



## 2017 ADMS Program Steering Committee Meeting

# Development of an Open-Source Platform for Advanced Distribution System Management – GridAPPS-D™

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October 12, 2017

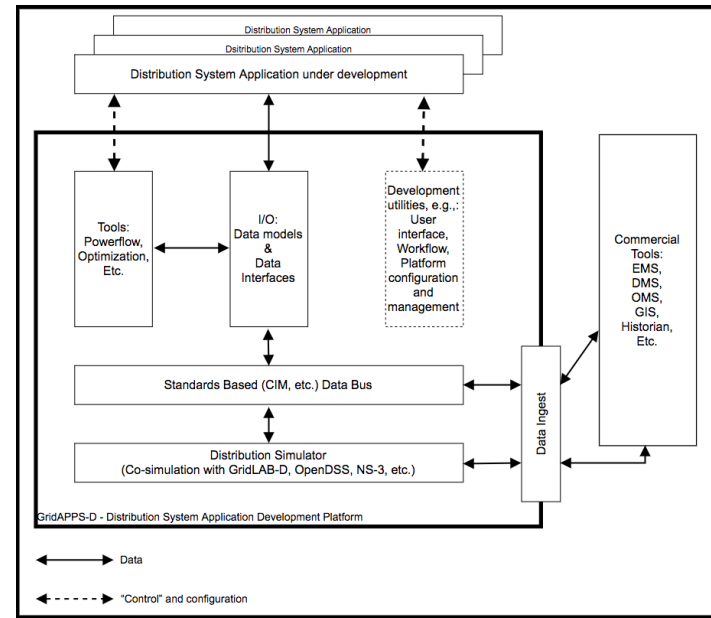
# GridAPPS-D

## Objectives & Outcomes

Provide an open source, standards based platform for developing advanced distribution system planning and operations applications

Evaluate the benefits of advanced applications that take advantage of a data rich, data driven environment

Transition the capability to industry



## Technical Scope

Applying agile software development process to creation of V1.0 of GridAPPS-D

Establishing a formal application evaluation methodology

Deployment of platform to multiple project team organizations for their development of example advanced applications

Formal evaluation of the example applications

## Life-cycle Funding Summary (\$K)

Year 1, authorized	Year 2, authorized	Year 3, requested	Out-year(s)
\$3.7M	\$3.3M	\$3.8M	TBD
\$0.7M	\$0.6M	\$0.7M	TBD

Line 1 – PNNL

Line 2 – NREL



# **PROJECT CONTENT**

# Industry Need & Project Response

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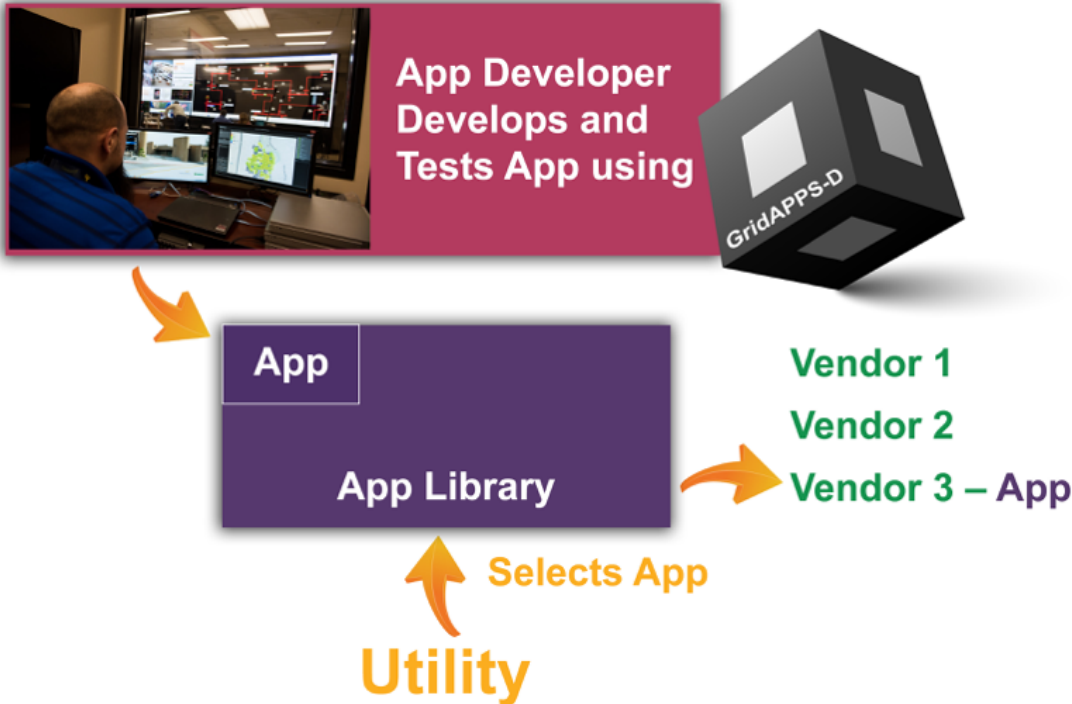
## Three barriers:

- Cost and complexity of integration of multiple systems
- Quantitative evaluate of benefits of advanced distribution system applications
- Availability of solutions to utilities of all sizes

## Project response:

- Open source, standards based, platform for application development (GridAPPS-D™)
- Formal evaluation of advanced applications
- Transition of results to industry sustained maintenance and enhancement of the platform

# Expected Benefits



Enabling utilities to choose applications meeting their specific needs should improve their reliability and resilience in an affordable and sustainable manner

**Develop Once - Deploy on Multiple Vendor Systems**

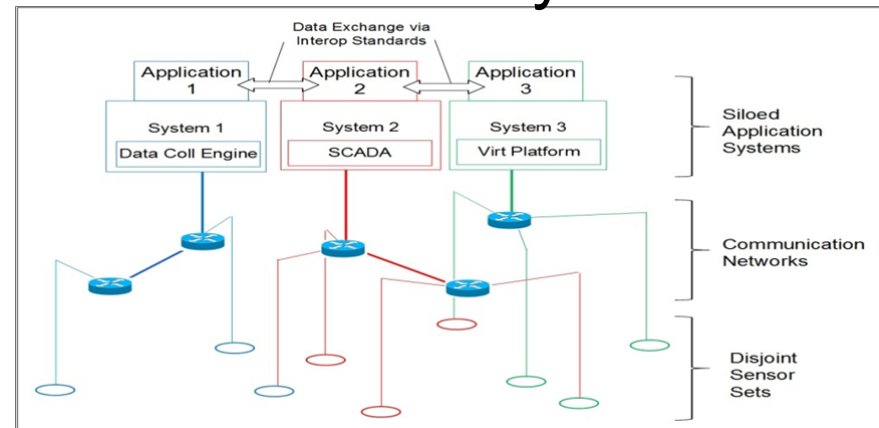
- ▶ Utility choice of apps
- ▶ Vendor expanded functionalities, via variety of apps
- ▶ App developed - access to customer

**Innovation - Enabled!**

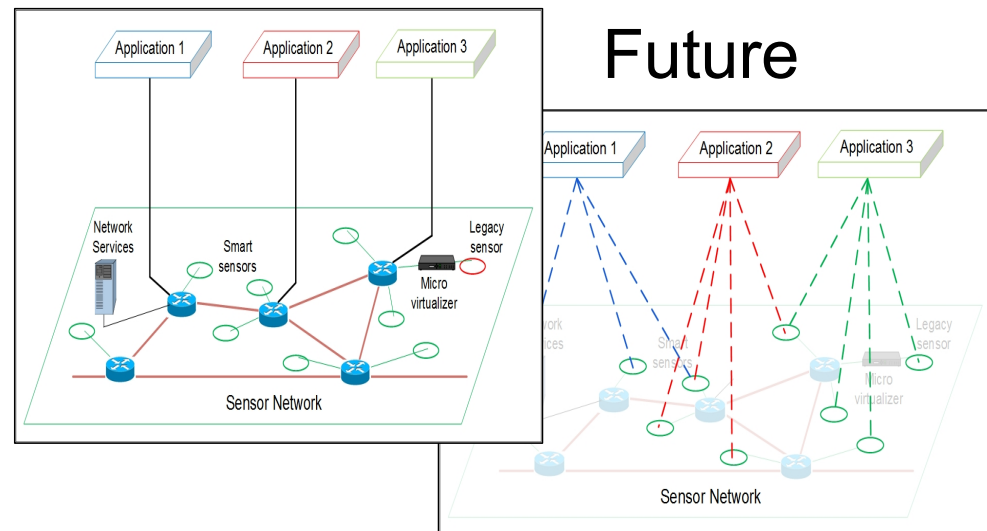
# GridAPPS-D™ – enabling distribution utility flexibility in future planning and operations

- In the future distribution utilities will have to operate a data rich, distributed system with
  - Diverse resource mix including customer and 3<sup>rd</sup> party owned DER
  - Increasing number of “smart” devices and systems
  - New market interactions
  - Automated operation
- While maintaining situational awareness, reliability and resiliency
- GridAPPS-D enables cost-effective development and integration of applications for these future needs

## Today



## Future

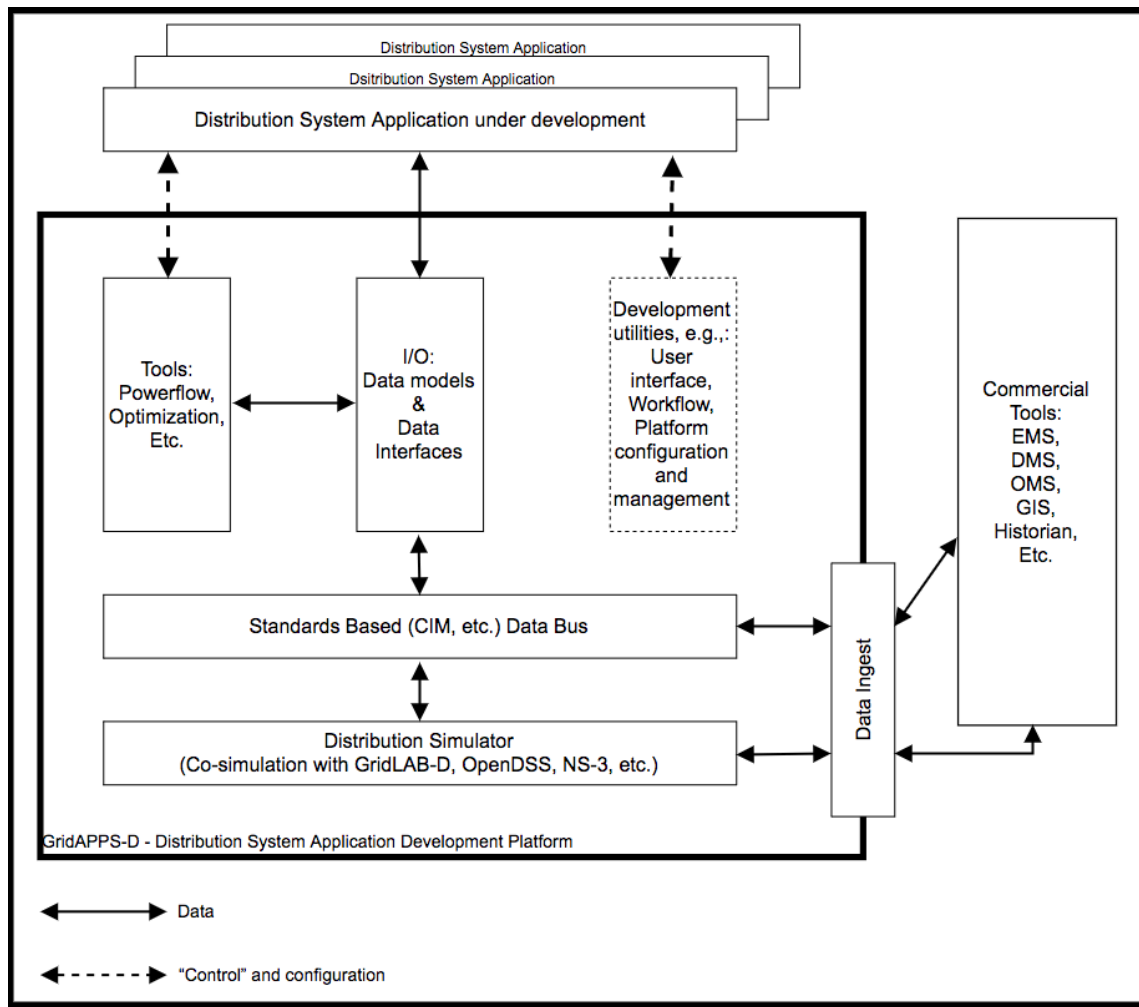


# Expected Outcomes

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- Enables standards-based development of advanced applications that can be deployed on any vendor's compliant system, reducing cost to develop, integrate and maintain future systems while increasing utility options.
- Data-rich, data-driven applications will improve distribution system reliability with increasing penetration of distributed energy resources.
- Provides a common platform for distribution system planning and operations research and development within the DOE labs and industry.

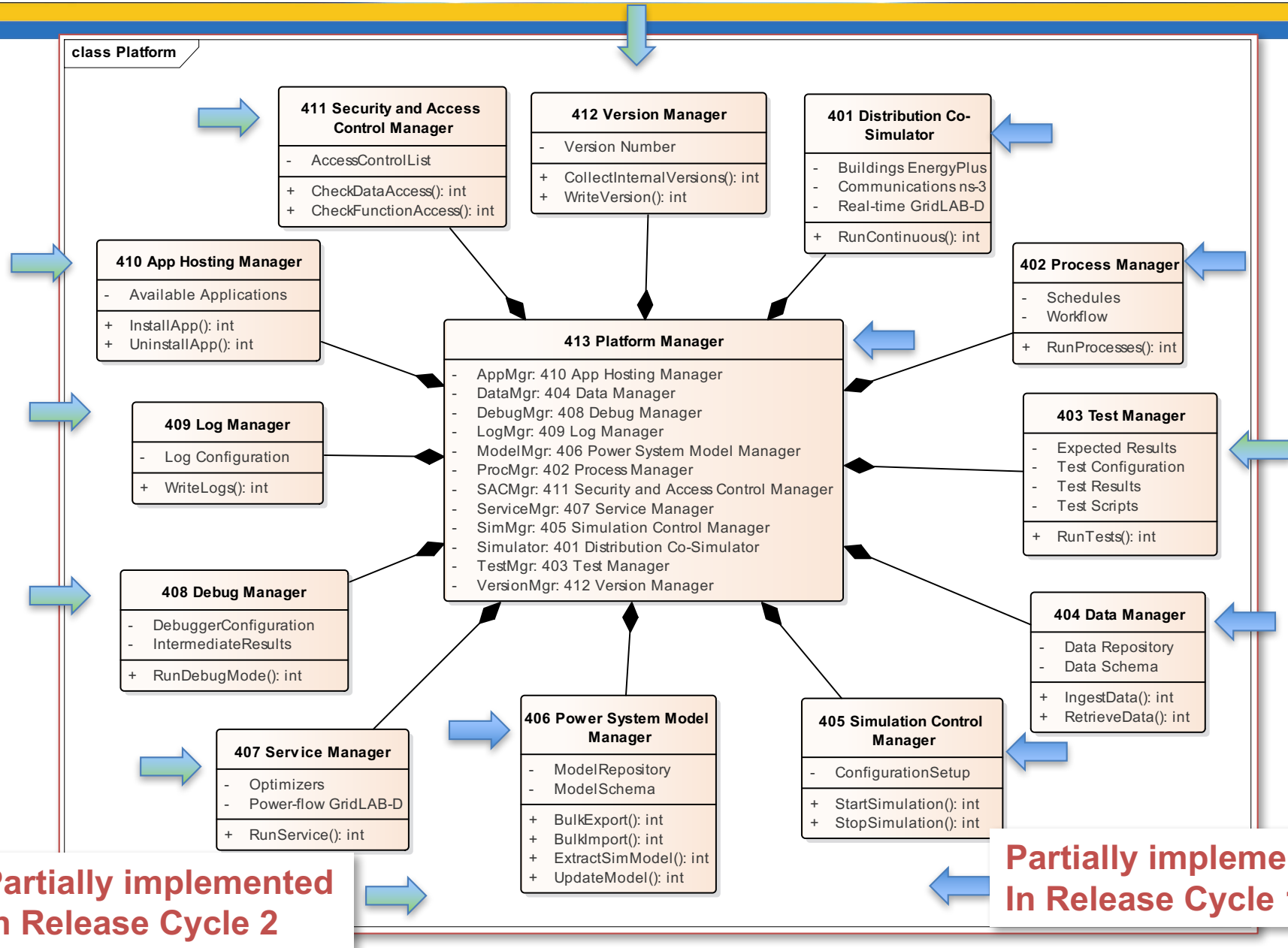
# GridAPPS-D™ conceptual architecture



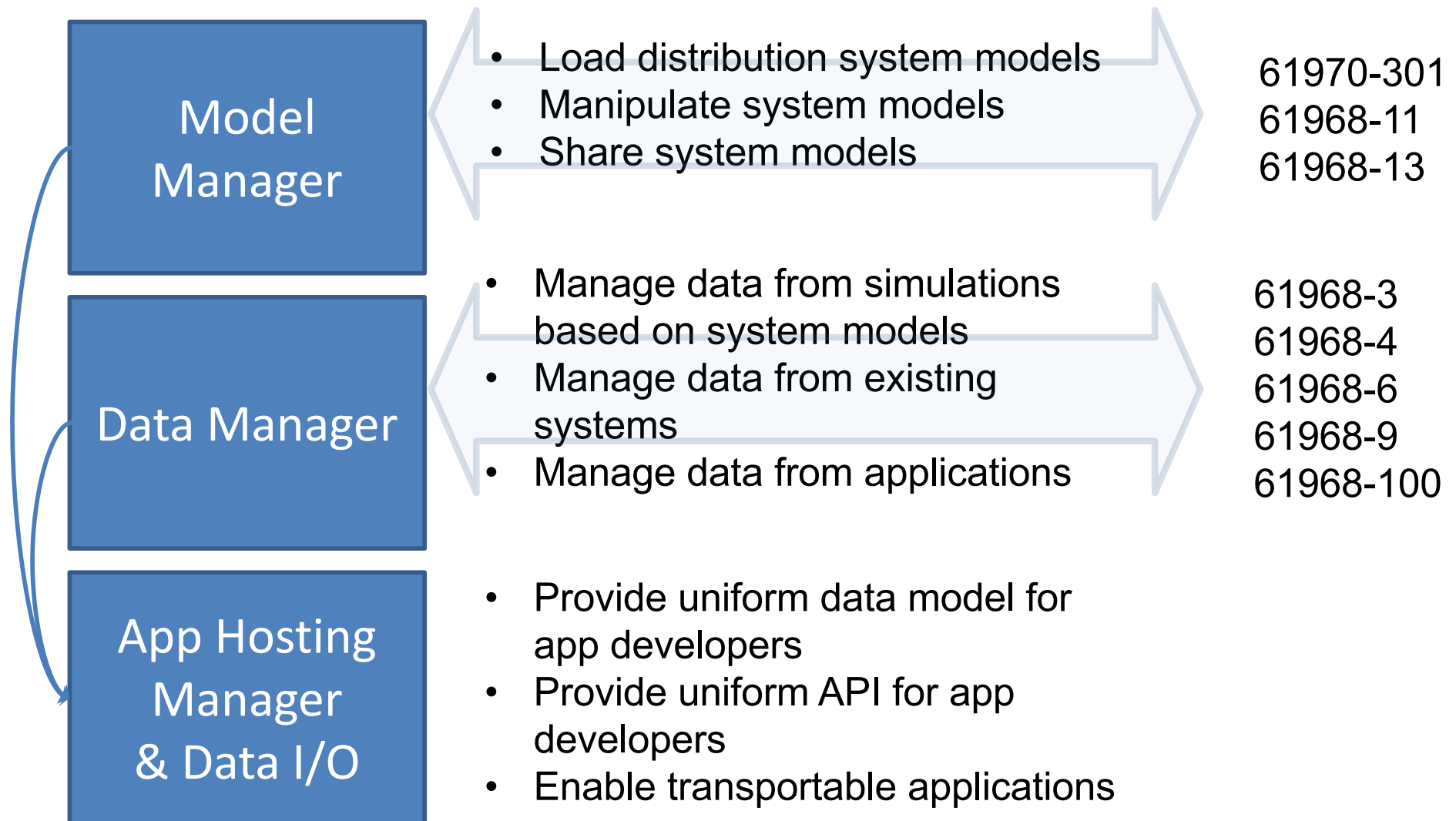
- Reference implementation
- Open architecture
- Open source
- Standards based
- Well defined logical data abstractions
- Extensible and adaptable for distributed applications and distributed data sources
- Interoperable with existing systems



# Functional Elements of GridAPPS-D™



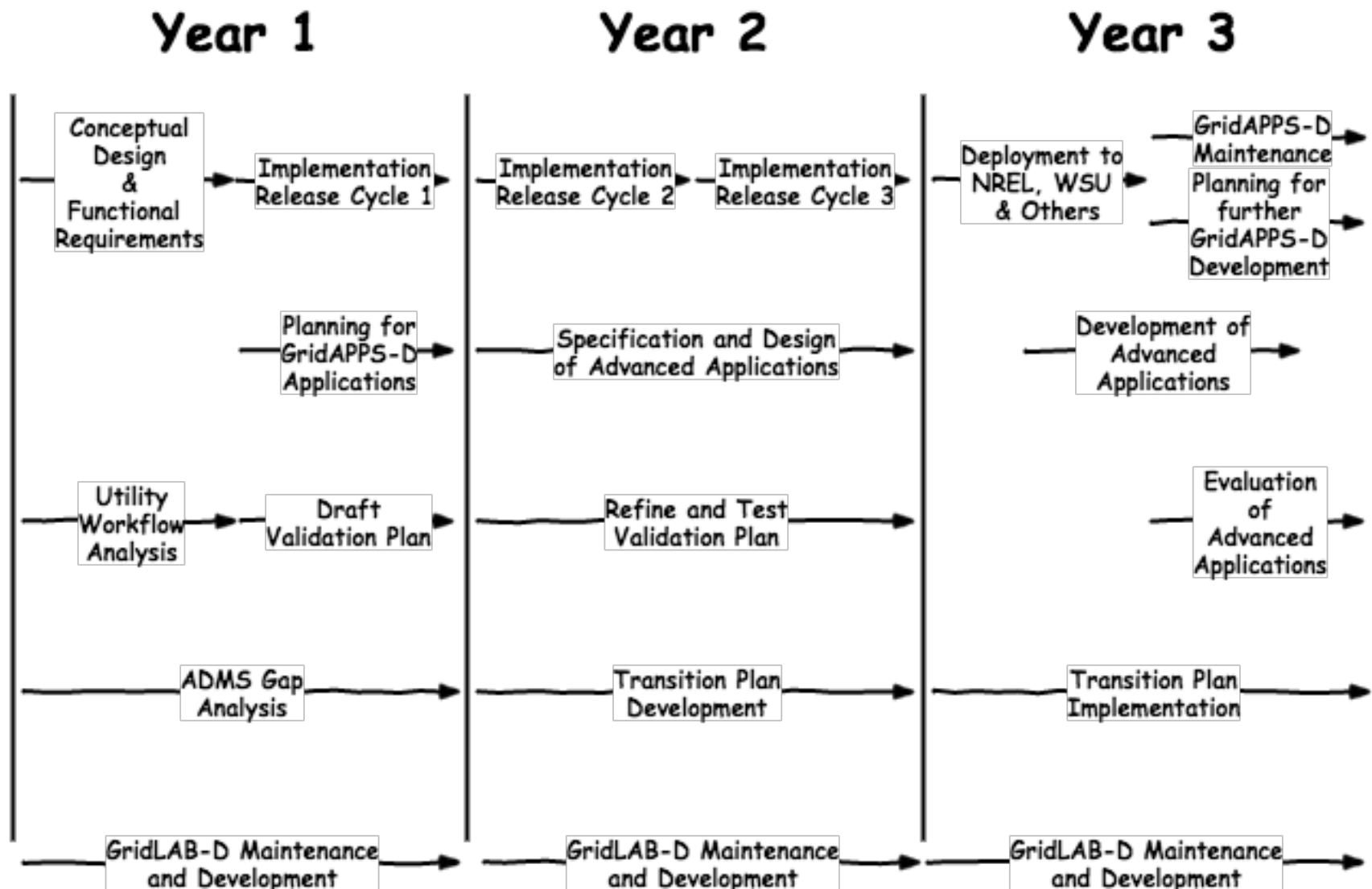
# GridAPPS-D™ & The CIM





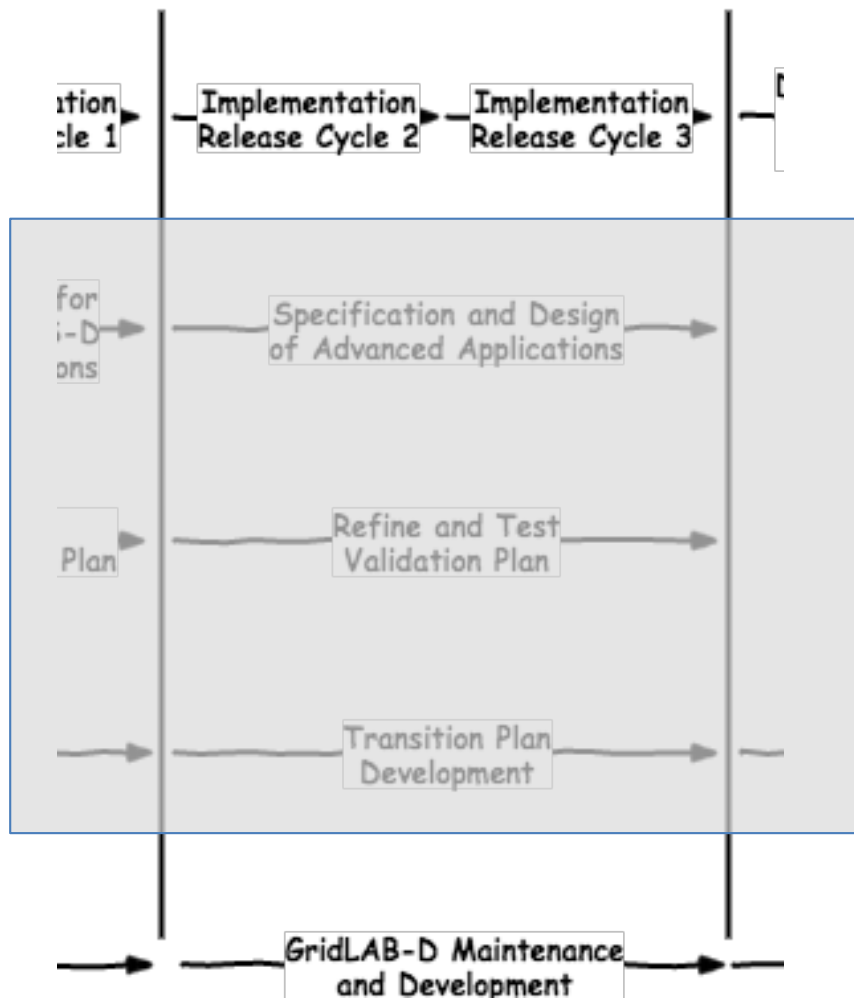
# **PROJECT STATUS**

# Overall Time Line and Key Tasks



# GridAPPS-D Development

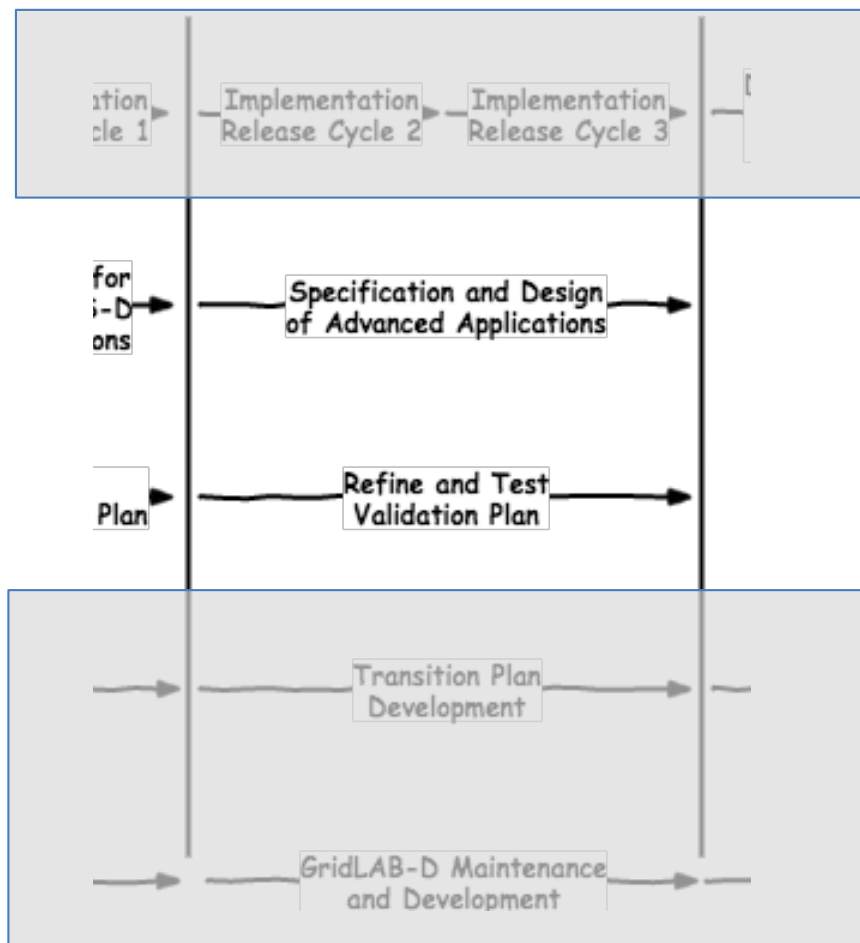
## Year 2



- Release cycle 1 completed in May
- Release cycle 2
  - add remainder of functional elements
  - Transition from SQL to triple-store data management
- Release cycle 2 completes mid- October
- Release Cycle 3 – V1.0 – all functional elements – May 2018
- GridLab-D release completed in April 2018

# Advanced Applications

## Year 2



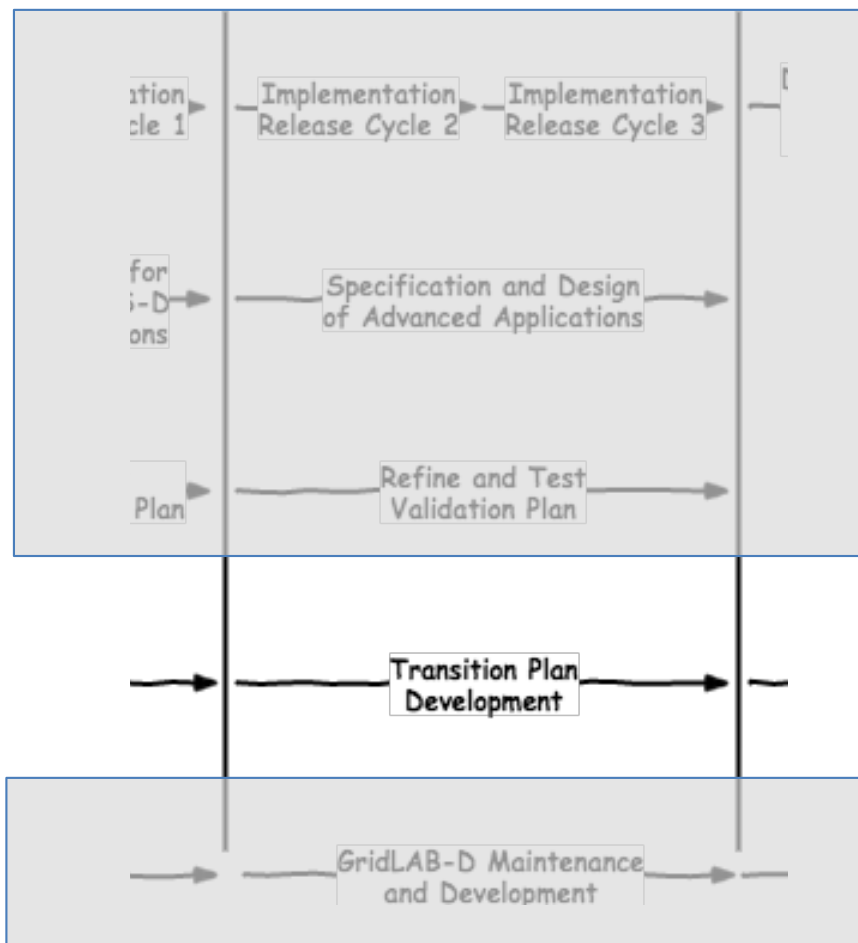
- Data rich, data driven, advanced architectures
- Application developer workshops
- Evaluation methodology – formally defined
- Utility application “hosts”
- Currently working on application specifications
- Beta version of apps – January 2018
- V2.0 of evaluation methodology – April 2018

# Applications and Utility Hosts

App	App Org	"Host" Utility	Type	Contact	Status
Transactive	PNNL	SCE	IOU	Robert Sherick	Accepted
Volt-VAR Optimization	PNNL	Duke Energy	IOU	Leslie Ponder	Accepted
Fault tolerant microgrid control	UAF	Austin Energy	Muni	Dan Smith	Accepted
Distribution OPF	NREL	Avista Utiltites	IOU	John Gibson	Accepted
SE and Model Validation	PNNL	Avista Utiltites	IOU	John Gibson	Accepted
Volt-VAR Optimization	WSU	SDG&E	IOU	Thomas Bialek	Responded in positive
Data driven forecasting	NREL	City of Palo Alto	Muni	Kennth Boyd	Accepted
Traffic flow analysis	WSU	Central Hudson	IOU	Erica Tyler	Accepted
SE and Model Validation	PNNL	Entergy	IOU	Raiford Smith	No response yet
Traffic flow analysis	WSU	SnoPUD	Muni	Mark Oens	No response yet
Data driven forecasting	NREL	CPS Energy	Muni	Shaneshia McNair	Need to contact
Traffic flow analysis	WSU	TBD			
Fault tolerant microgrid control	UAF	TBD			
Volt-VAR Optimization	PNNL	TBD			

# Transition Planning

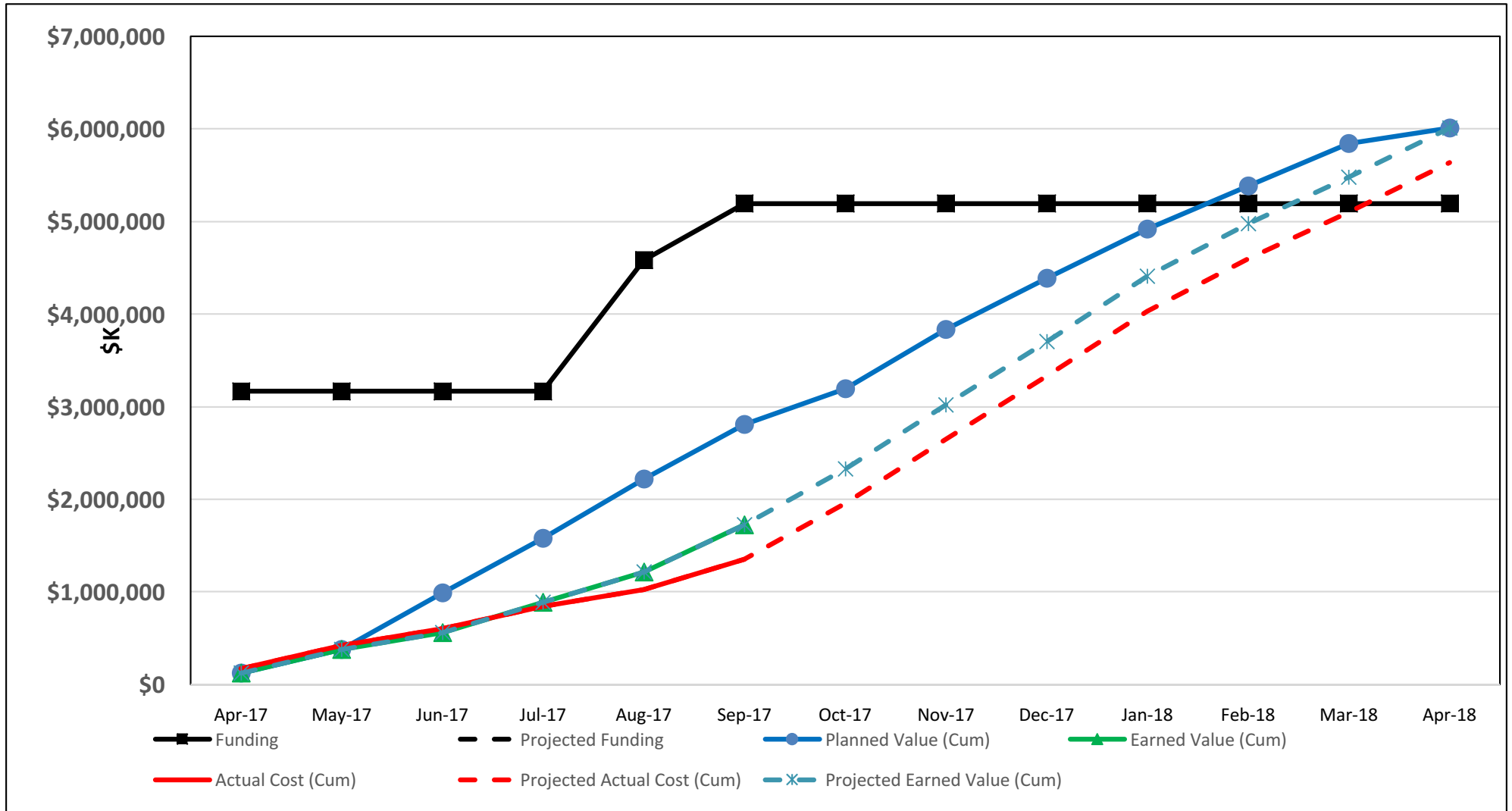
## Year 2



- Beginning discussion on transition of GridAPPS-D from DOE research project to industry supported reference implementation
- Two threads:
  - GridAPPS-D code base and documentation
  - Utility application “hosts”
- Discussing with interested utilities, EPRI, NRECA, venture capitalists
- Next step – meeting / Workshop with interested parties
- Transition plan draft for review – February 2018



# Overall Project Budget



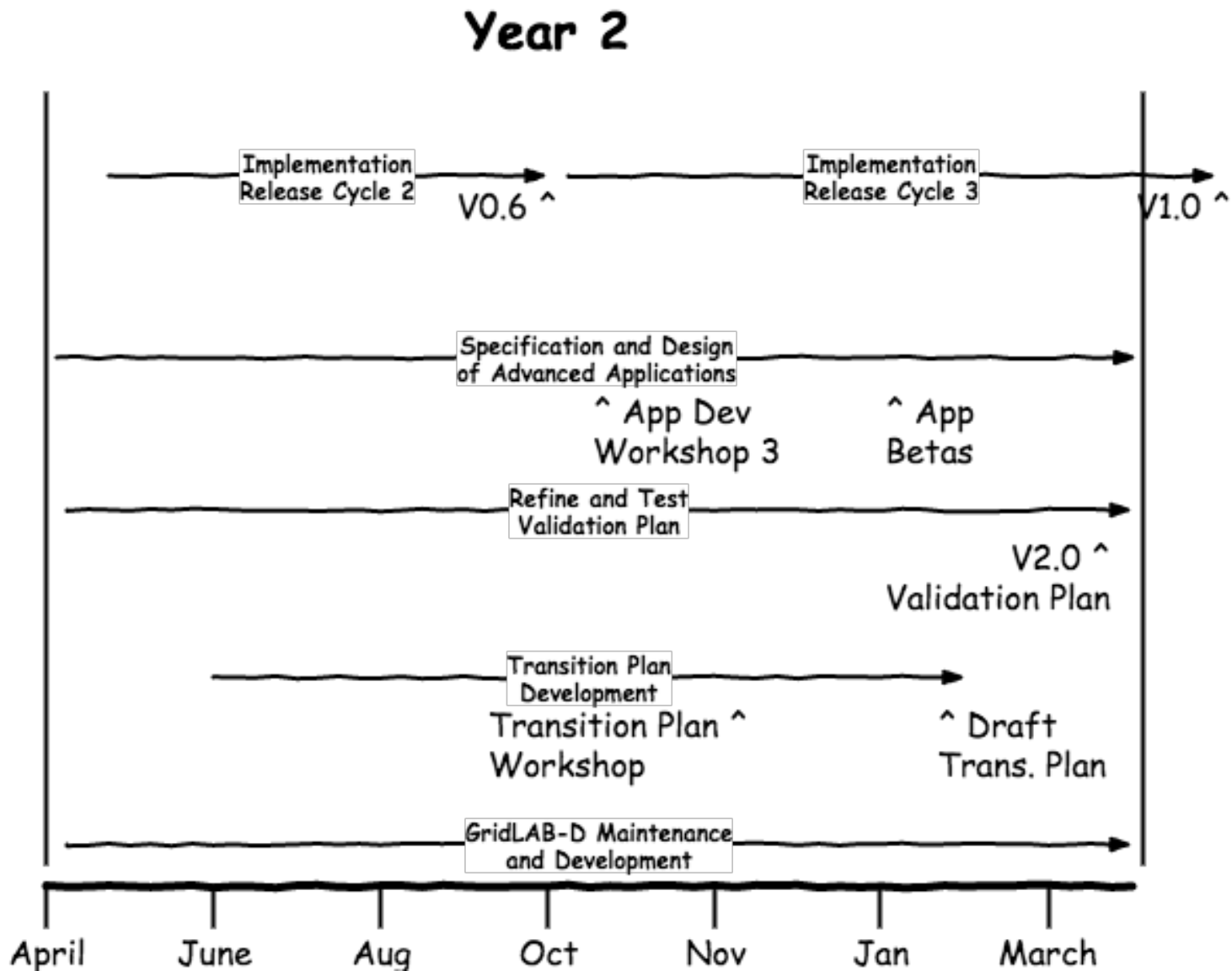
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# **FY2018 / PROJECT YEAR 2 PLAN**

# Key Tasks, Milestones

Task or Milestone	Deliverable	Date
IAB	Hold IAB Meetings	Annual F2F, Quarterly web
GridAPPS-D Implementation	Completion of Release Cycles	May 2017, October 2017, May 2018
GridAPPS-D V1.0 Release	Software and Docs online	June 2018
GridAPPS-D SWQA & Testing	Test Harness release 1.0	January 2018
EIOC Operating Environment	Demo of EIOC HW & SW supporting project	April 2018
Application validation / evaluation	Evaluation Framework V2.0 complete	April 2018
Application Development	Beta version of each app	January 2018
Platform modeling and sim	GridLAB-D Annual release	April 2017, 2018, 2019
GridAPPS-D Transition	Plan Draft for DOE review	February 2018

# Year 2 Schedule Summary



# Project Risk Management

Risk	Consequence	Mgmt Strategy	Mitigation Plan
Data "ingest" capabilities – lack of vendor API documentation	Limits the scope of vendor systems GridAPPS-D can interact with	Mitigate	Schedule contingency, prioritize order of vendor interactions, vendor training
Proposed CIM extensions not well formed	Rework of portions of GridAPPS-D	Mitigate	Involve SME's, establish review process, participate in CIM working groups
Losing code repository in GitHub	Work lost – significant time to recover	Mitigate	Establish backup processes
Real-time simulation performance lacking	Limits scope of application development	Mitigate	Testing guides optimization and diversify to include OpenDSS

Examples from risk register (currently 18 total risks documented)



# **TECHNOLOGY TRANSFER ACTIVITIES**

# Industrial Advisory Board



# Presentations and Publications

## Completed

- R. Melton, K. P. Schneider, T. McDermott, and S. Vadari, "GridAPPS-D Conceptual design V1.0," PNNL-26340,, 2017.
- Y. Agalgaonkar, K. P. Schneider, C. Marinovici, R. Melton, and S. Vadari, "ADMS State of the Industry and Analysis Gap," PNNL-26361,, 2017.
- T. F. Sanquist and K. P. Schneider, "GridAPPS-D Evaluation Framework: A Systems Engineering Approach," PNNL-26362, 2017.
- Multiple presentations including:
  - ISGT 2016 and 2017
  - 2017 IEEE PES General Meeting and
  - presentations to several utilities

## Planned

### Journal Papers

- PNNL ADMS overview 2/1/2018
- PNNL VVO application 4/1/2018
- PNNL SE/PE application 4/1/2018
- PNNL Transactive application 4/1/2018
- NREL State Forecasting Application 4/1/2018
- NREL Online-OPF Application 4/1/2018
- WSU VVO OPF Application 12/31/2017
- WSU Resilient Restoration 7/31/2018

### Conference

- PNNL Graph Theory paper
- PNNL ISGT 2018
- WSU ISGT Control of DERs

### Trade Journals

- MGS TBD
- INCSYS TBD

Project reports and documentation associated with major tasks



# Open Source Development

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- BSD License
- GitHub repository

<https://github.com/GRIDAPPSD/GOSS-GridAPPS-D>

- Read the Docs documentation site

<http://gridappsd.readthedocs.io>

- Referring interested parties directly to results

# Project Team

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**Pacific Northwest**  
NATIONAL LABORATORY



# Thank You

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GitHub Repository:

<https://github.com/GRIDAPPSD/GOSS-GridAPPS-D>

ReadTheDocs:

<http://gridappsd.readthedocs.io>