PG&E SmartMeter™ Project (AMI)

The Intelligent Network
Delivering the Power to Innovate
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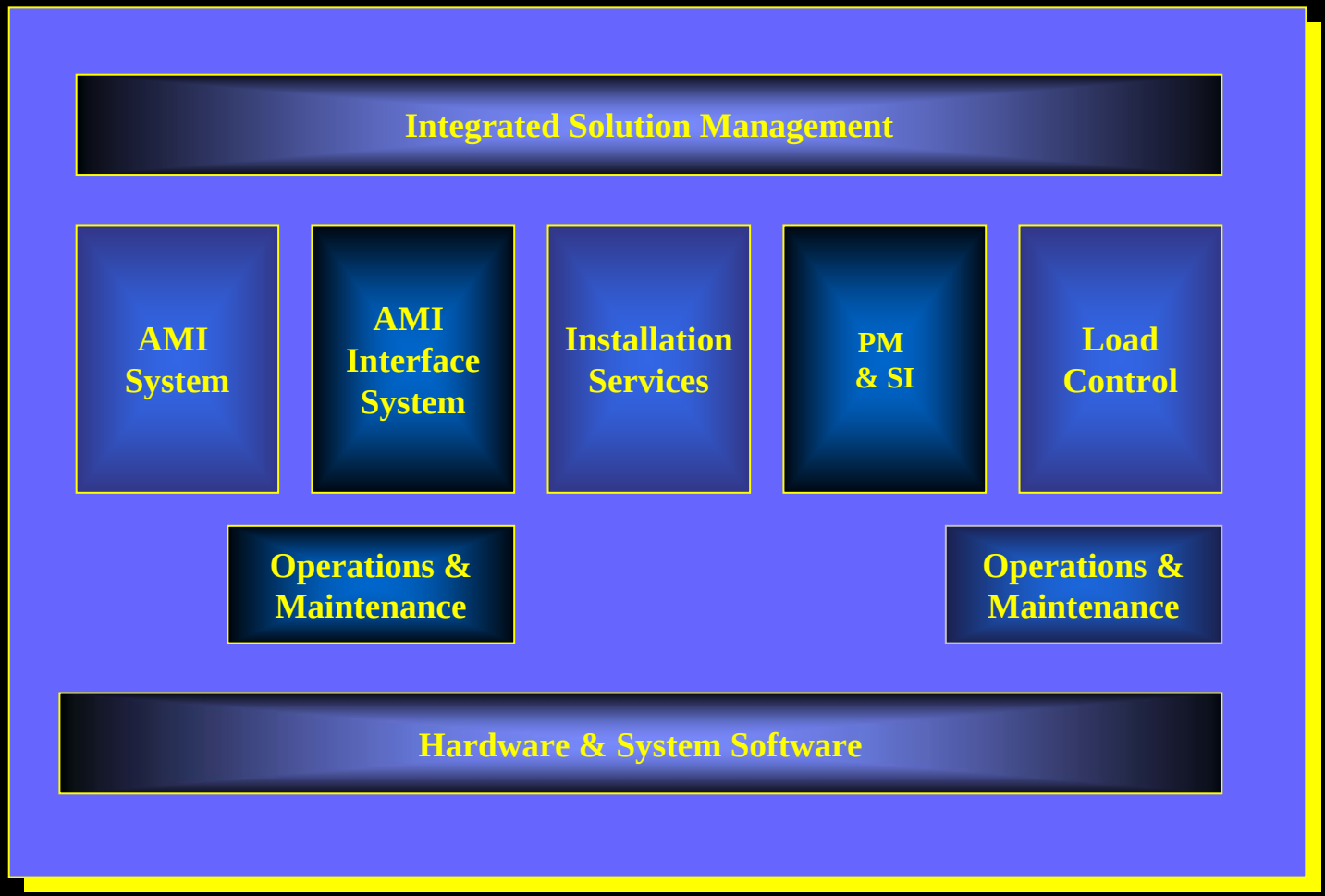
Agenda

- Big Picture View of a SmartMeter™ Project
- PG&E Project Overview
- One Year In … Lessons Learned

Big Picture View of a SmartMeter™ Project

Comprehensive SmartMeter™ Framework



SmartMeter™ is by any measure a challenging project

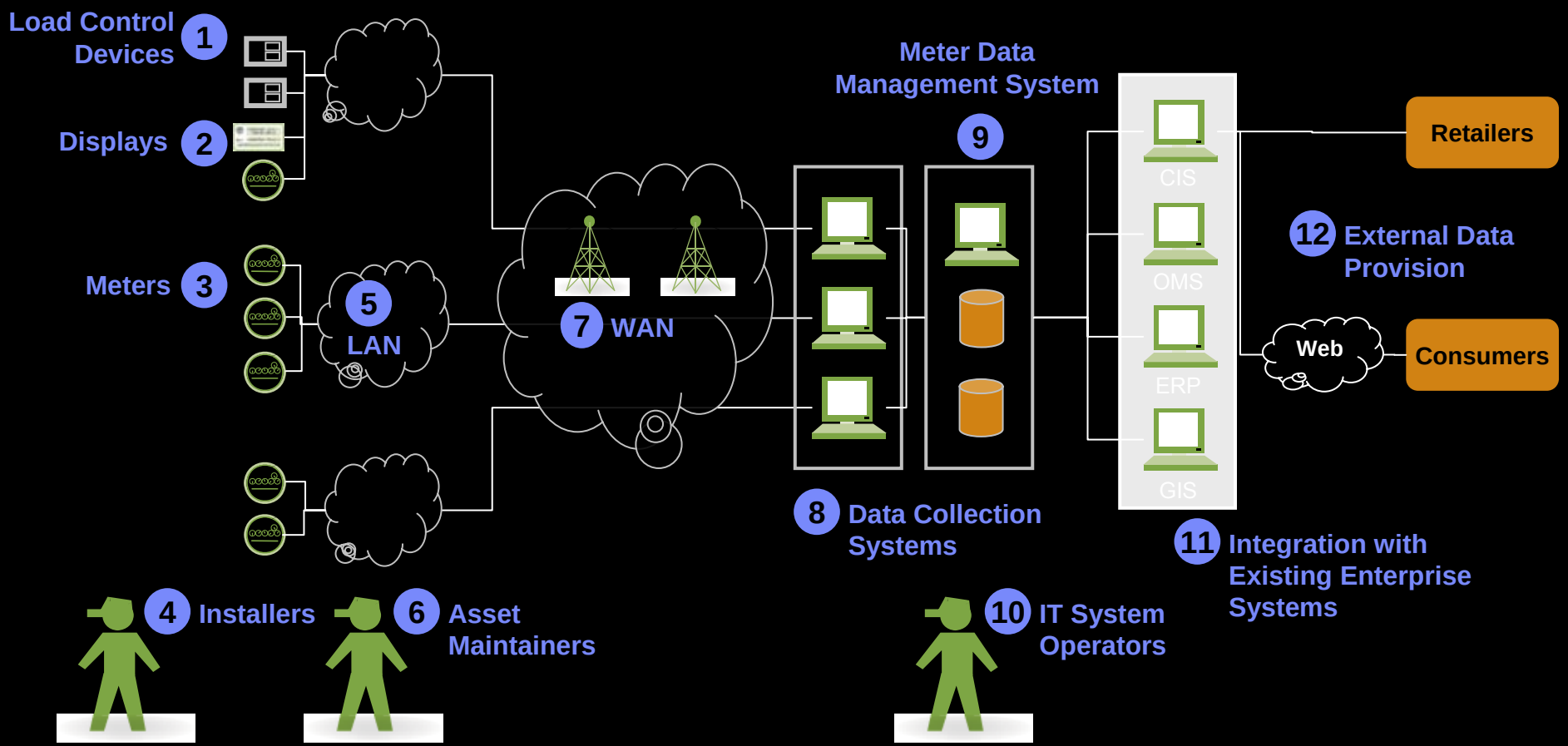
The Challenges

- **Complexity**
  - Processes and people must be orchestrated, harmonized and integrated
  - The team must be talented, motivated and capable
- **Scale**
  - A large scale project over a short time
  - Significant logistics, supply chain and financial challenges
  - Broad challenge to assimilate the new system, and the changes it necessarily precipitates, into the enterprise.
- **Technology**
  - The technology to be deployed, integrated and operated is new and in many cases emerging
  - Multiple vendors must be integrated into a seamless real time information system

Key Risks

- **Field Systems**
  - Technology
  - Supply chain
- **IT Systems**
  - Integration
  - Scale
- **Deployment**
  - Procedure Quality
  - Labor Management
- **Project Management**
  - Process
  - Accountability
  - Communication

Understanding the Pervasiveness of the Challenge



Architectural tenets on which a successful approach is built

- It is unlikely that a single homogeneous SmartMeter™ system technology will fulfill all requirements. Although there certainly should be a bias to limit the number of multiple vendor components, the architectural approach must assume such integration challenges.
- The primary locus of integration should be the "SmartMeter™ Interface" system. This system component is the most flexible and least expensive in which to both achieve and maintain integration. The architecture for the interface system should be open and standards based.
- Backend systems (CIS etc.) should be strategically segmented to mitigate risk. To the extent possible, modifications to these systems should be limited to changes necessary to realize the business and operational benefits of SmartMeter™ deployment and operations.

PG&E SmartMeter™ Project Overview

PG&E's SmartMeter™ Project Objectives

PG&E has the following objectives in deploying SmartMeter™:

1. Implement 10 flavors of price responsive tariffs (4 residential, 3 large C&I, 3 very large C&I)
2. Collect data at no less than an hourly interval level
3. Give customer access to their usage data
4. Compatible with applications that use read data: billing, energy management, education
5. Compatible with applications that promote operations efficiency: outage management, reducing theft, etc.
6. Capable of interfacing with load control technology

PG&E's Position on SmartMeter™

- SmartMeter™ holds tremendous promise both as a vehicle to deliver customer demand response and as a means to improve operational performance
- Investment in infrastructure of $1.6 billion. Electric and gas rates increase by about 1% in early years with rate decreases later due to operational benefits
- A voluntary demand response rate and marketing program has been designed for targeted customers to make the business case cost effective
- Supports the CPUC's price responsive tariff requirements
  - Electric meter data on an hourly basis
  - Gas meter data on a daily basis
- Supports customer access to personal energy usage data
- SmartMeter™ empowers customers to control their energy bill to the extent that they can change their energy usage in peak periods

Benefits

Customers

- Faster restoration times for outages
- Receive usage information to better understand and manage their bills, and ability to participate in energy efficiency and demand response programs
- Reduced inconvenience by no longer needing to unlock gates and tie up dogs for meter reads
- Improvements in timeliness and accuracy of billing, fewer estimated bills
- Remote service turn-on and shut-off
- Customer can call PG&E Customer Service for real-time meter read.
- Ability to participate in other tariff options

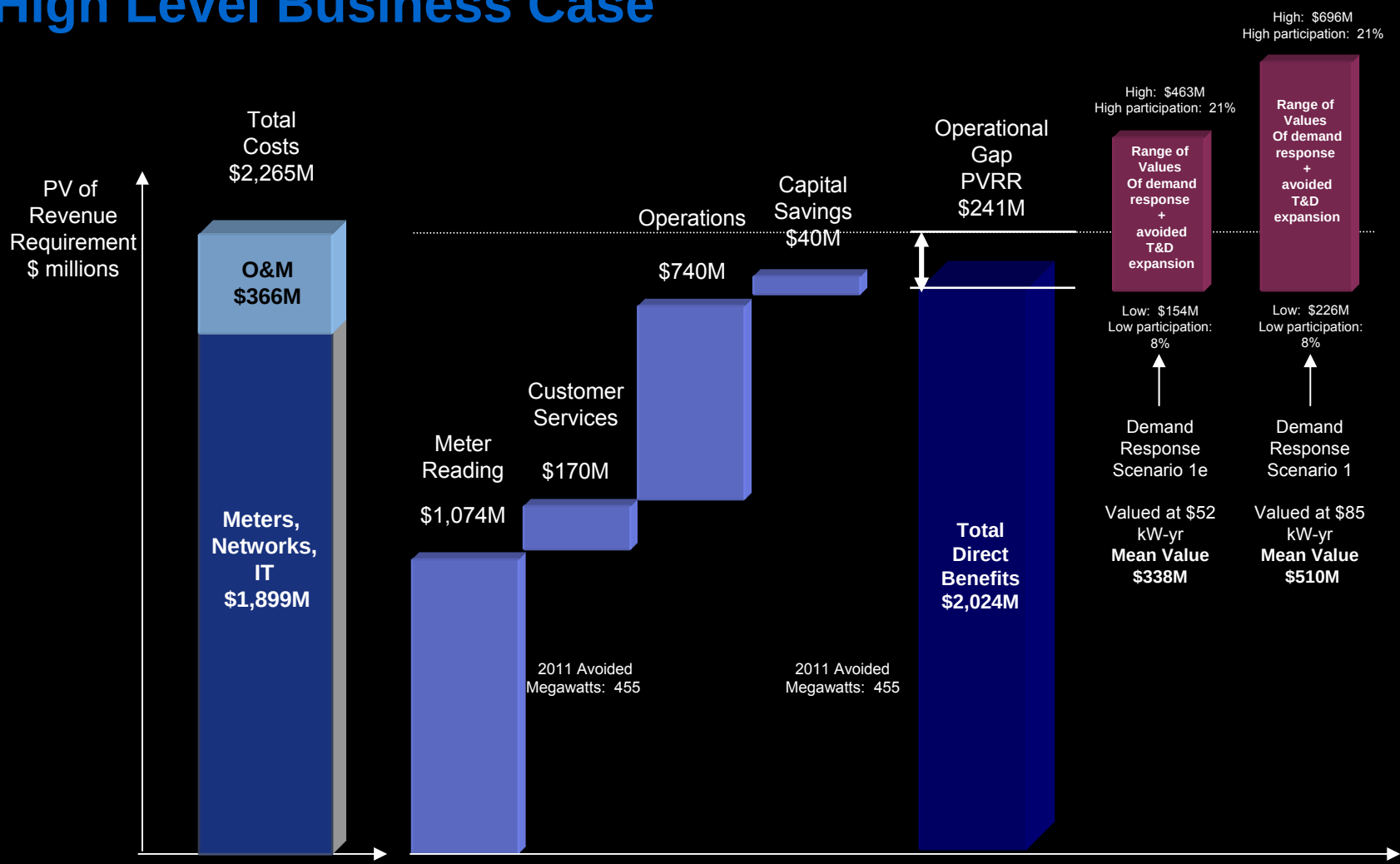
PG&E

- Reduced operating costs
- Improved outage management – ability to quickly determine if power is off or on
- Reduced number of delayed and estimated bills
- Reduced energy theft
- Lower procurement costs

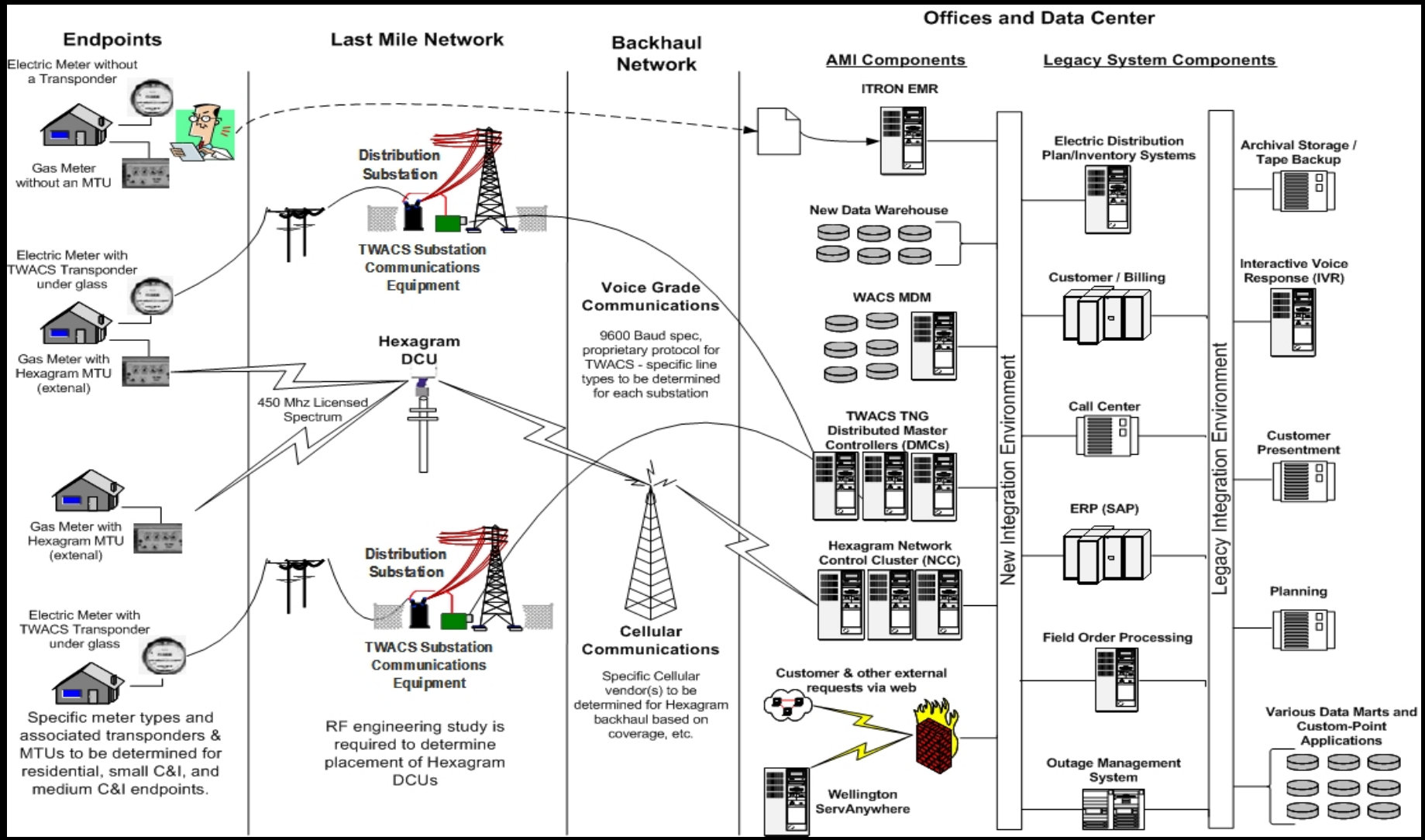
CPUC/State

- Reduces need for additional generation and transmission capacity in California
- Supports the CPUC's price-responsive tariff requirements

High Level Business Case



PG&E's Context Architecture



PG&E SmartMeter™ Releases

SM 1.0

Supply Chain
- Planning
- Purchase order
- Partial orders
- Shipment
- Shipper file
- Goods received
- Three-way match
- Invoices
- Payment

(not IT equipment)

Meter & Network Deployment

Initiate + Design (Plan)
- Field install
- Field exchange / UTC
- Field order process
- Network start-up
- Retrofit shop
- Backhaul
- Excludables

Asset Tracking (Financial)
- Meter and module
- End point devices
- Network
- Equipment – labor capitalization

Metrics & Reporting
- Operational reporting & performance (non-critical for deployment or ops)
- Warranty mgt metrics

MBC Data Warehouse
- Storage of usage data
- SQL & Brio internal queries only
- Customer Web Presentment Data

Lifecycle Mgt: Equip
- Network & Meter Module
  - Inventory
  - Installation
  - Test results
  - Marriage
  - Validation
  - Meter exchange
  - Maintenance
  - Retirement

Meter Read
- AMI data collection
- On demand data collection
- Data synchronization
  - Customer
  - Meter/Modules
  - Rates
  - Meter data
  - All end-point devices

Operations
- Meter, Module & AMI Network
  - Alarms & flags
  - Exceptions
  - Statuses
  - Field Order Process

Outage Mgmt
- Single meter ping
- On-demand trigger/Ping

Customer Care
- Contact ctr support
- Cust. records maintenance
- CPP event notifications (source notify system TBD)
- Letters

Meter Data Mgt
- V E E
- Receipt & storage MRE file
- Generate file to CIS
- Meter read file/usage data
- Meter read comparison
- Manual estimate override

Bill Calculation
- Framing
- Rate calculation
- Bill print
- Re-bill
- Revenue reporting
- System estimation
- CPP operations

Customer Web Presentment
- SmartMeter & CPP Marketing
- Energy usage graphs
- CPP enrollment
- Subscriptions to CPP Alerts
- MyProfile page enhancements

CC&B Interfacing to other PG&E apps
- RSS
- ABS
- MADS
- ES3/UDR
- MDSS
- RDS
- Mass Transactions
- Rates DB
- CC-RAT
- PG&E Cust. Records Group

SM 2.0

Outage Mgmt
- Area outage scope verification
- Outage restoration validation
- Network outage information to OIS

Customer Care
- Remote Connect/Disconnect Collar
  - Deployment
  - Supply Chain
  - Asset Tracking
  - Lifecycle Mgmt
  - Operations
  - Revisions to credit collection process

Customer Care
- Letters
  - CPP letters for target audiences
  - E-bill notification e-mails
  - Automated support of Account Services letters

Bill Calculation
- Additional functions for system determination of estimated bill
- Some ABS accounts switched to CC&B

MBC DW
- Interval Data from MBCDW to MADS
- Additional functionality TBD (reporting)
- Archived usage data provided to CC&B for Cancel/Rebill beyond 14 months

Operations
- Real Time Meter, Module & AMI Network alarms & flags (Hexagram)
- Direct Load Control

Meter Data Mgt
- Weather data

Meter Read
- Full TNG support of new endpoint metering products
- Net Metering and TNG support for Interval Data for ABS Billed SAs
- On-Demand Meter Read – CSR request and response
- Identification of Broken Lock usage
- Prioritization of electric interval data collection

Customer Web Presentment
- Online Auditing
- Audit Trail tracking and archiving
- Employee proxy view
- Administrative tool to control privileges, access, views
- Simple rate analysis Tool
- Rate analysis request to CSRs
- Data download

Ops Dashboard
- Display of high-level status of daily performance issues
- Automated dispatching capabilities
- Drill-down query capabilities
- Real-time data
- Interactive capability

Hexagram Electric
- Deployment, Supply Chain, Asset Tracking, Lifecycle Mgmt, Meter Read, Operations, Outage Mgmt

SM X.0

Outage Mgmt
- Autonomous system pinging based on pre-configured strategy
- Real-time outage info to WACS
- Real-time switching info to TNG

Lifecycle Mgt: Equip
- BT-driven transition
- SAP as source system

Meter Read
- Other functionality associated with TNG 3.0

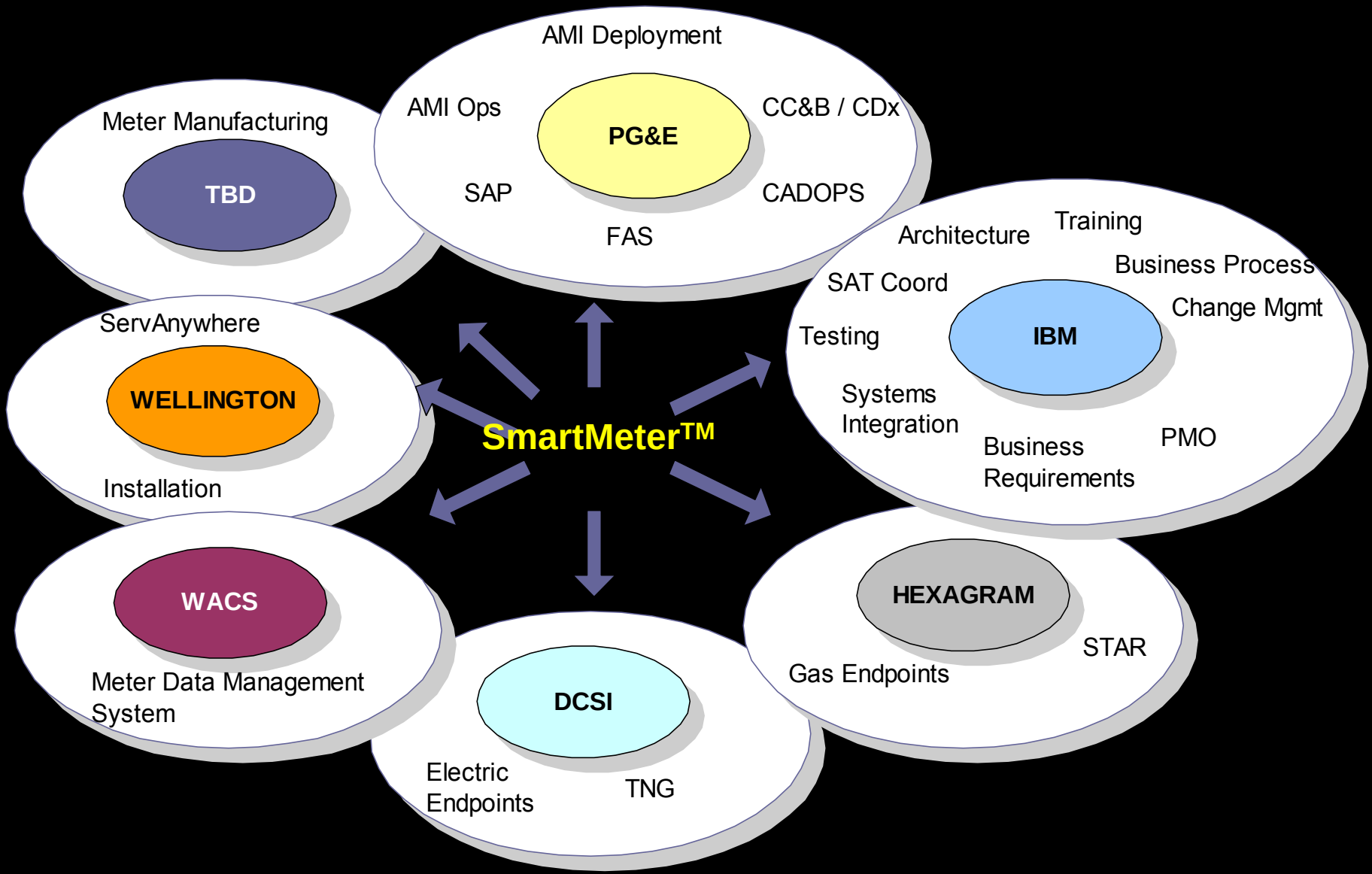
Operations
- Real-time TWACS network alarms

MBC DW
- Added functionality TBD

Customer Web Presentment
- Prompt interest-customers to enroll in CPP when eligible
- Compare actual usage
- Overlay actual usage with TOU or CPP rate
- Display usage data in bill-cycle month
- Inform CPP customers that they are eligible at account level
- Display event information by customer
- CPP Calculator showing potential savings

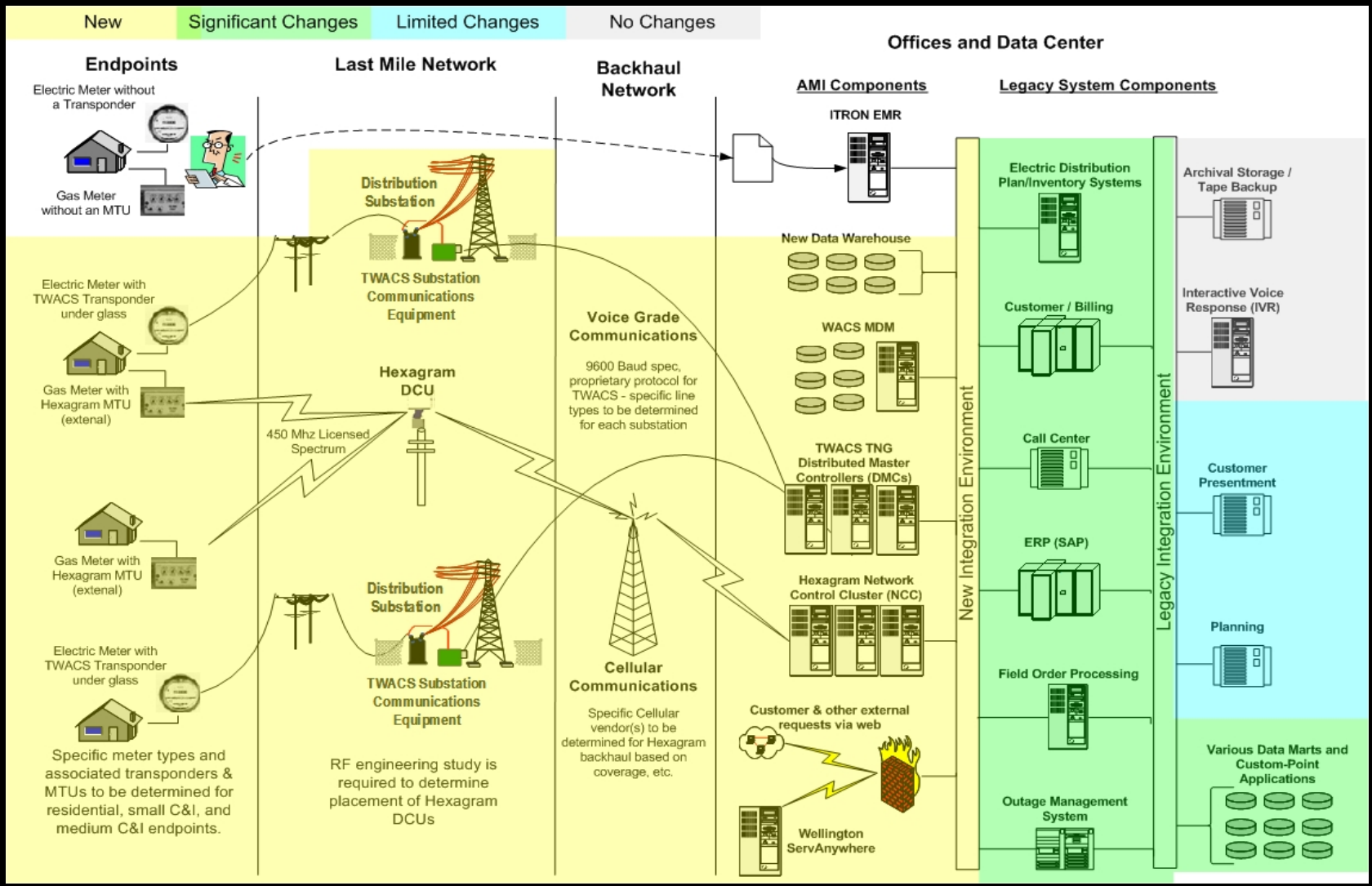
Other
- T&D Data Acquisition
- Assets for customer in-house display
- Real-time output
- Data aggregation for third parties
- End-use devices

PG&E SmartMeter™ Partners



One Year In … Lessons Learned

SmartMeter™ is pervasive – it changes nearly everything



SmartMeter™ Architecture touches deep within the Enterprise

- A focused architecture governance process is critical to deciding and implementing key architectural elements of the system
- Significant architectural tradeoffs are required to integrate multiple in-production utility and new vendor systems each in different stages of their respective product lifecycles
- Key differences in the temporal characteristics of various component systems and business requirements present a significant challenge
- Data is a critical facet of the system technical architecture

A Complex Project With Good Key Health Indicators

- Executive buy-in/interest. Good Steering Committee that is actively protecting the project when called upon.
- Corporate wide understanding of what our project is trying to achieve. Corporate wide interest. Excitement/buzz.
- Strong Issue management process. Issues are known and being worked.
- Cooperative workstreams.
- Active schedule management.
- Active Change Management
- Strong project team. Good mix of Subject Matter Experts as well as Execution focused people.
- Have a good target end insight.
- Enterprise level coordination/support

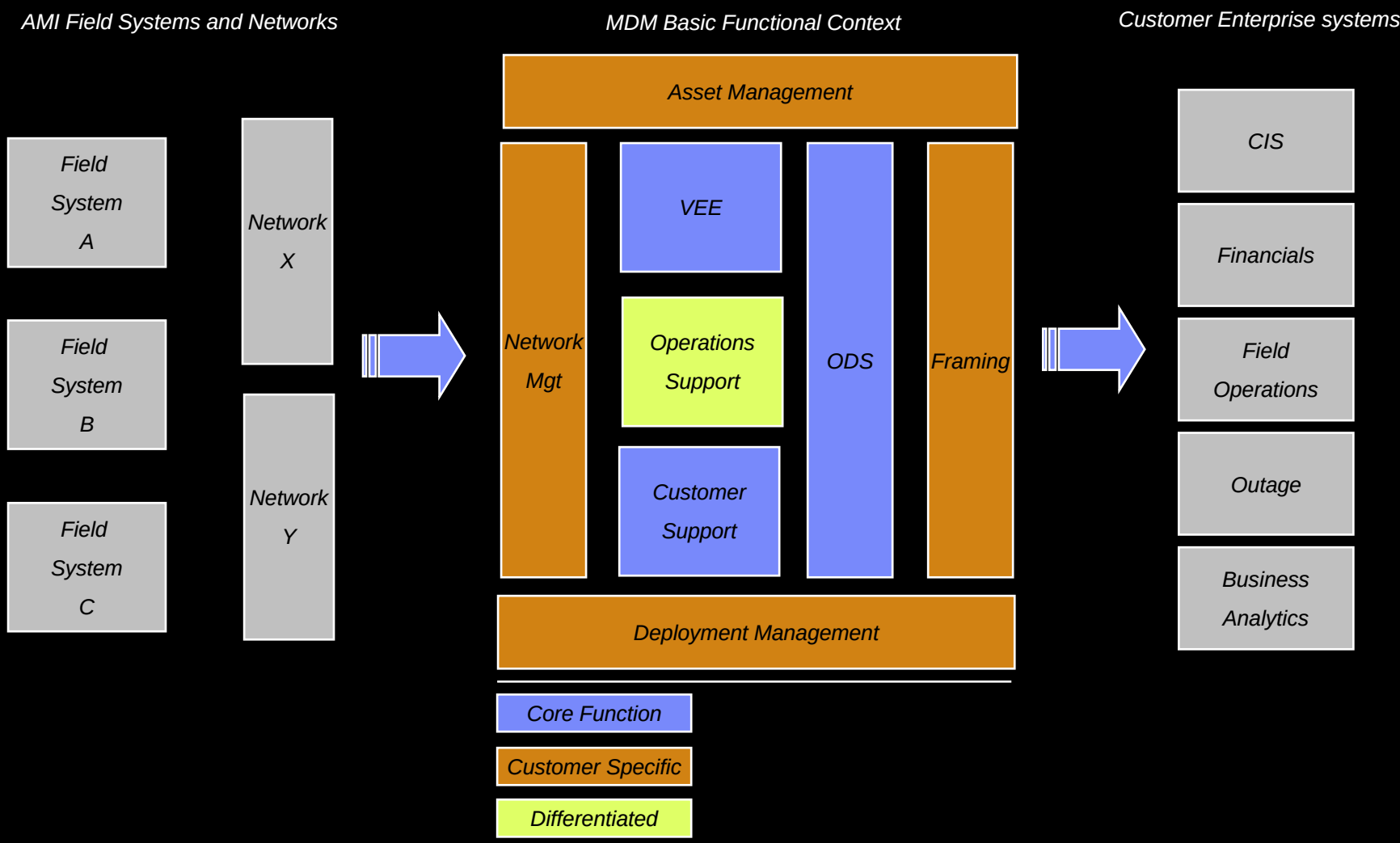
Program Management is Complex and Challenging

- Contention for limited and specialized subject matter expert resources present significant scheduling challenges
- Harmonizing, coordinating and integrating with other enterprise initiatives is difficult and critical
- Gaining final schedule commitment from all participating parties within the enterprise will take longer than you anticipate
- You can not over communicate with anyone

Business Process Definition is Sticky

- The level of effort to define SmartMeter™ "To Be" processes can be easily underestimated
- Vendor product lifecycles will not neatly fit business process objectives or benefits realization
- Vendor involvement in developing business processes is critical
- New SmartMeter™ processes introduce the need for transformed business controls (eg remote disconnect)
- The business will always want more functions faster than the system or business case will support
- Robust requirements change control is a critical and painful project control point

Meter Data Management Systems are Enigmatic



Systems Integration is Broader Than Just Interfaces

- Conventional views of SOA aren't a perfect fit with SmartMeter™
- A singular development methodology across all systems development is unlikely
- The "do no harm" to current production systems doctrine of implementation can easily result in underestimation of the level of effort to implement
- Integrating across the enterprise will impact more collateral systems than you think

Deployment is an Intricate Repeatable Process which must be flawless

- Field deployment schedules are substantially impacted by operational considerations which are only typically fully understood late in the planning process
- All the data required to successfully deploy meters may not exist and/or will not be in the form needed within the current systems of the utility enterprise.
- A robust view and management of the entire deployment supply chain is a critical success factor

Testing Requires Meticulous Planning and Execution

- Ensuring rigorous and consistent testing execution at each phase of implementation is critical
- Realistic test environments are not a luxury
- Multiple testing skills and regimens are required (e.g. meter certification vs code unit test)

SmartMeter™ Key Themes

- Pervasiveness of the program
  - SmartMeter™ will (eventually touch much of the business)
- SmartMeter™ isn't just an IT project
  - It's a regulatory project (Business Case)
  - It's a construction project (Deployment)
  - It's a software development project (Systems integration)
  - It's a product design project (Load control / demand response)
- The "devil" is in the details
  - As each layer of detail is uncovered, it causes changes to business processes, system interfaces, and schedules
- Key project issues and risks come from the legacy side of SmartMeter™ – not from the new systems
  - Constrained schedules
  - Contention for resources
  - Harmonizing the new system in the enterprise

So What? What is Special About SmartMeter™?

- SmartMeter™ requires that you integrate business processes operating in different time domains (e.g. Meter Reading, Billing, Customer WEB Presentment, Outage Operations)
- SmartMeter™ requires that you harmonize business data across multiple business domains (e.g. Asset management, Customer, Operations)
- SmartMeter™ requires a revaluation of some basic business control processes (e.g. remote shut on/off)
- SmartMeter™ requires an enterprise view of data architecture and a view of the value in the data presently not leveraged