

# Powernet :Tech. for 'smart' grid

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## Project Final Presentation

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INI Project Practicum, Fall 2015

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# Sponsors

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## “Bits And Watts” Group @ Stanford SLAC center

Defining next generation “smart” electric grid system.



NATIONAL  
ACCELERATOR  
LABORATORY

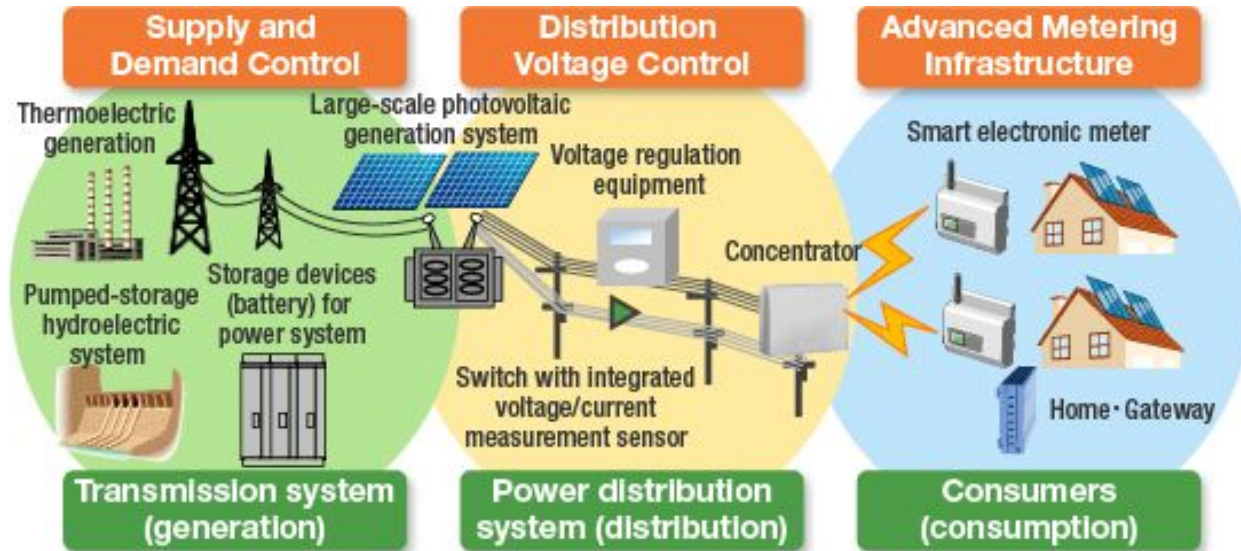


U.S. DEPARTMENT OF  
**ENERGY**

Office of Science

# Motivation : The Future

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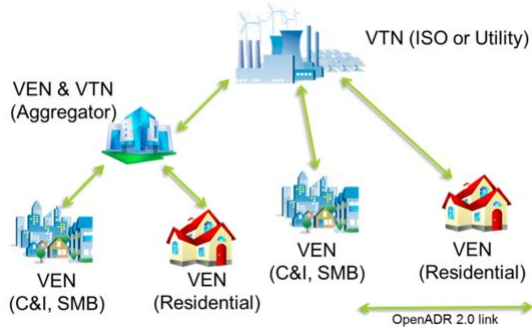


# Motivation : “Smart Grid”

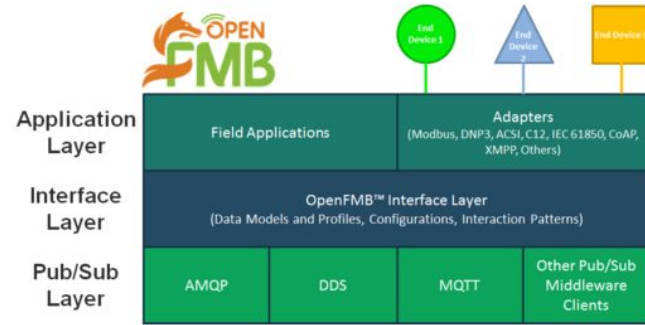
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#	Primary Motivation
1	Supply Side : Extensive use of renewable energy - Solar PV and Wind
2	Demand Side: Variable Load – Electric cars
3	Reduction in cost of Storage batteries
4	Emergence of Decarbonization policy
5	Increase in natural calamity

# Related Work



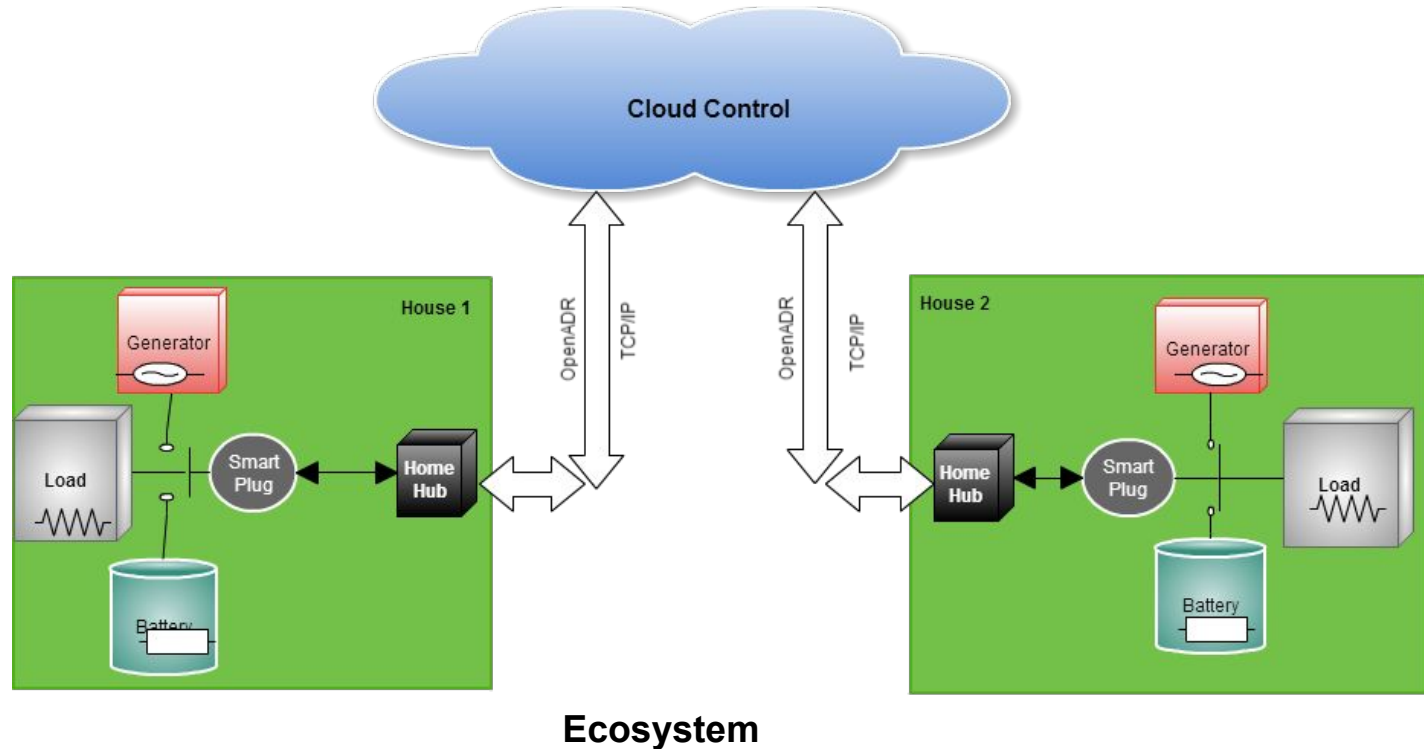
OpenADR<sup>2</sup>



SGIP<sup>3</sup>

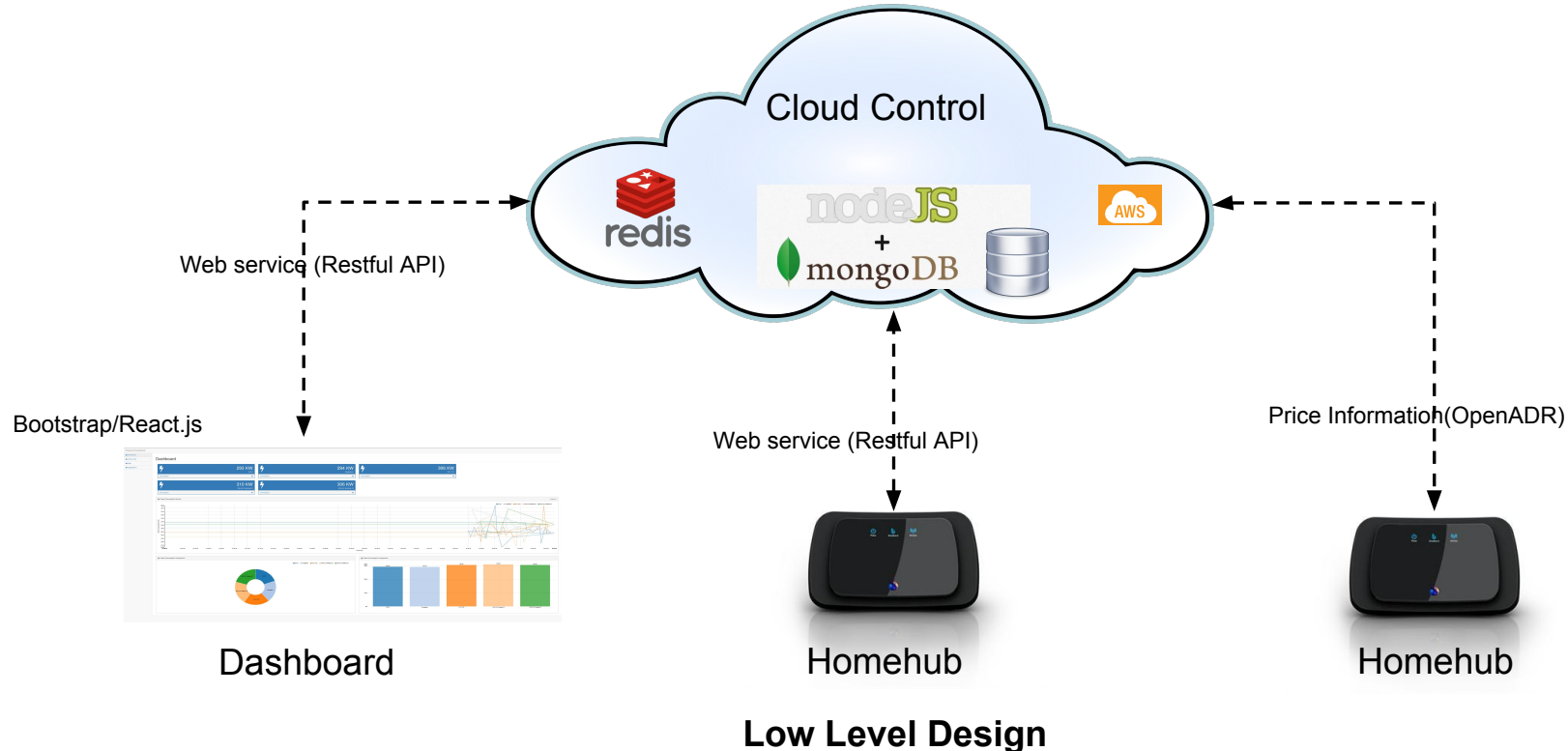
# System Design - High Level

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# System Design – Low Level

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# System Implementation

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## ❑ Persistent layer - MongoDB

- ❑ homehubs - Configuration for each homehub

```
> db.homehubs.find()
{ "_id" : ObjectId("56635b22c1f1e8080e1f394e"), "callback_url" : "www_homehub1_com/callback_url", "state" : { "device_3" : { "status" : "on", "type" : "Generator", "name" : "Generator23", "power" : 22 }, "device_2" : { "status" : "on", "type" : "Consumer", "name" : "Light23", "power" : 100 }, "device_1" : { "status" : "on", "type" : "Consumer", "name" : "Fan23", "power" : 1 } }, "total_power" : 296, "location" : "CMU-SV", "label" : "CMU-SV Building 23", "uuid" : "56635b22c1f1e8080e1f394e", "timestamp" : 1449361413245 }
```

- ❑ hhstatus - Status history for homehub

```
> db.hhstatus.find()
{ "_id" : ObjectId("56635b22c1f1e8080e1f3951"), "total_power" : 299, "uuid" : "56635b22c1f1e8080e1f394f", "timestamp" : 1449351970060 }
{ "_id" : ObjectId("56635b24c1f1e8080e1f3952"), "total_power" : 278, "uuid" : "56635b22c1f1e8080e1f3950", "timestamp" : 1449351972077 }
{ "_id" : ObjectId("56635b26c1f1e8080e1f3953"), "total_power" : 293, "uuid" : "56635b22c1f1e8080e1f3950", "timestamp" : 1449351974082 }
{ "_id" : ObjectId("56635b28c1f1e8080e1f3954"), "total_power" : 373, "uuid" : "56635b22c1f1e8080e1f394f", "timestamp" : 1449351976091 }
```



# System Implementation

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#	REST APIs	Method	Usage
1	/api/homehubs/	POST	OpenBMS
2	/api/homehubs/<uuid>/	PATCH	OpenBMS
3	/api/price/	POST	OpenADR
4	/api/homehubs/aggregation/<timestamp>	GET	Dashboard
5	/api/homehubs/	GET	Dashboard

# System Implementation

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- ❑ View Layer
  - ❑ Reactjs -- view engine
    - ❑ Bootstrap
    - ❑ React-NVD3
    - ❑ Leafletjs

# Project : Setup

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- ❑ Setup : *node.js*
    - ❑ Install required package using “*npm install*”
  - ❑ Deploy : *MongoDB*
    - ❑ Start daemon for MongoDB “*mongod*”
  - ❑ Start : server using *gulp* script provided.
    - ❑ “*gulp run*”
    - ❑ customize script to switch from development to deployment.
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# Experiment & Analysis

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## WebApp framework choice:

- ❑ express (node.js)

- ❑ Pros :

- ❑ designed for coordination with mongoDB
    - ❑ powered with react for efficient frontend rendering and re-rendering. ( Critical to a real time web app like Dashboard)

- ❑ Cons:

- ❑ learning curve for node.js, javascript and react.
    - ❑ hard to debug

- ❑ django (python)

- ❑ Pros

- ❑ mature framework
    - ❑ easy to use

- ❑ Cons

- ❑ not designed for coordination with MongoDB

# Experiment & Analysis

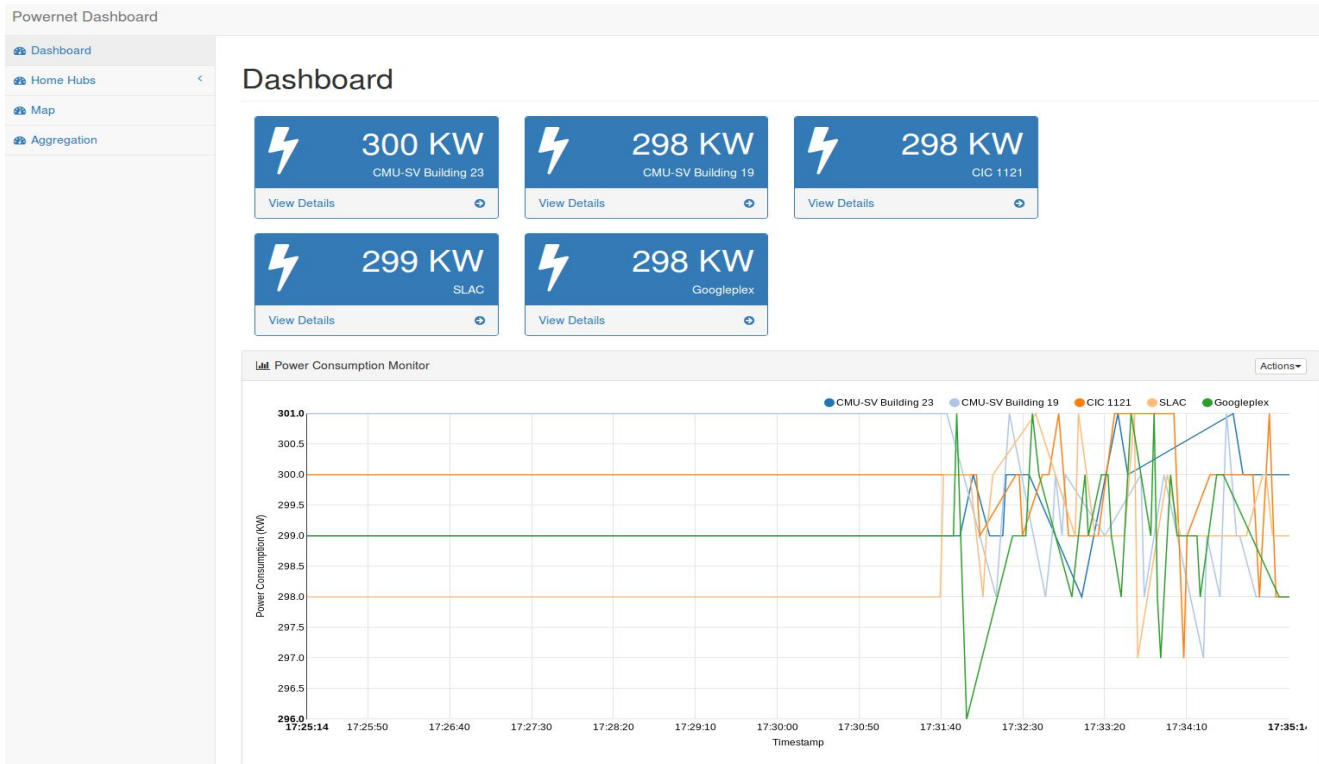
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## Database choice:

- ❑ MongoDB
  - ❑ Pros :
    - ❑ Scalability
    - ❑ Json based (Simple)
    - ❑ Widely used nosql solution
    - ❑ Fit the data
    - ❑ Allows atomicity of single writes and transactions to be added
  - ❑ Cons:
    - ❑ No support for bulk transactions

- ❑ Relational DBS
  - ❑ Pros
    - ❑ Good support for transaction
  - ❑ Cons:
    - ❑ Not scalable

# Demo



# Known Issues, Bugs, Problems

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- ❑ SSL communication is not supported yet
  - ❑ No integration test with OpenBMS
  - ❑ No integration of OpenADR
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# Next Step

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#	Activity	Motivation
1	Integrate with OpenBMS	Integration
2	Integrate with OpenADR	Integration
3	Add SSL Communication	Security
4	Add Redis Cache Layer	Performance

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# References

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# Questions?

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