



Data Explosion in Smart Grids

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Haidian District, Beijing China

- Smart Metering example
 - 15 minute reads
 - 10 measurements per meter
 - Energy, (3 bins)
 - Real power
 - Reactive power
 - Voltage
 - Frequency
 - Tamper
 - On-Off
 - Power factor

Population

- Assume 3 million
- 5 people per apartment
- 500 watt average load
- District load = 300 MW
- Six substations at 50 MW each

Summary

<i>Data Model</i>		
PopulationServed	3,000,000	Haidian
PeopleperApt	5	average
Apartments	600,000	residences
ApartmentperBuilding	300	average
ApartmentBuildings	2,000	estimate
Residential-Load	500	watts
ApartmentBuildingLoad	150	kW
DistrictLoad	300	MegaWatts
SubstationCapacity	50	MegaWatts
NumberofSubstations	6	
ReadInterval	15	minutes
NumberTagsperMeter	10	
NumDataConcentratorsperSub	333	Apartments per Substation
DataConcRateApt	3.33	each Apt Data Concentrator
RateToSubstation	1,110	per second
RateToDistrict	6,660	per second
DistrictTags	6,000,000	
BytesperEvent	10	
Bytes per Day	5,754,240,000	~5.7Gbytes
Bytes per Year	2,100,297,600,000	~2.1 Terabytes

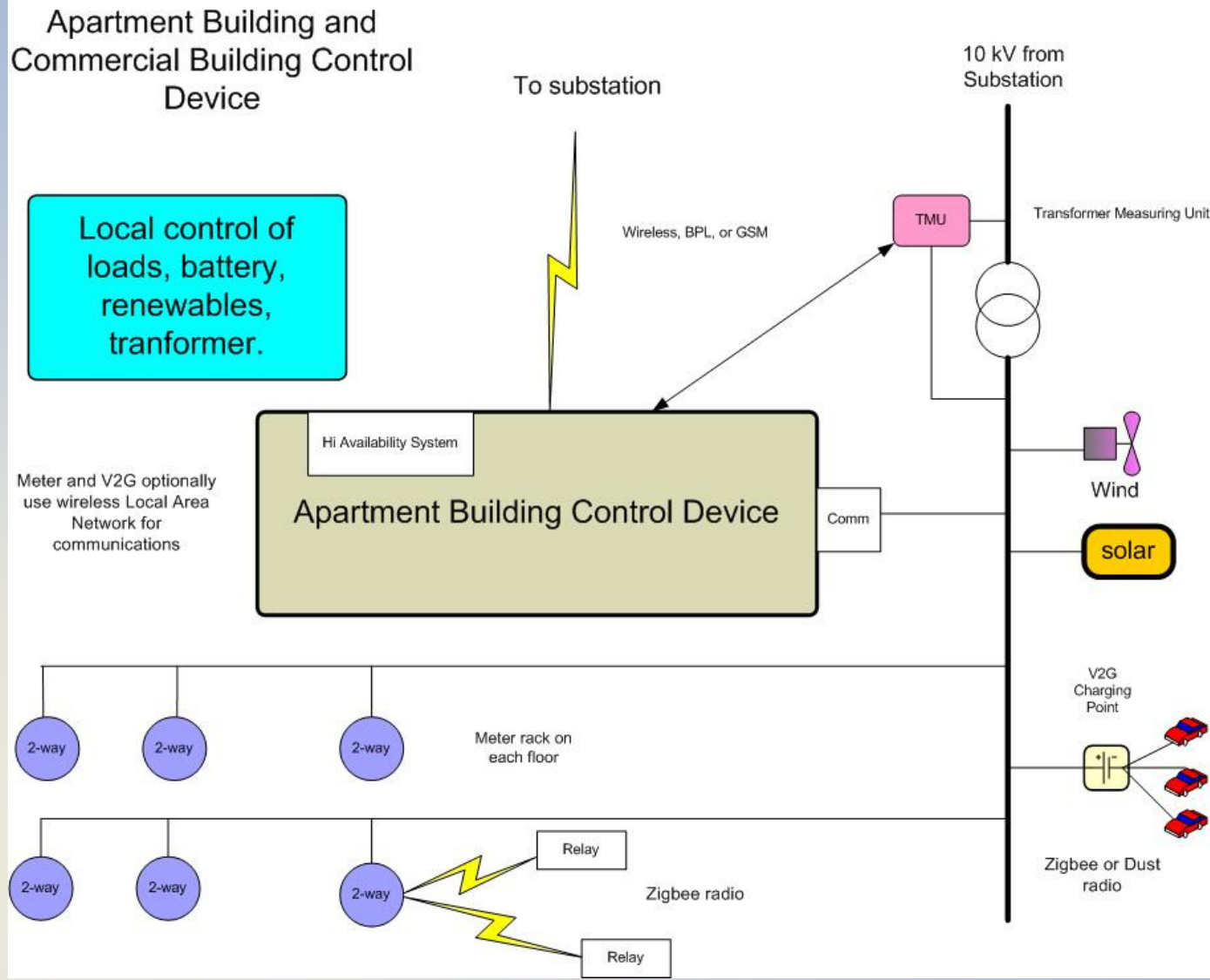
Controls

- Each substation will have multiple PMUs
- Assume four feeders
- Each PMU has 50 measurements

Conclusion

- Raw data should flow from source to substation
- Consumers of data should request the data they need for their application at the rate they need it.
- Backup should be via MS BITS
- Substation should supervise Microgrids
- Substation gets 6.7 Gbytes per day of data

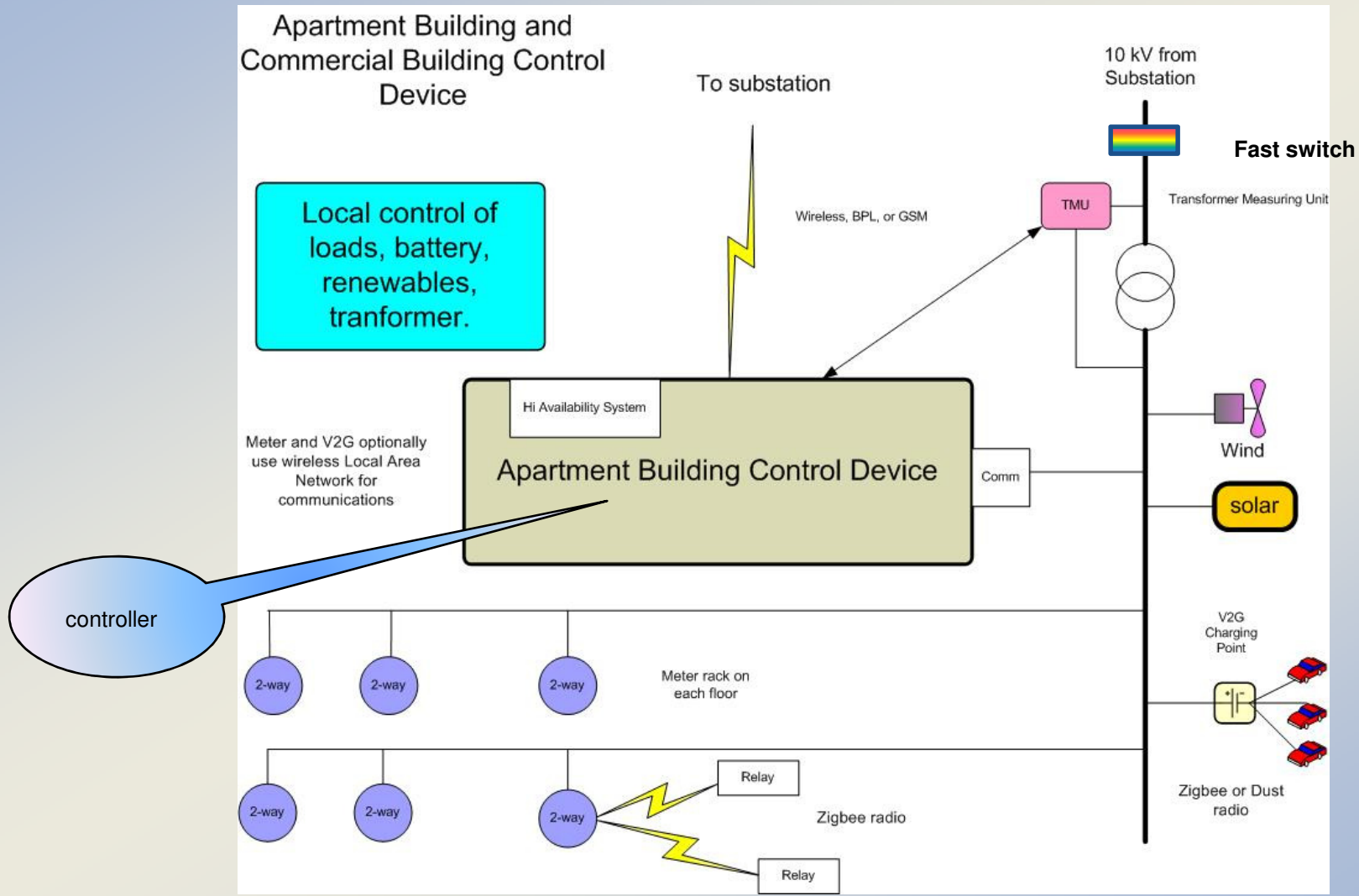
Apartment



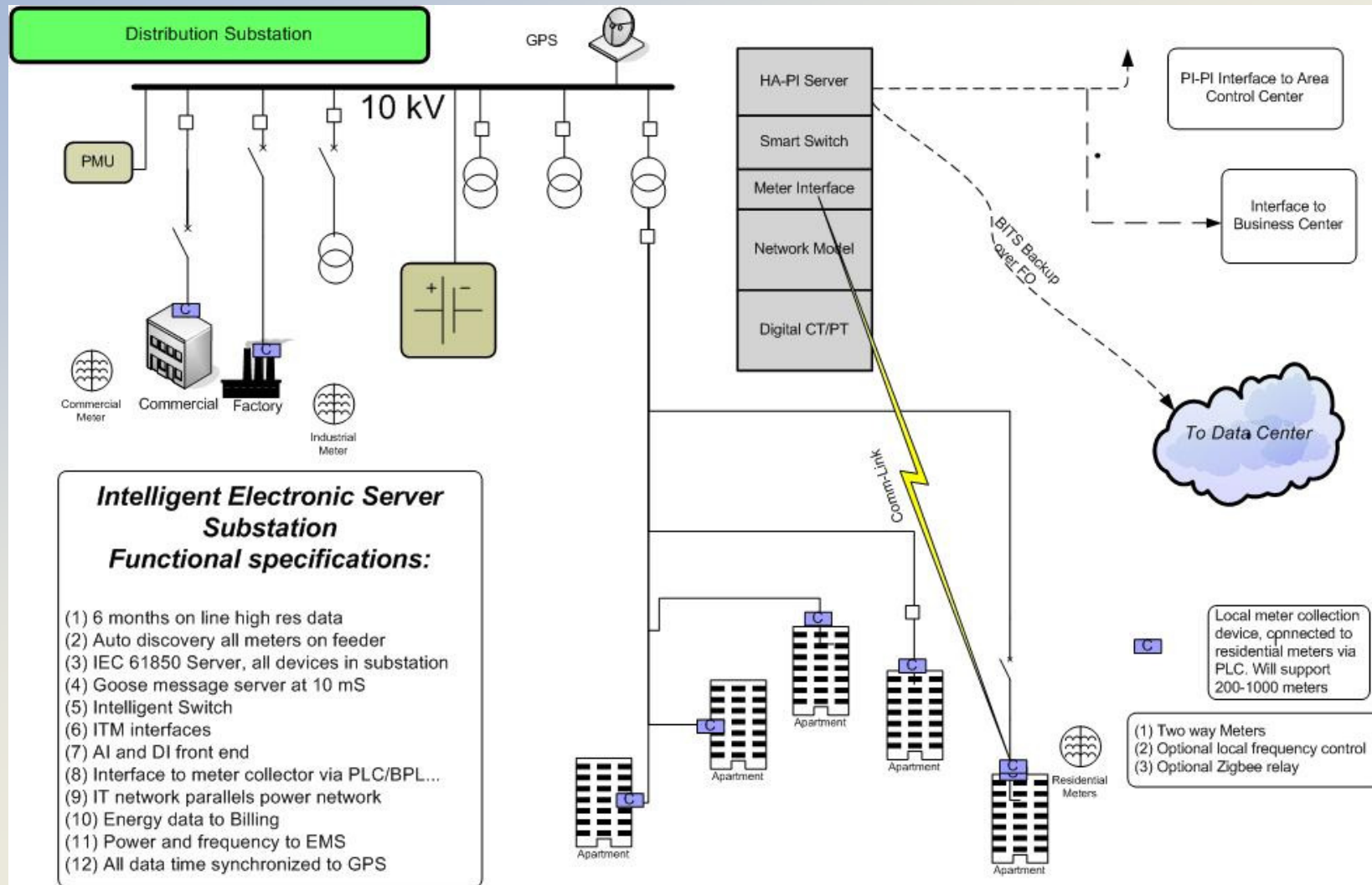
Apartment MicroGrid

- Fast switch
- Local frequency control
- Local voltage control
- Local DER
 - Microturbine
 - With waste heat utilization (absorbtion chillers)
 - V2G
 - Rooftop Solar PV
 - Rooftop Solar Thermal
 - Rooftop Wind turbines

Apartment/Building Microgrid Controller

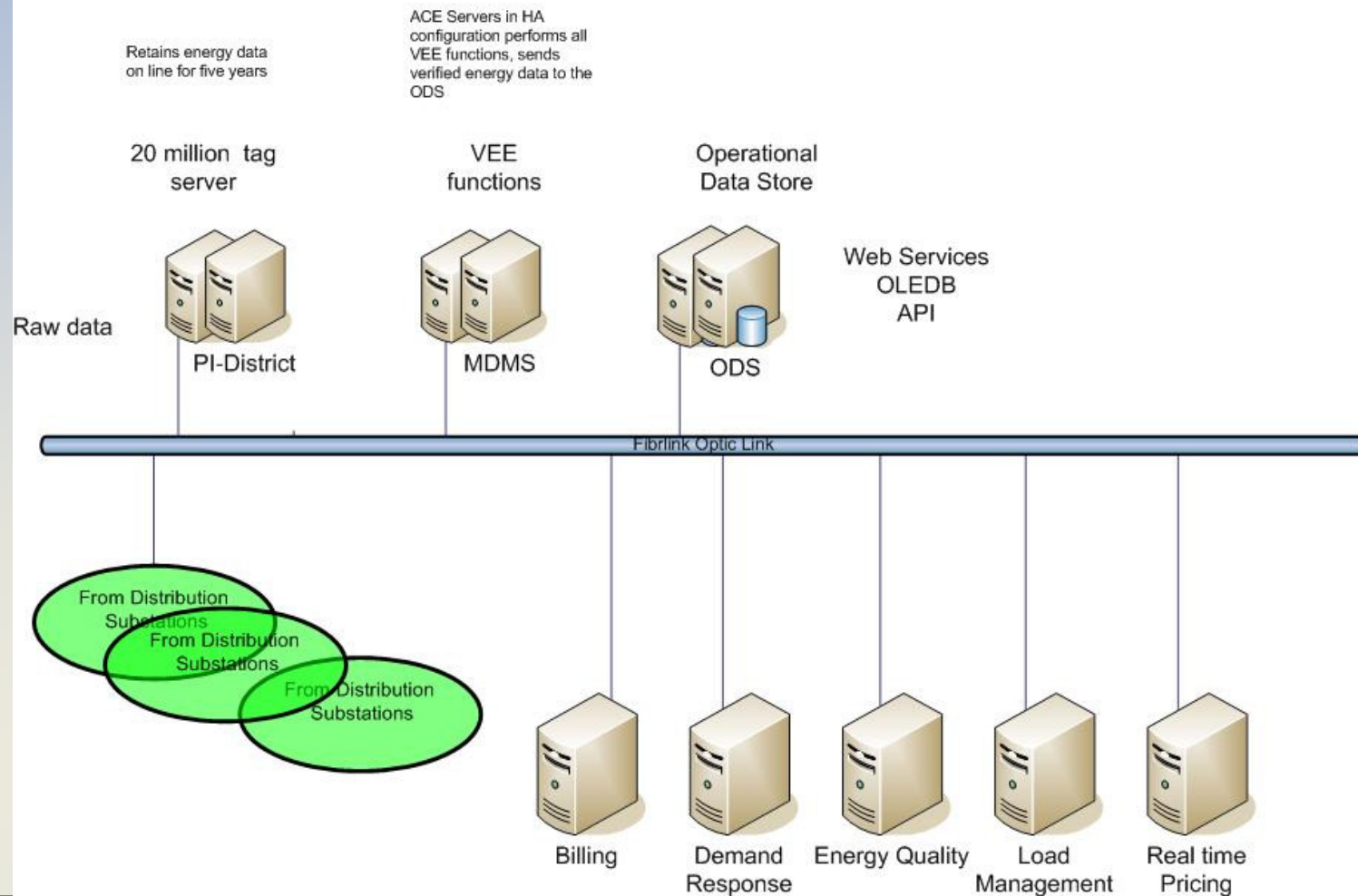


Substation

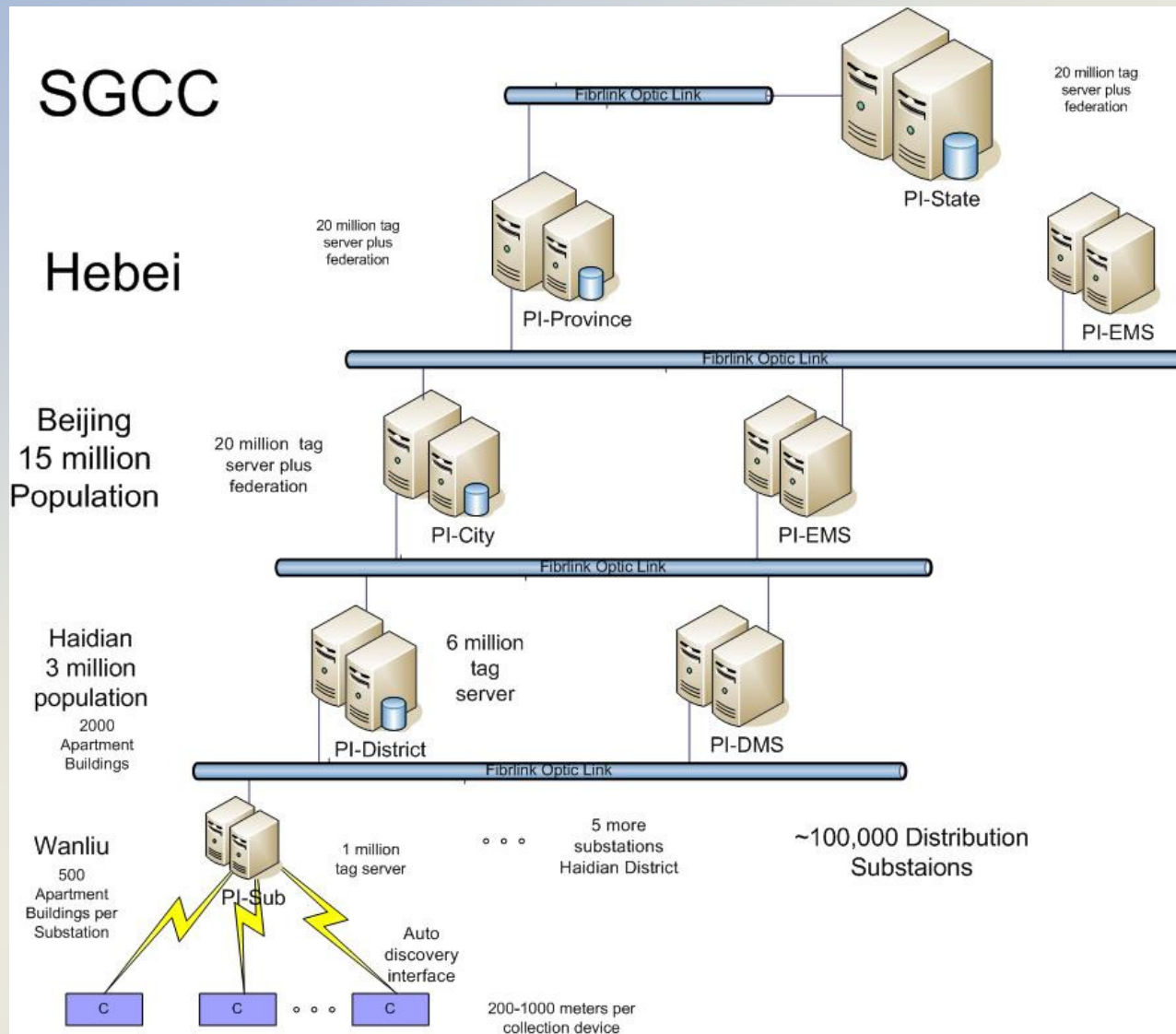


District

District AMI Data Center



State Grid



Thank you