & PERLSTEIN & ALUMNI*	1	32/16	9	18	5	16	1	2	1	PT1/CT7	*4*	*1*	*set 1*
8	*SIEGEL*	1	16/16	6	6	4	16	0	1	1	PT6/CT2	*2*	*1*	*set 1*
9	*NORTH SUBSTATION*	1	40/16	6	27	7	16	0	4	1	PT6/CT2	*5*	*1*	*set 1*
10	*IIT TOWER*	1	24/16	9	9	6	16	1	1	1	PT1/CT7	*3*	*1*	*set 2*
11	*LIFE SCIENCE RESEARCH & INCUBATOR*	1	24/16	12	12	0	16	1	1	1	PT4/CT4	*3*	*1*	*set 2*
12	*CO-GEN POWER PLANT*	1	16/16	9	6	1	16	1	0	1	PT1/CT7	*2*	*1*	*set 2*
	Total	*12*		*106*	*133*	*49*	*192*	*9*	*15*	*12*		*36*	*12*	

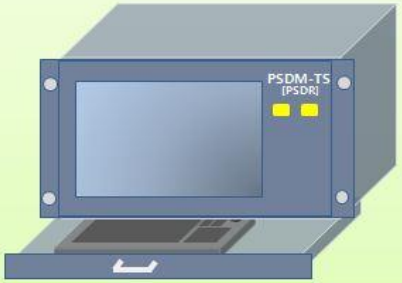
Redesign and Manufacture of PMU(I)

Subrack Chassis

12.1″ LCD

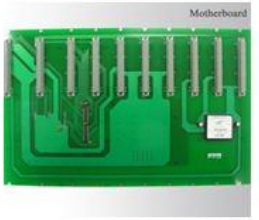
Console Module

Power Module



PMU(PSDR)

Back Plane(Mother Board)



DI Module

SPU

SBC(CPU)

CPU Back

CPU Module

AI Module

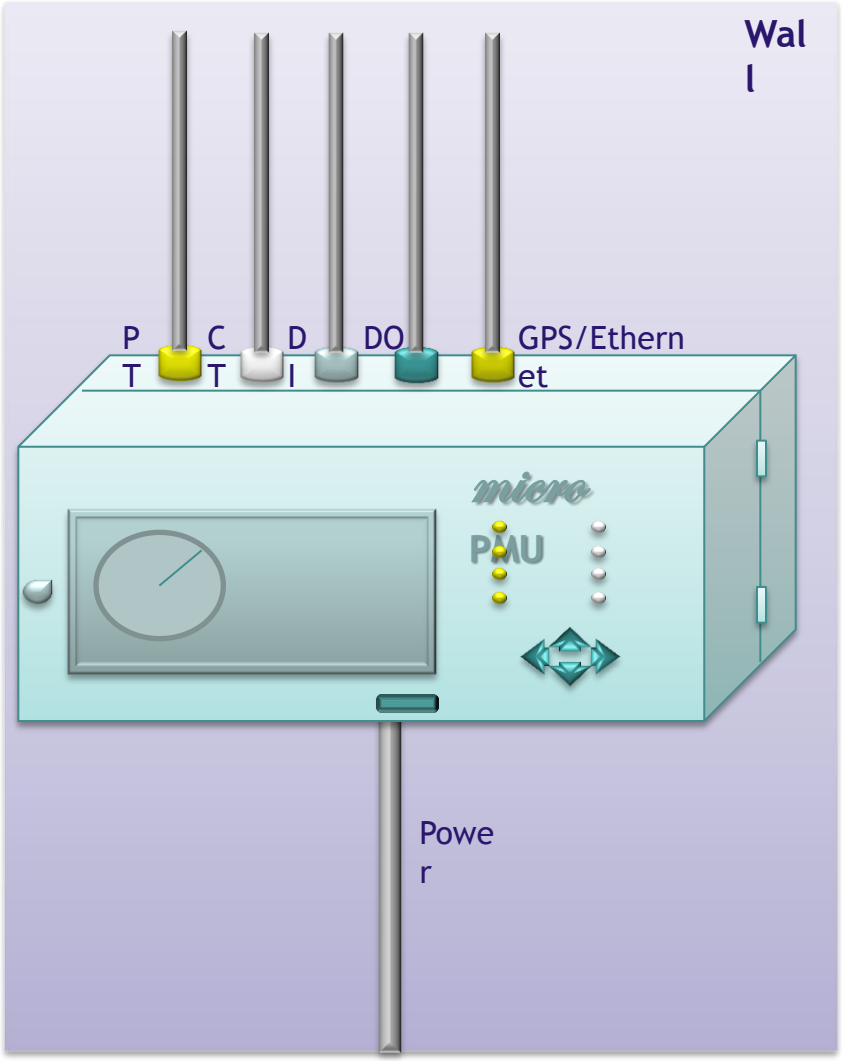
Redesign and Manufacture of PMU(II)

Installation of PMU in Site

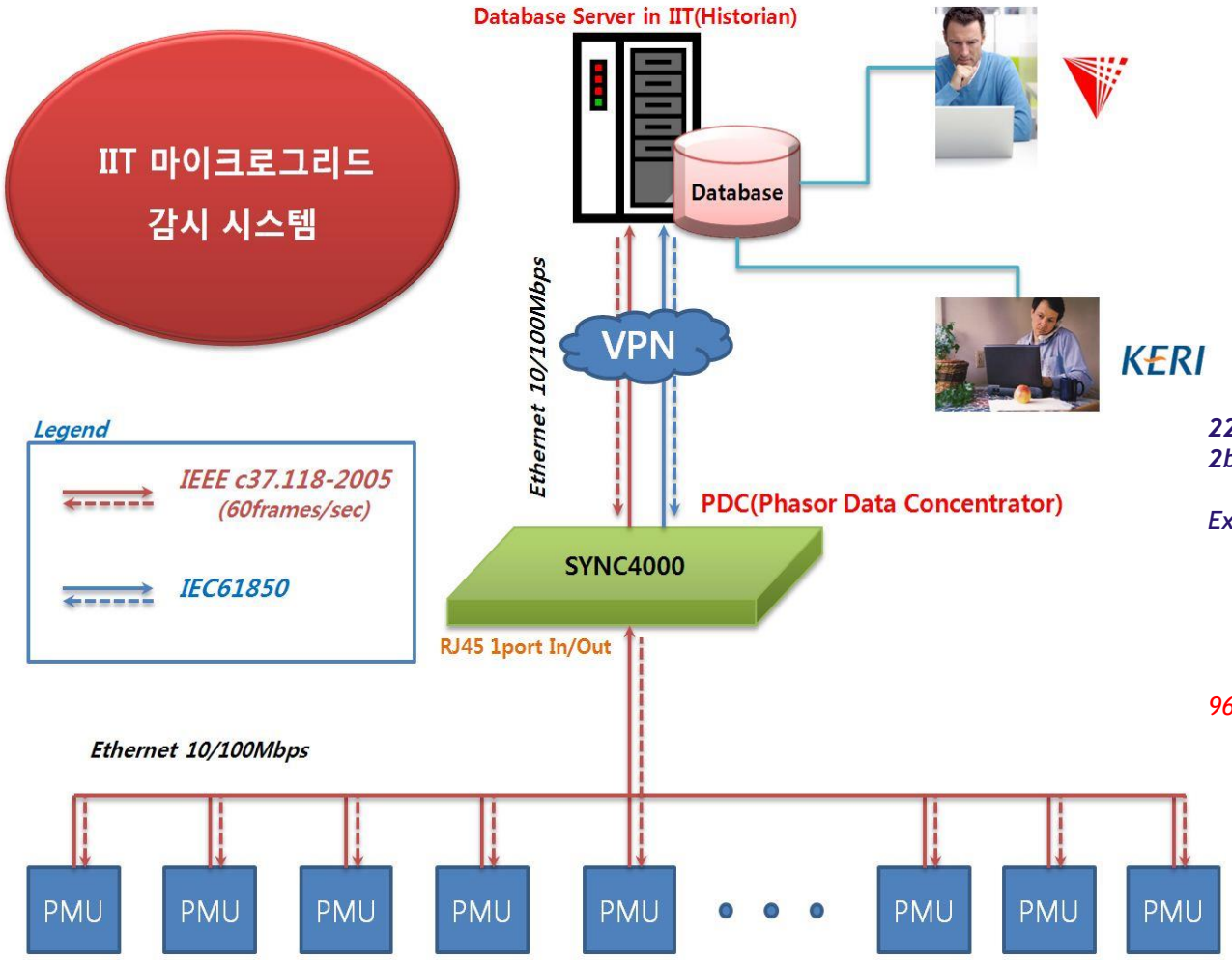
Design Draft of New PMU

Micro PMU Specification(Draft)

- Data Sampling : 256 sample/cycle
- A/D converter : 16bit
- Voltage Input : 4 channels
- Current Input : 4 channels
- Digital Input : 8 channels
- Digital Output : 4 channels
- PMU Standard : IEEE c37.118(2005)
- PMU Data Frame Send : max 60Hz
- Communication : Ethernet
- Panel Type : Wall Mount / Compact Panel
- HMI : Touch LCD Screen(7 inches)
- Device Control : Remote / Local Key
- Arithmetic Element : V, I, angle, Power, PQ,
- Function : PMU, DFR, PQ, Island Detection
- Storage : 16GB Internal Memory
- OS : F/W, Windows 7 Embedded
- Power : 110Vdc, 220Vac, 30W SMPS
- GPS Timesync : Internal Time synchronization



Design Conceptual Structure of LAMS(I)



- *Continuous sending data packets per a PMU*

22bytes + (Analog 1ch x 4bytes) + (Digital 16ch x 2bytes)

Example)

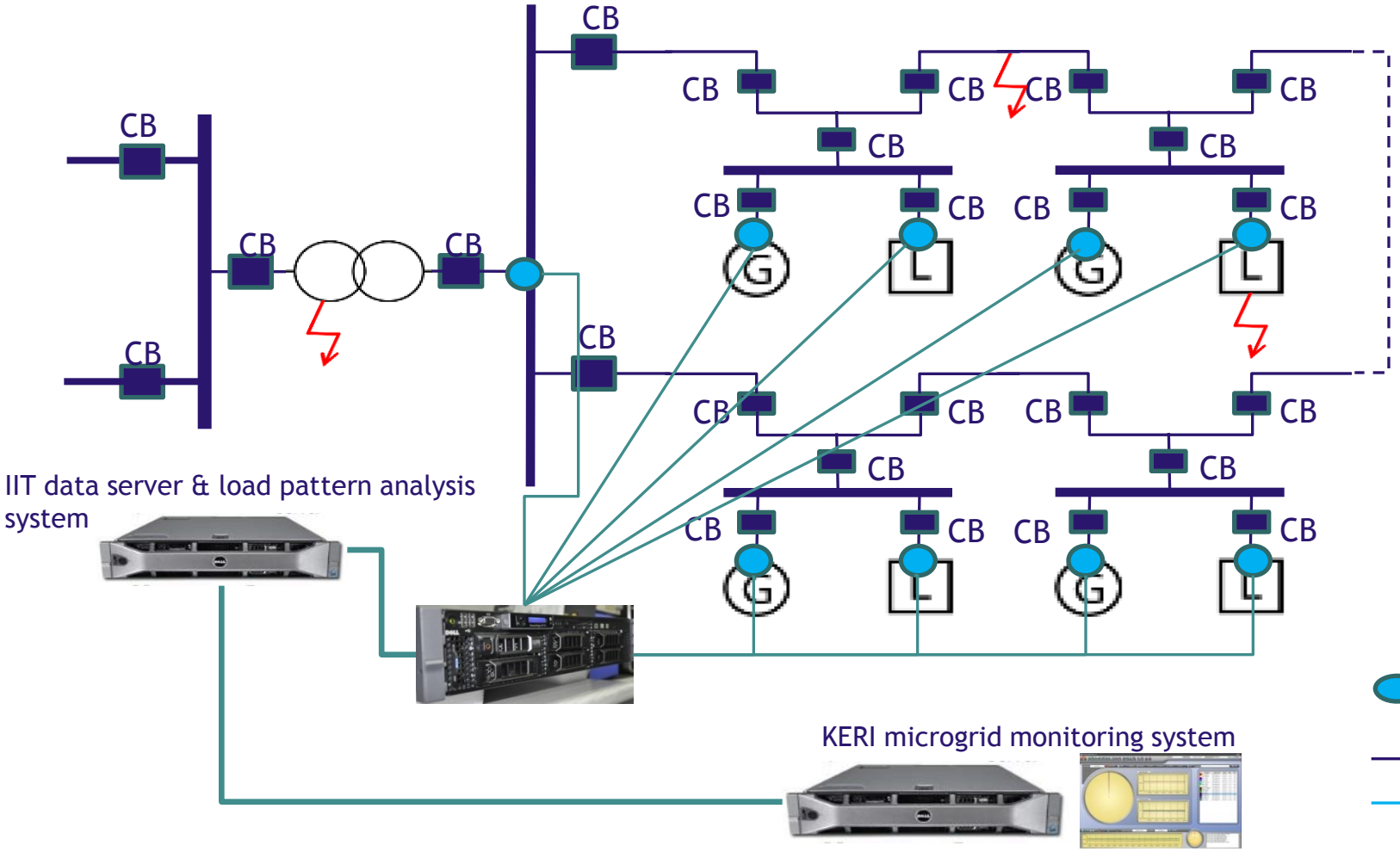
Analog PT 6 channels
Analog CT 12 channels
Digital (binary contact) 16 channels

22bytes + ((6+12)x4bytes) + (1x2bytes) = 96bytes/frame

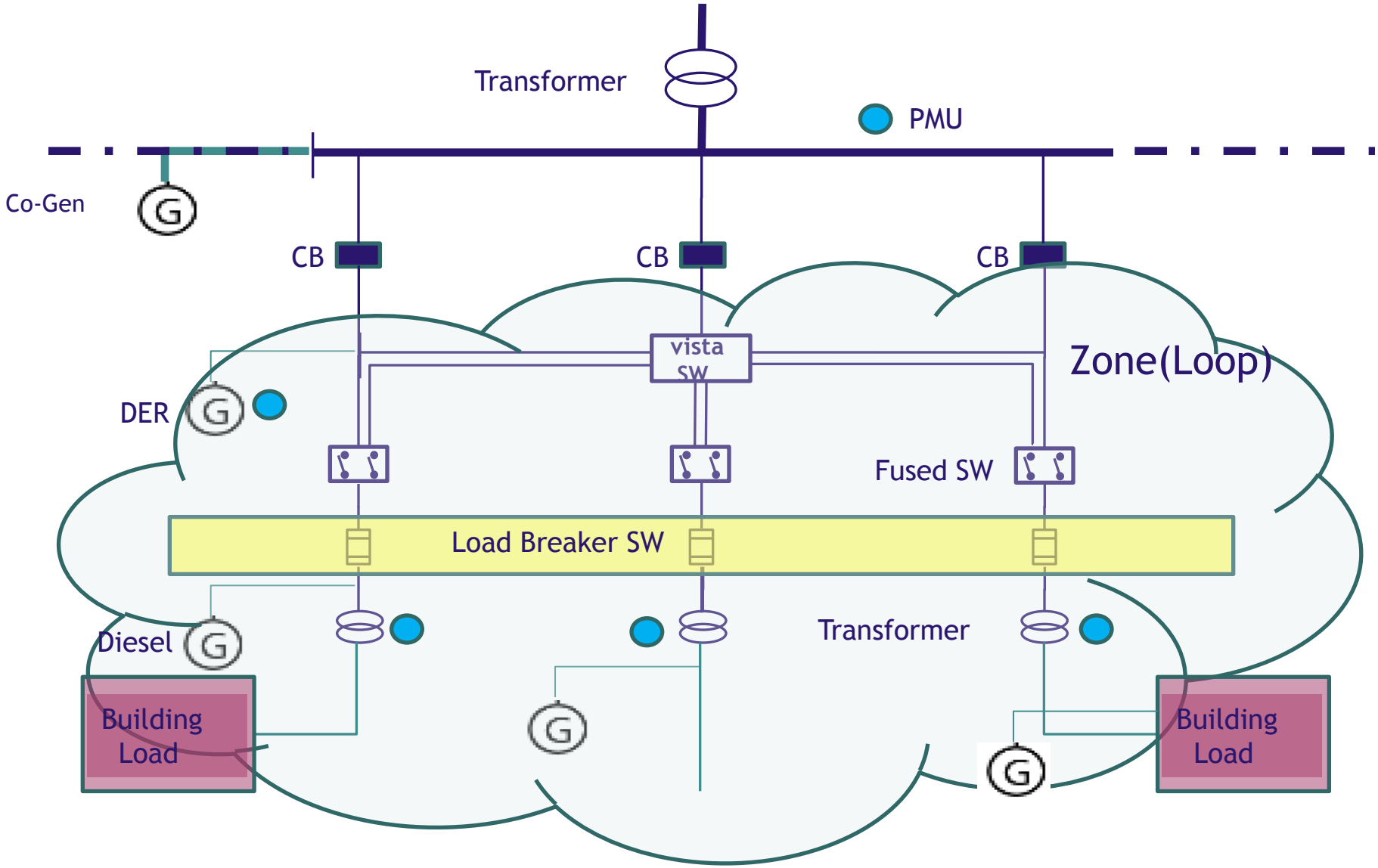
96bytes x 60frames = 5.76kbytes/sec per a PMU

http://www.kalkitech.com/

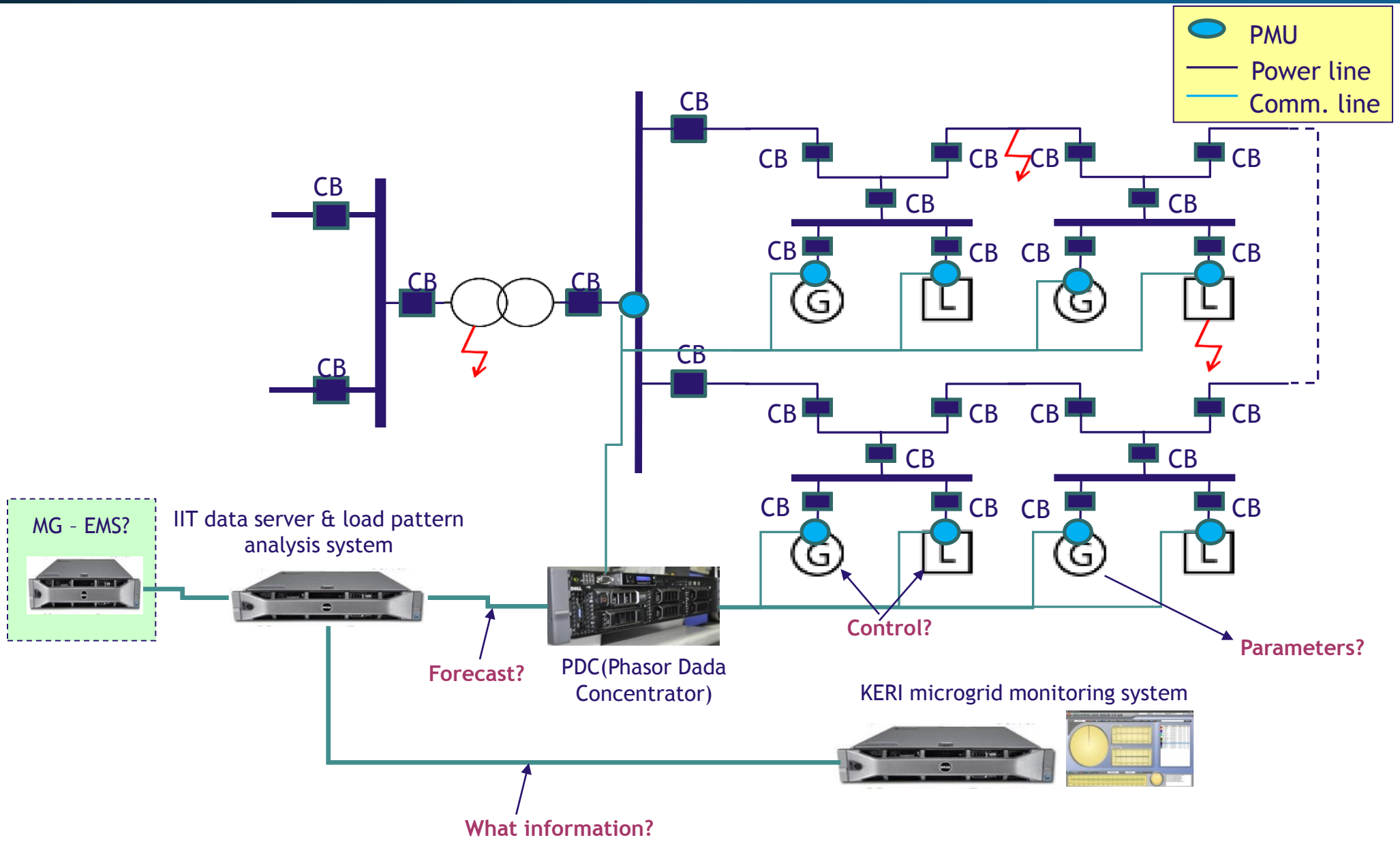
Design Conceptual Structure of LAMS(II)



Physical Structure of IIT Grid and LAMS(I)



IIT Microgrid system configuration



KERI work scope in IIT Microgrid

❑ Measuring points of PMU in IIT Microgrid

- ✓ Load : each building
- ✓ Substation output power
- ✓ DER : Co-gen, PV, WT, BESS, etc?
- ✓ Data communication between PMU & IIT Data server

❑ Simulation study for load pattern characteristics

- ✓ Scope : DER, distribution network
- ✓ Tools : PSCAD/EMTDC, Matlab/Simulink, RTDS

❑ Discussion

(1)Modeling & simulation

- ✓ Purpose of simulation study → level of accuracy, fault simulation, islanding etc
- ✓ Test/data acquisition for parameter extraction or data sheet?

  → Weather monitoring for radiation, wind speed etc..

(2)Functions of LAMS

- ✓ Data server only? Or Load forecast for generation scheduling?
- ✓ DER/Load control : Setpoints, start/stop, shedding?

Thank you!