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NAVFAC
Naval Facilities Engineering Command

ADVANCED METERING INFRASTRUCTURE (AMI) PROGRAM

Bill Anderson
AMI Project Manager
NAVFAC ESC

GovEnergy
August 2009

PROGRAM DRIVERS

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Congressional Mandates

- **The Energy Policy Act 2005 (EPAct 2005)**
  - **Mandates federal facilities install interval meters where practicable and, collect hourly interval data daily.**
  - **Chartered Navy to incorporate interval metering for new buildings and current buildings above a specific consumption level**

- **Energy Independence and Security Act 2007 (EISA 2007)**

  - **Mandates Improved energy efficiency, demand response, & reduction of Green House Gas (GHG) emissions**
    - Time of Use (TOU) billing
  - **Smart Grid technology (Two way communications to meters)**
    - Electric, Gas, Water and Steam "Smart Metering"
  - **Total Energy use in Federal Buildings be reduced 30% by 2015, and fossil fuel use be reduced by 55%**

- **Future energy acts will target GHG reduction and smart grid technologies**

  - **Energy Savings in Government Institutions requires improved energy efficiency, reduced energy costs, reduce GHG emissions.**
  - **Smart meters key enabler of Smart Grid**

- **American Recovery and Reinvestment Act of 2009**
  - **Funds the Mandates of EPAct 2005 and EISA 07**
  - **Funds Demonstration Projects for Smart Grid and Renewable Generation**

ROUGH ESTIMATE

ADVANCED METERING BY 2013

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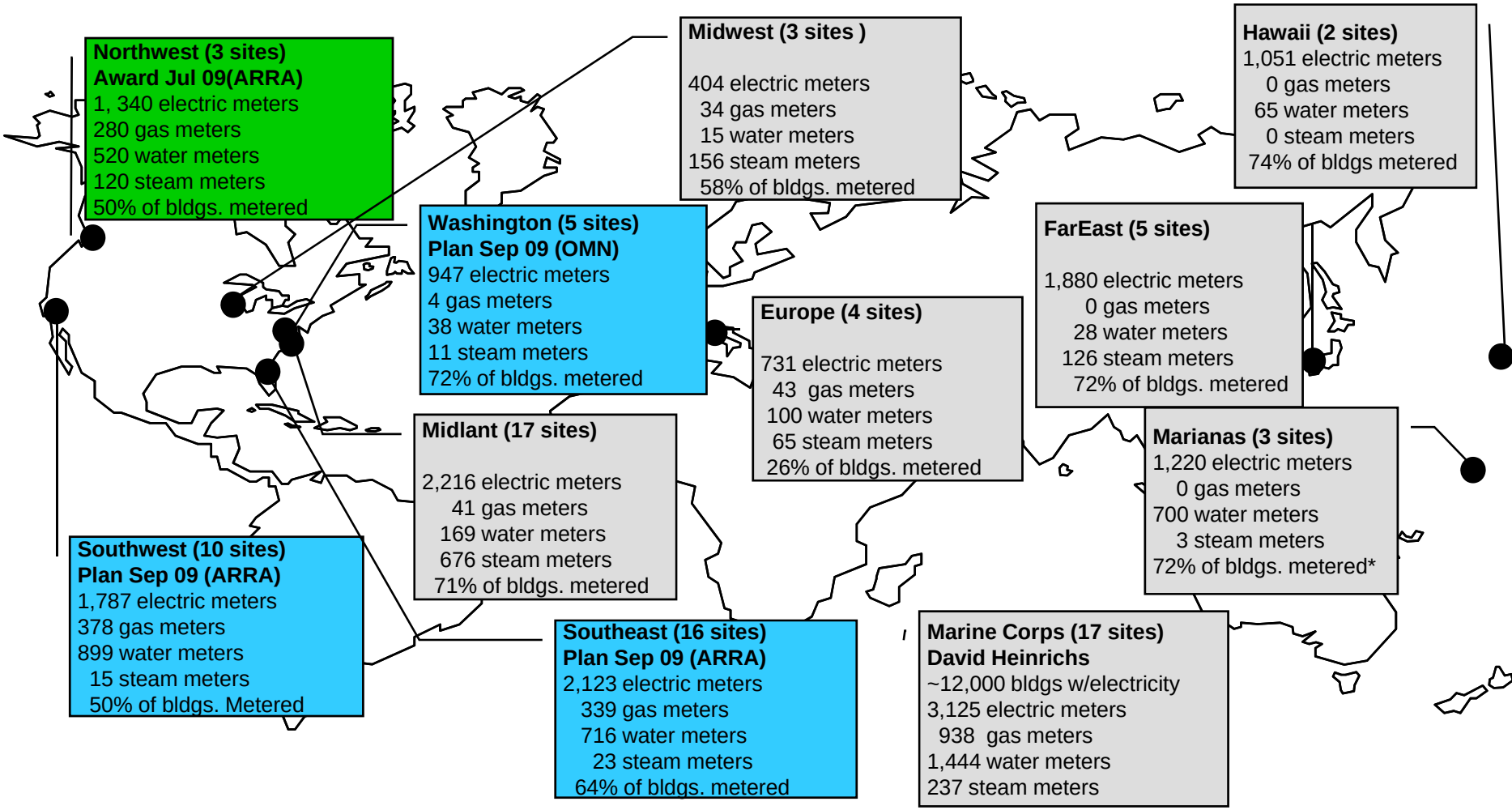
Total *~19K advanced meters(1) across ~40K facilities throughout ~120 installations*



* "Total" numbers include both CNIC and non-CNIC entities here. CNIC supports electric meters at all Navy facilities. It also includes areas covered and not covered by AR&RA.

(1) Exclusive of HQMC

AMI / SMARTGRID PROGRAM BENEFITS

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Benefits

- Meeting regulatory requirements
- Conservation effect % savings off costs
- More accurate billing and loss identification
- Reduced meter maintenance of reading
- Energy management % - savings off costs for commercial facilities (support, MWR, etc)
- Better visibility of utilities management
- Better visibility of energy management
- Enterprise wide “Benchmarking”
- Burden analysis and comparison
- Greater granularity of consumption
- Outage monitoring and management
- Power quality monitoring and management
- Consumption management and reduction
- Carbon analysis and management
- Green House Gases (GHG) management
- Distributed Generation and Storage
- Ability to allocate per TOU rates
- Demand and outage response events

GREENER NAVY WITH AMI/SMARTGRID

- **Projected reduction of 3% - 5% of load consumption by metering**
- **Improving "demand response" and "outage management"**
  - **Reduction of pollutant auxiliary diesel generation**
- **Reducing and isolating energy losses by monitoring the system**
- **Enhancing the use of renewable energies such as photovoltaic and wind**
- **Building energy management by utilizing HAN applications**

Reduction of Green House Gas (GHG) Emissions and Fossil Fuels

CONCEPT FOR BUSINESS MODEL

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Costs

a. Total Number of Meters, Collectors, Transformers
b. Install costs per meter
c. Meter Data Management (MDM) Systems
d. Variables for different communications solutions

Benefits

a. Conservation effect % savings off costs
b. More accurate Billing and Utility-Navy allocations, reduced customer service
c. Reduced Meter Maintenance of reading
d. Energy Management % - savings off costs for Commercial Facilities
e. Ability to allocate per TOU rates
f. Determine line losses between utility and the base
g. More rapid outage response

BUSINESS CASE ANALYSIS (BCA)

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Basis

- **EPAct 2005 requires the Navy to implement interval metering for all facilities larger than a set value, "where economically viable"**
- **Business model was designed to assess the cost effectiveness of the AMI solution**
  - **Identify where savings opportunities are from AMI**
  - **Itemize the usage and energy costs for all FECs**
  - **Create a tool that allows the benefits to be weighed against the costs of an AMI system**
  - **Show the differences between utility AMI approaches and savings areas for the Navy (Utility vs. End User)**

Results

- **Expenditure for Energy and Commodities amount to $1 Billion annually**
- **A limited number of electric meters will capture 95% of the consumption at less than ~50% of buildings.**
- **Payback period of AMI deployment is anticipated about 10 years**
- **Reduction in unallocated consumption and conservation effect are quick benefits at each FEC.**
- **Benefits accrue every year of incremental implementation to completion.**

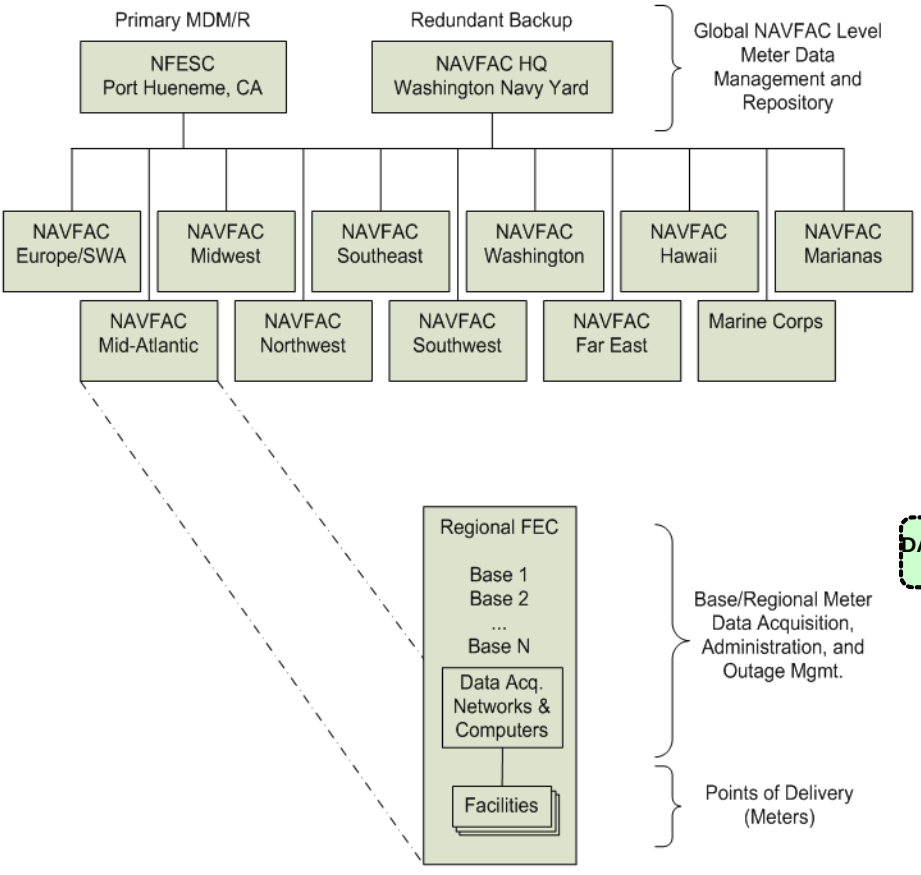
CORE FUNCTIONAL REQUIREMENTS

Meter	**Multiple communication protocols**
	IP Addressable[1]
	Monitors and reports power quality parameters
	Accurate billing (±0.2% Class Accuracy meters)
Communication	**Two way communication with endpoints**
	***Retrieve profile data every four hours from electric,* and once a day from mechanical meters**
	Capable of configuring electric meters remotely
	Enhanced security compliance (IA)
Meter Data Management	**Capture data / data repository / billing / allocation**
	Initiate on-demand data retrieval
	Provide data to manage alarms, outages, unusual demand, meter failures …

*** Italicized indicates for electrical meters only**
1 addressable (has the capability to be enabled) vs. enabled (when IP address has been assigned to meter)

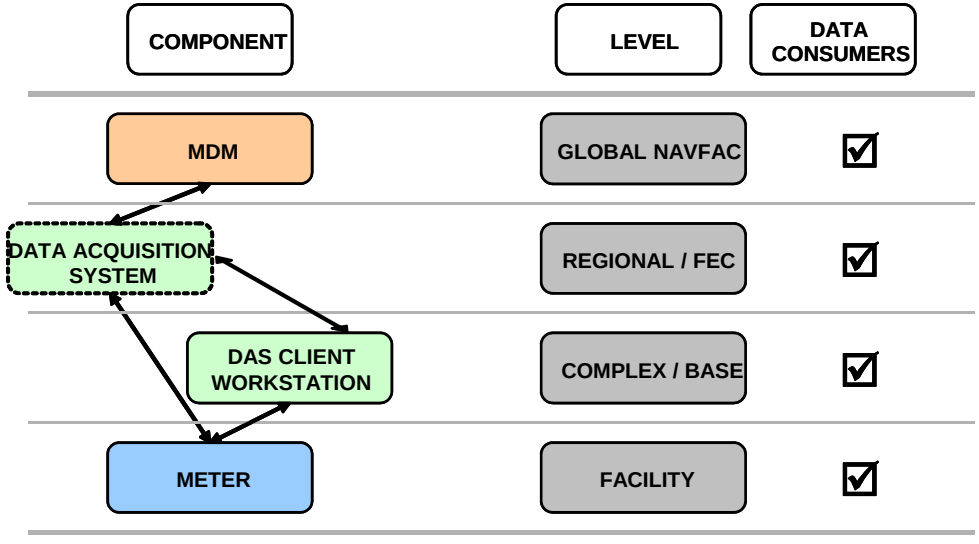
GLOBAL AMI DATA PATH & UTILIZATION :

SYSTEMS DATA ARCHITECTURE



Flexible and Multi-Layered

Data Distribution



Data consumers will exist at each level of hierarchy

* Across WAN-LAN-HAN

IN PROGRESS: AMI IMPLEMENTATION AT NBVC
PROOF OF CONCEPT

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- **Installation of 277 metering point at three sites: 149 electric, 53 gas, 69 water, and 6 steam meters at Port Hueneme, Point Mugu, and San Nicolas Island**
- **Electric meters are ION 8600**
- **Installation of ION Enterprise as Data Acquisition System (DAS)**
- **2.4 GHz Ethernet, using 3eTI network equipment will be utilized for two-way communication with meters**
- **Communication solution will be a part of the Navy global "Public Safety Network (PSNet)"**
- **PSNet Points of Presence (POP) will be utilized to gather data from PM and SNI and transmit to central DAS in PH**

INITIAL PROJECT
NAVAL BASE VENTURA COUNTY

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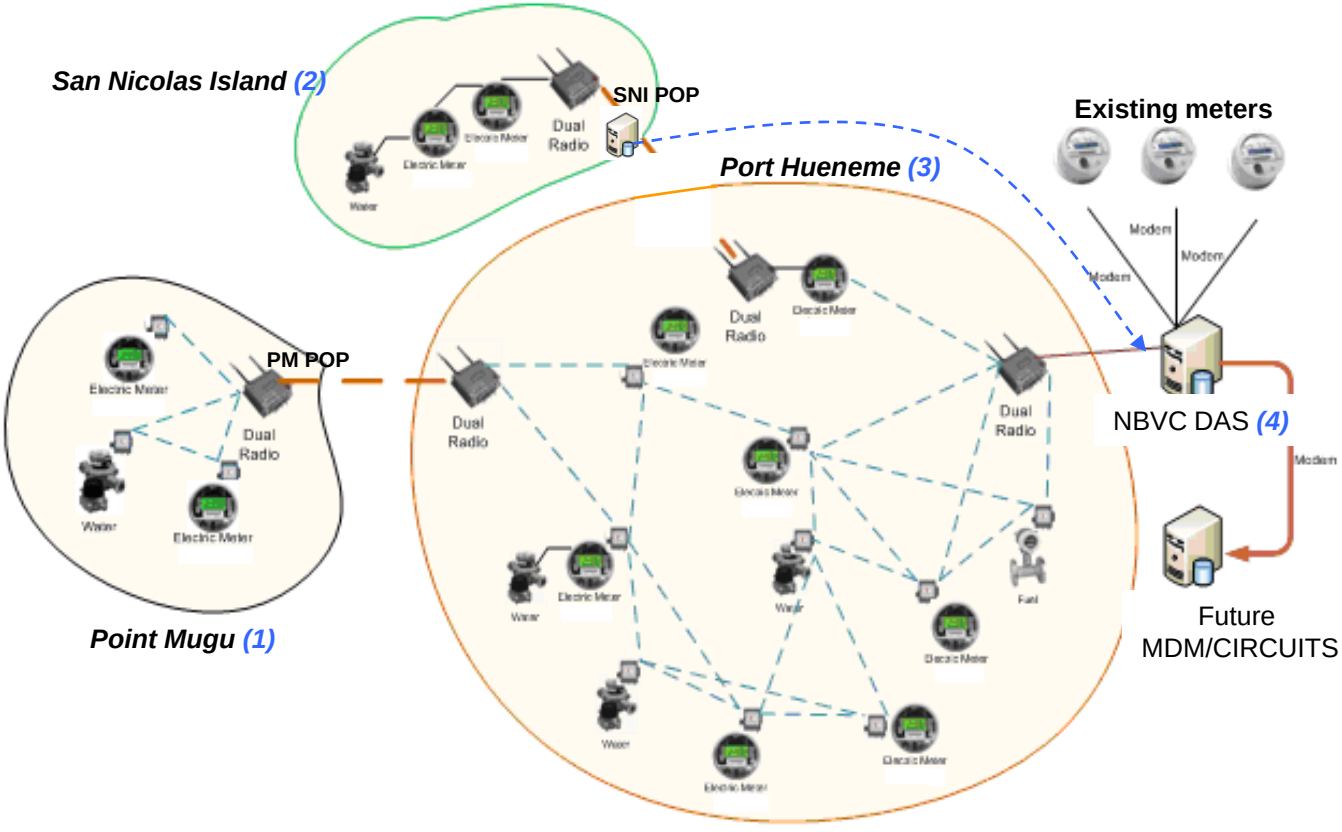
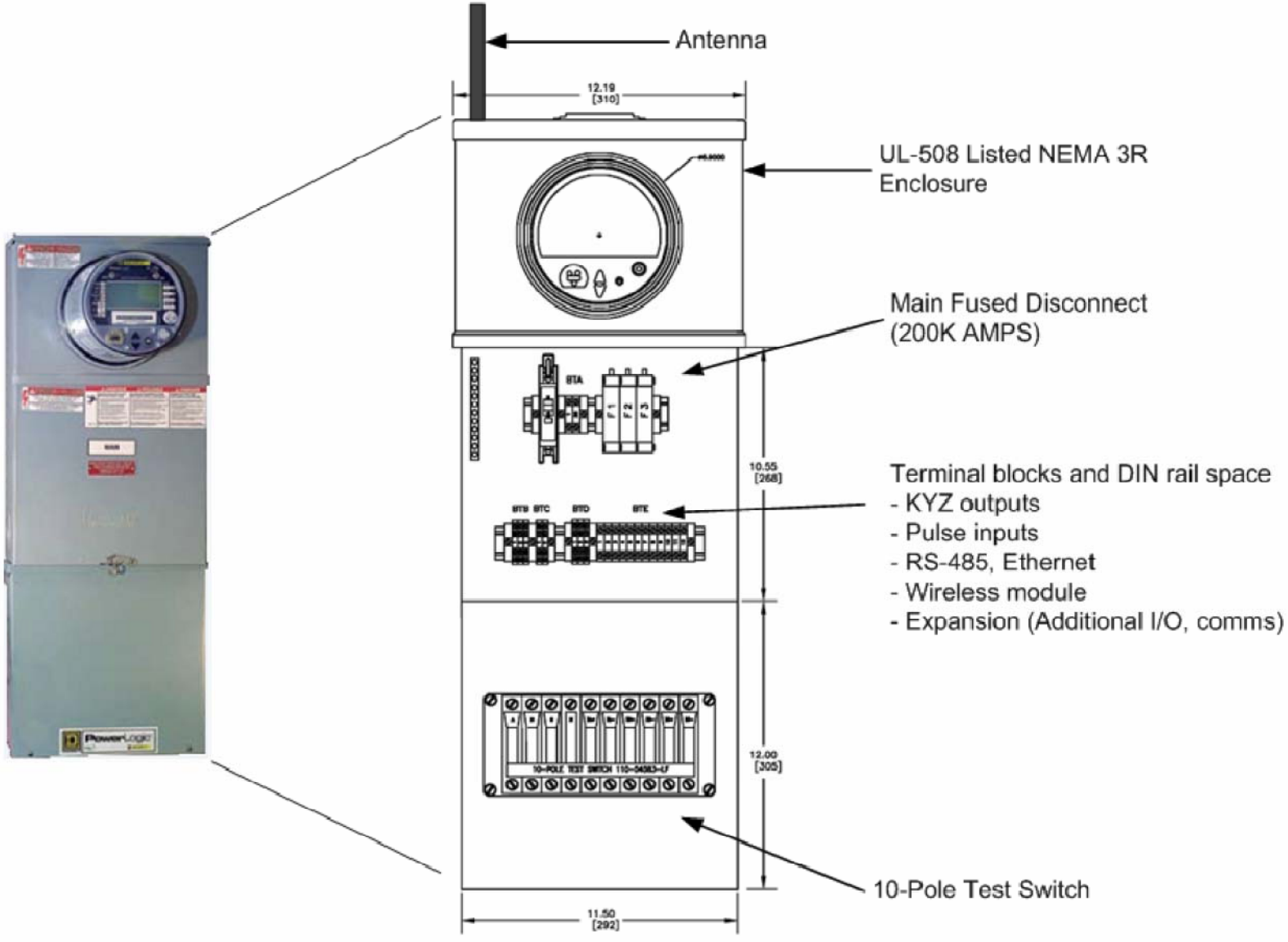
AS A MODEL OF CORPORATE AMI



NBVC AMI topology: Wireless 2.4 GHz Ethernet Mesh (PSNet)
with bridging between remote locations

NBVC pilot as a model of Navy corporate AMI Project: *(1) PM as model of NW region*, *(2): SNI as a model of Marianas*, *(3)* PH as model of NBVC, and *(4) PH DAS as a model of central MDM/CIRCUITS*

MAIN COMPONENTS OF ELECTRIC METER INSTALLATION



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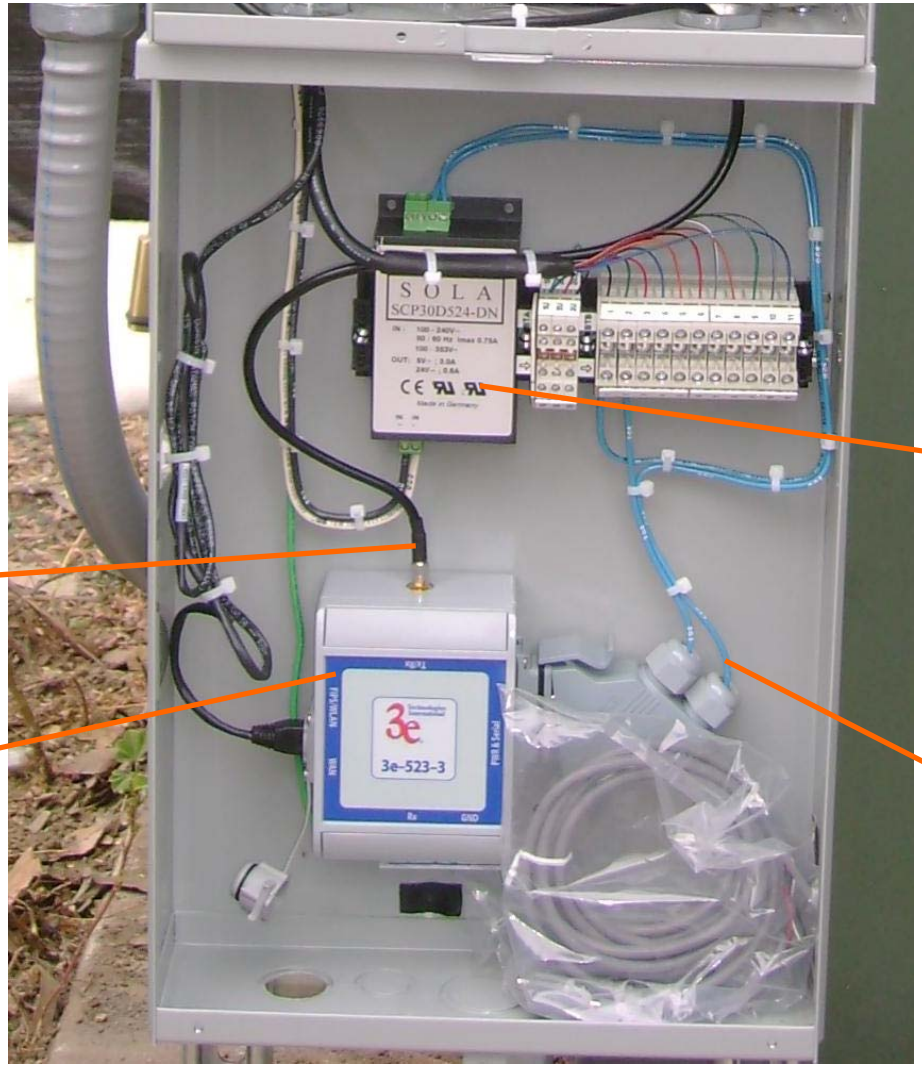


power supply

connection to the antenna

2.4 GHz Radio by 3eTi

connection to the meter

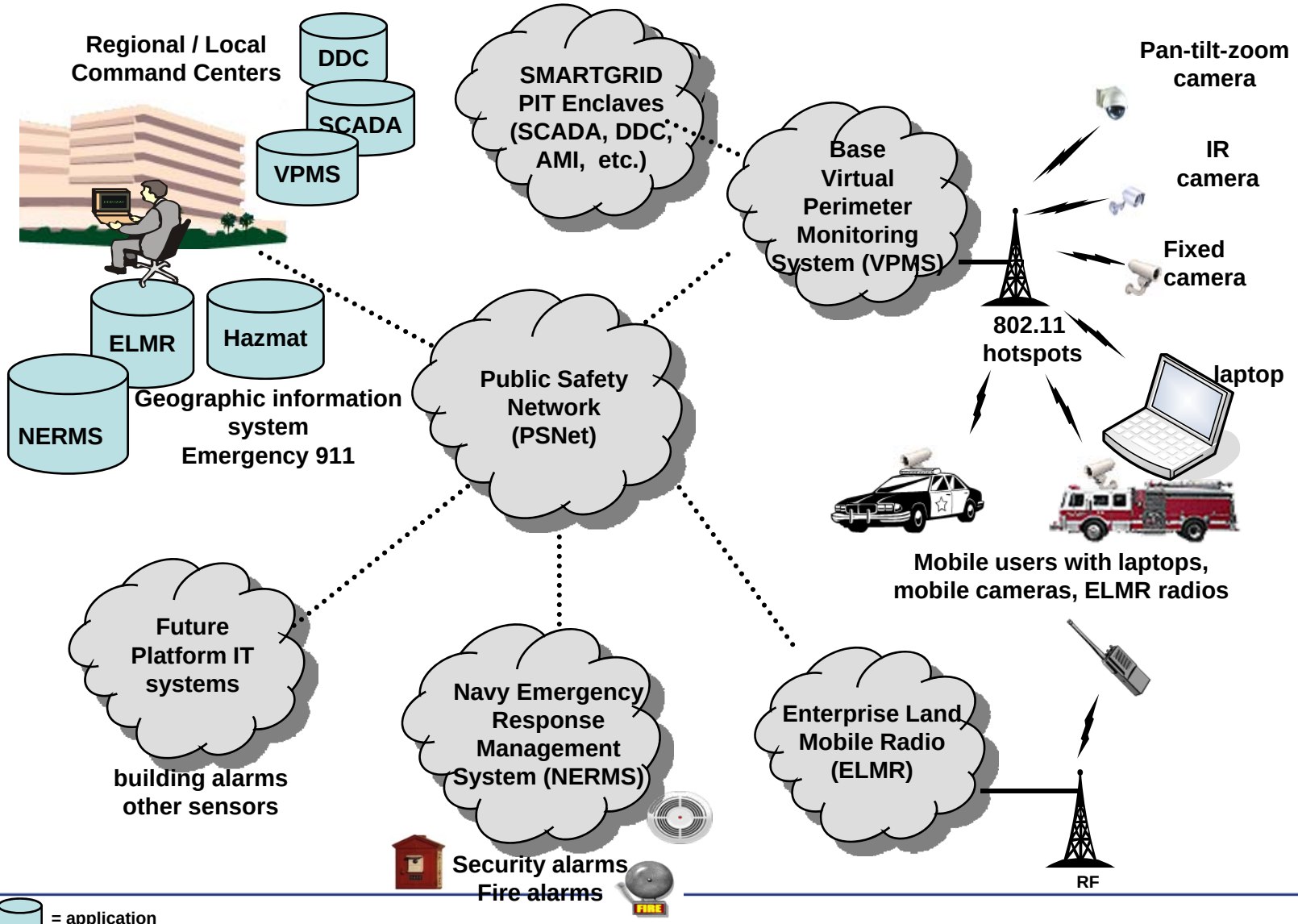
FIRST METERS INSTALLED AT NBVC

PORT HUENEME; 22 April 09; BLDG 73

Electric meter

Water meter, providing pulse output to electrical meter (electric meters function as collectors for non-electric meters)

PSNET: NAVY'S NETWORK FOR METERING AND ICS

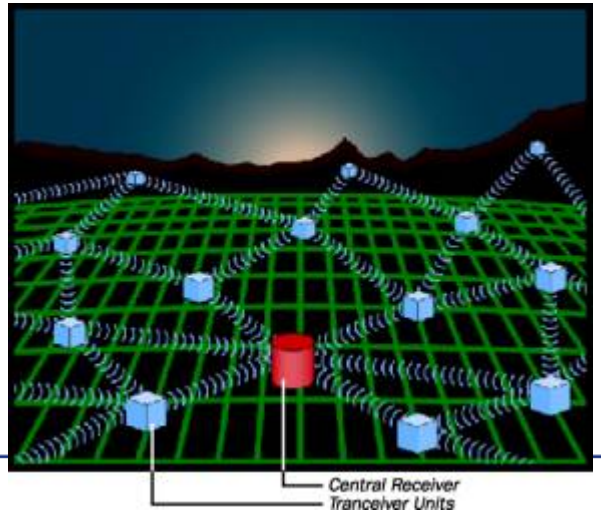


Slide courtesy of: CNIC-N6

A "POINT OF PRECENCE (POP)" AVAILABLE AT EACH BASE AS ACCESS POINT

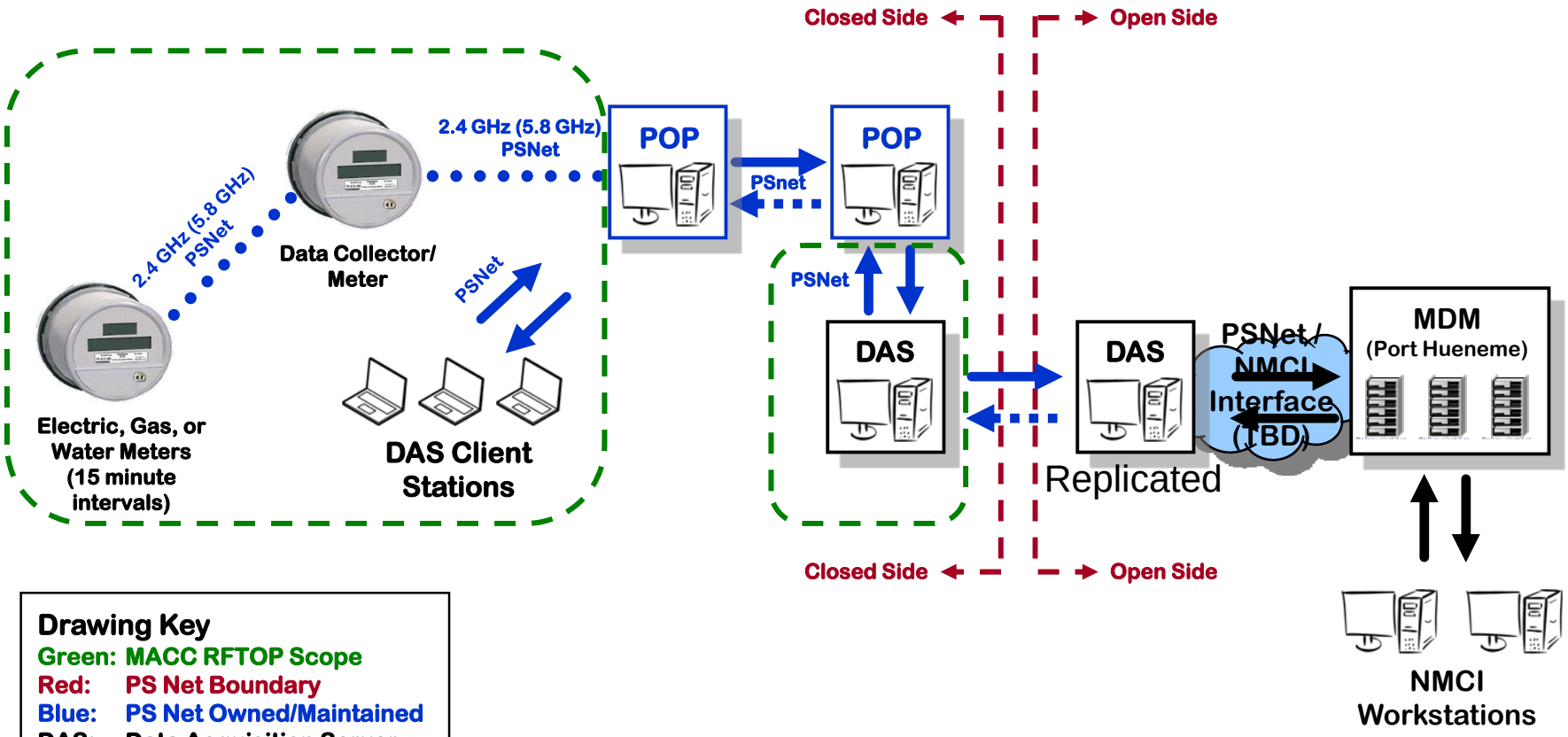
- **Public Safety Network (PSNet) is GIG compliant, functioning as a Multiprotocol Label Switching (MPLS) technology**
- **PSNet can include both wired and wireless solutions**
- **A "Point of Presence (POP)" will facilitate communication between the bases; also between a base and the DAS**
- **The requirements of IEEE 802.11 a/b/g, FIPS 140-2, and DoD Wireless Policy (DoDD 8100.2) will be met**
- **Wireless Intrusion Detection System (IDS) is a requirement**
- **Communication between meters creates a mesh network**

Units communicating with each other and with the central POP



AMI DATA TRANSFER VIA PSNET

A POTENTIAL ARCHITECTURE



Drawing Key

Green:	MACC RFTOP Scope
Red:	PS Net Boundary
Blue:	PS Net Owned/Maintained
DAS:	Data Acquisition Server
POP:	Point of Presence
MDM:	Meter Data Management
NMCI:	Navy Marine Corps Intranet

Architecture strategy is not finalized yet!

Drawing courtesy of: Tom Grant; URS Corp.

AMI AT NAVY NORTHWEST REGION

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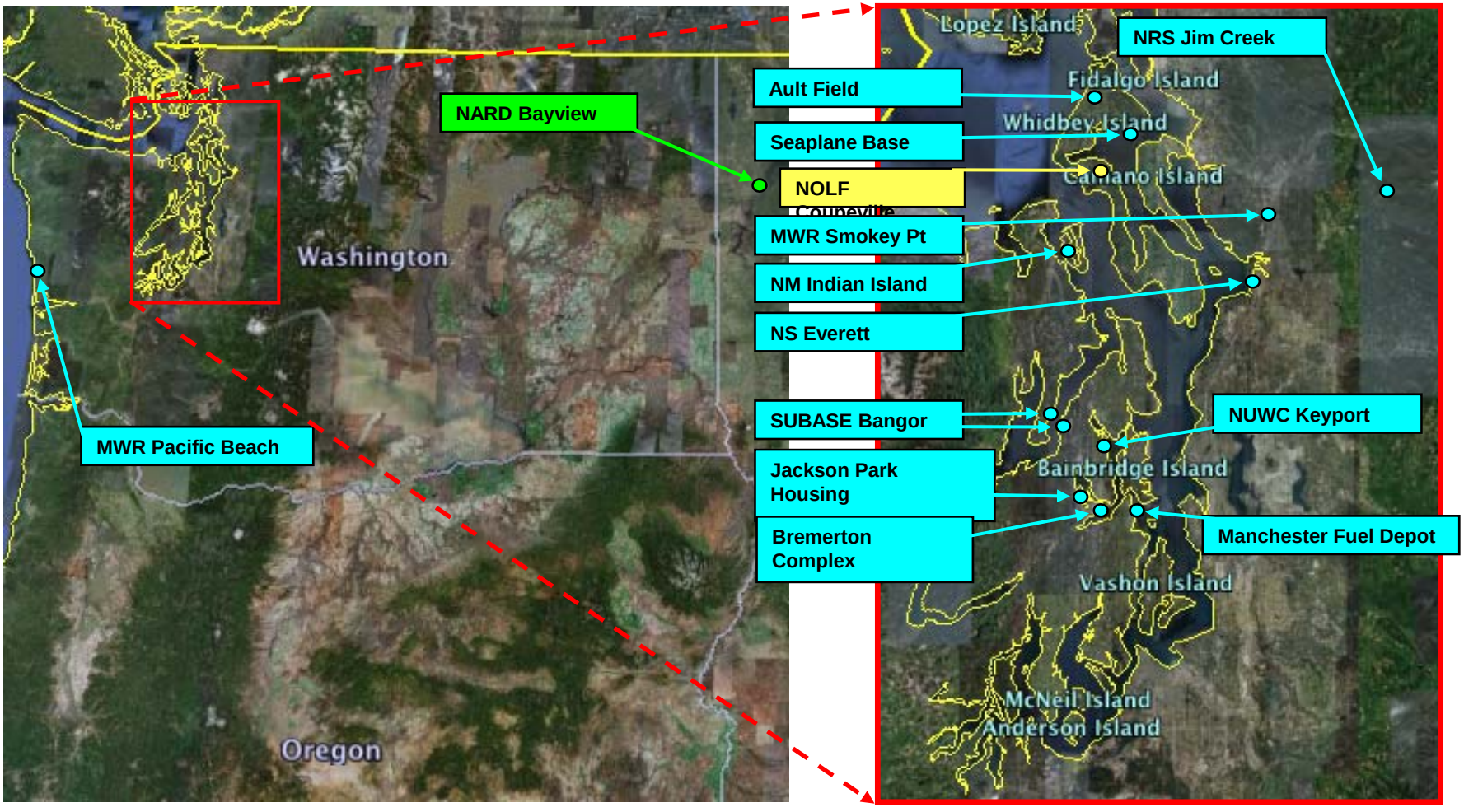
1343 electric, 280 gas, 520 water, and 120 steam meters are scheduled:



Sites not located in Washington

Sites Covered By ARRA

NOLF Not Funded

AMI AT NAVY SOUTHWEST REGION

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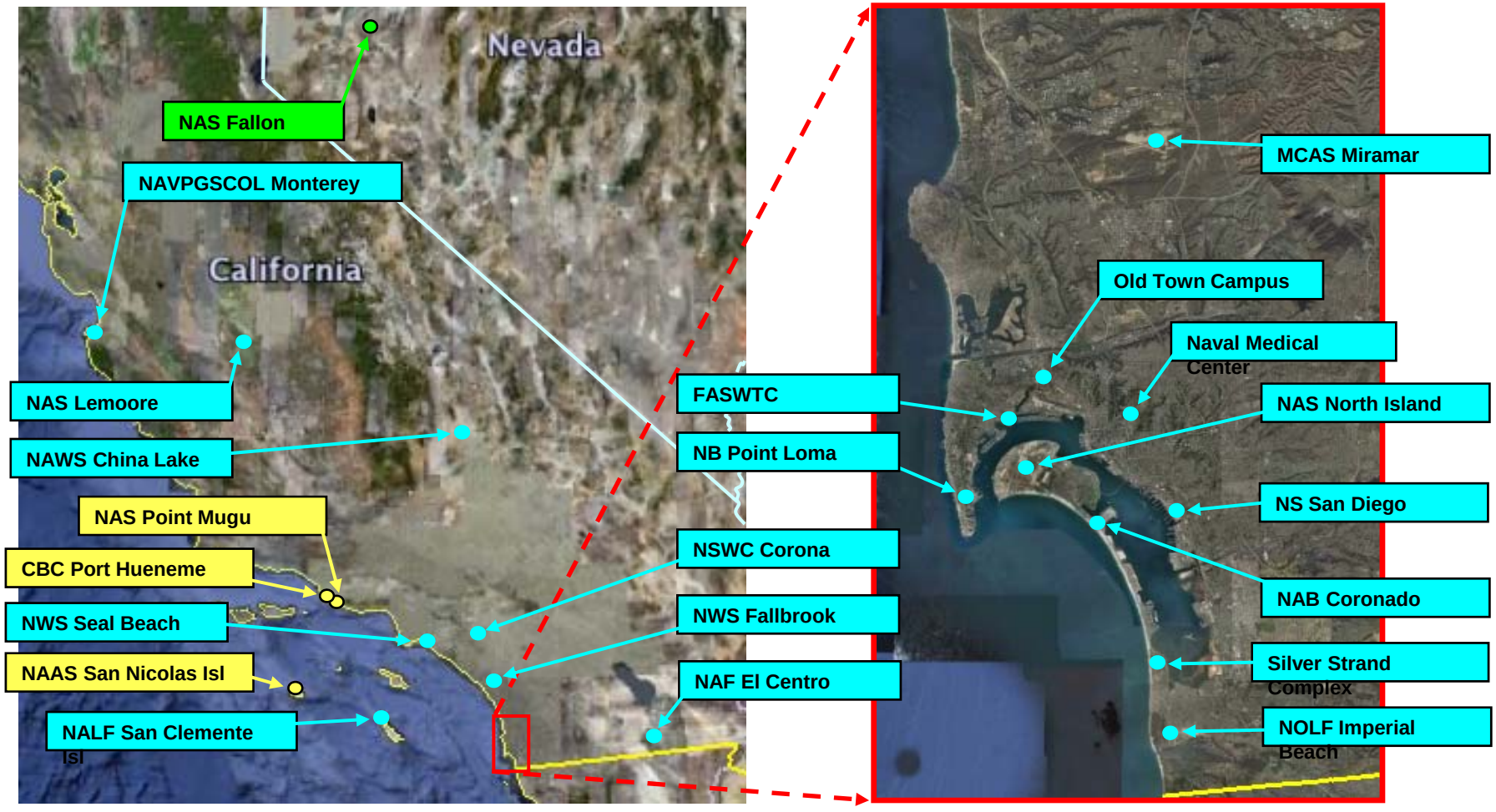
1787 electric, 378 gas, 899 water, and 15 steam meters are scheduled:



Sites not located in California

Sites Covered By ARRA

Sites Previously Funded

AMI AT NAVY SOUTHEAST REGION

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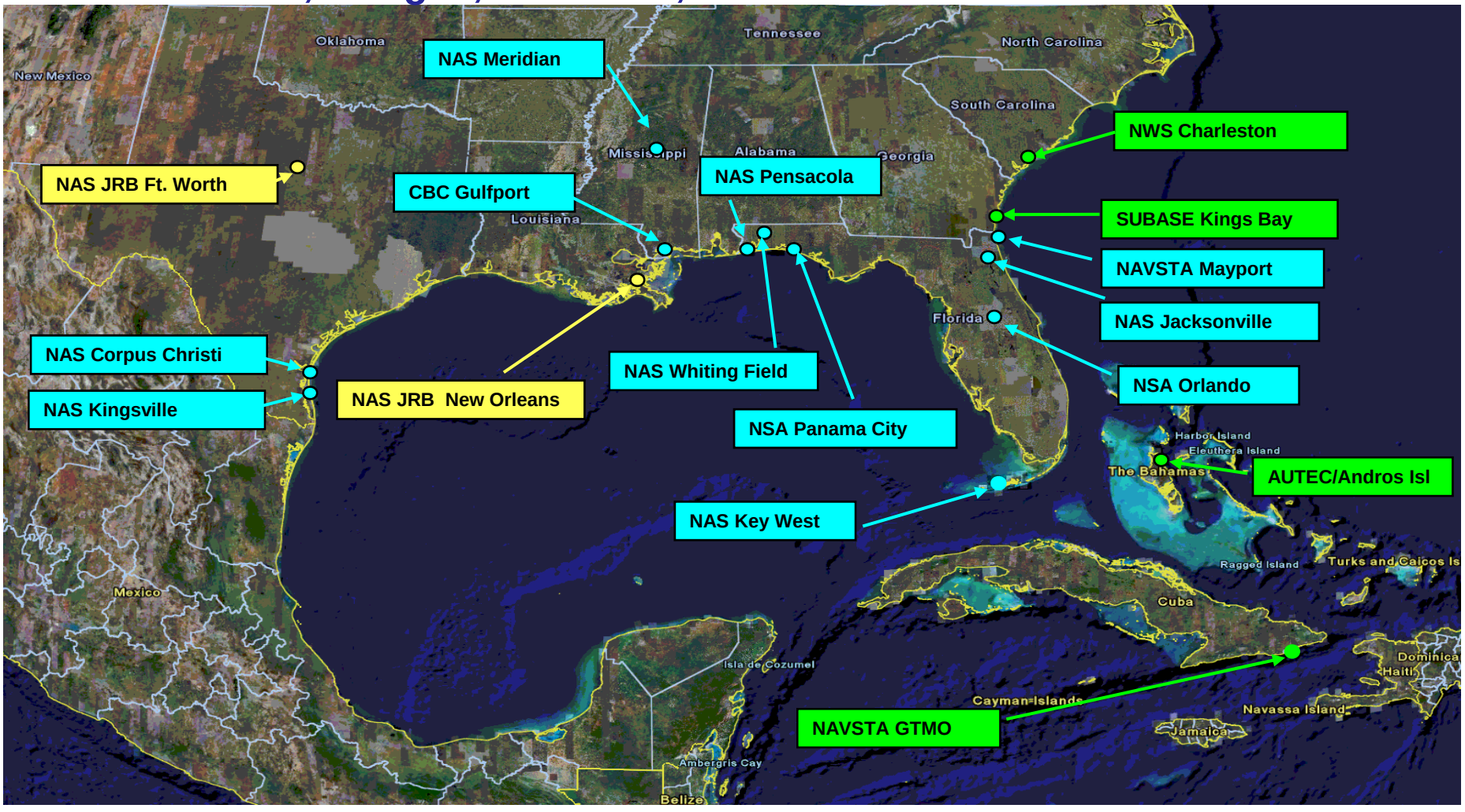
2123 electric, 339 gas, 716 water, and 23 steam meters are scheduled:



Sites not located in FL, MS, and TX

Sites Covered By ARRA

JRB Not Covered By ARRA

AMI AT NAVAL DISTRICT WASHINGTON

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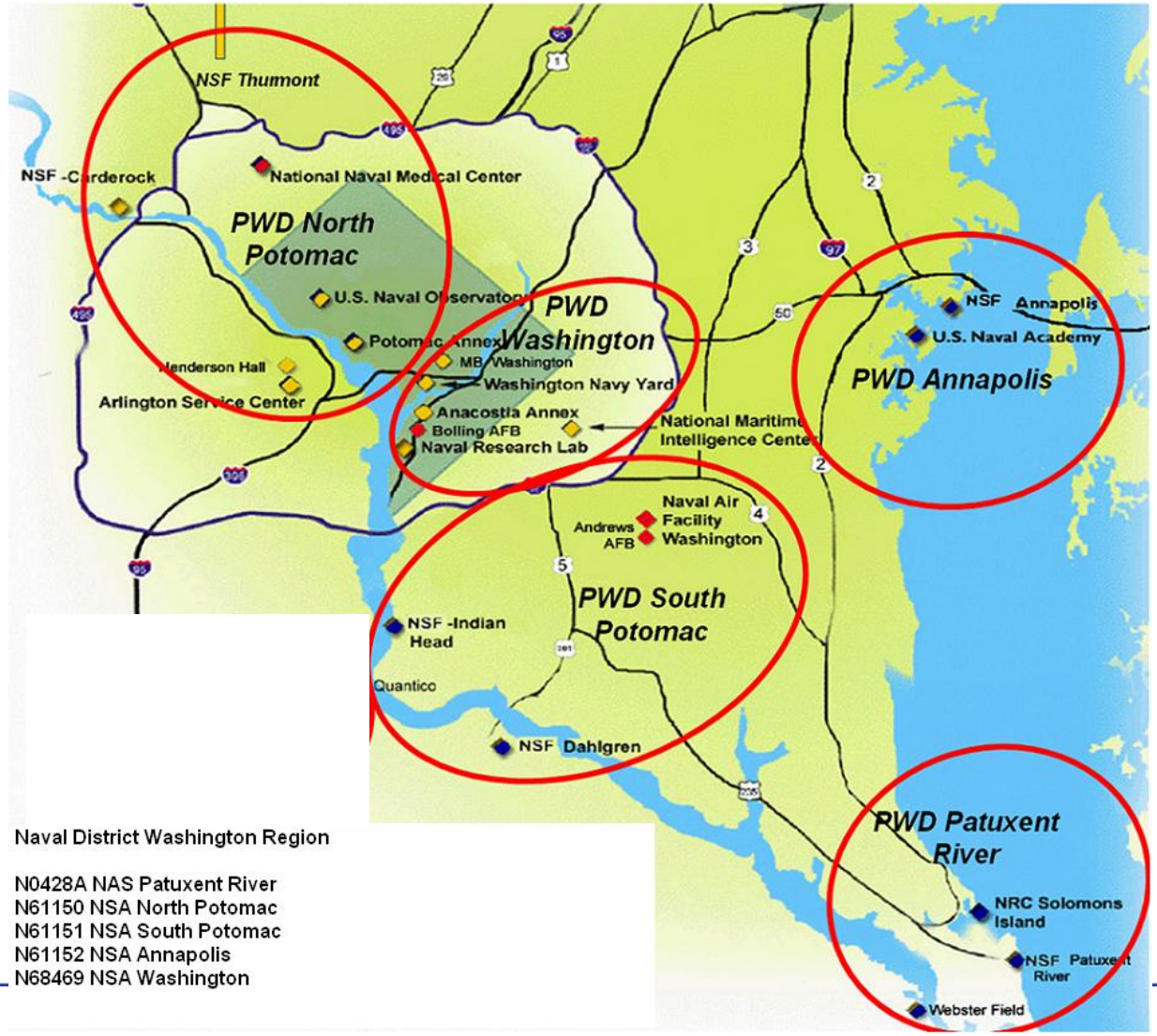
947 electric, 4 gas, 38water, and 11 steam meters are scheduled:



Naval District Washington Region

N0428A NAS Patuxent River
N61150 NSA North Potomac
N61151 NSA South Potomac
N61152 NSA Annapolis
N68469 NSA Washington

UNIQUE CHALLENGES OF NAVY AMI PROJECT

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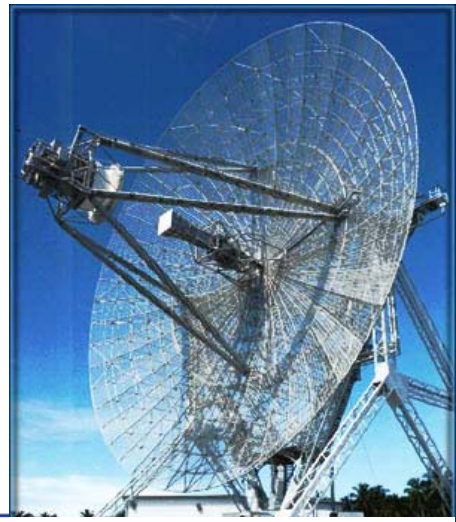
COMMUNICATION:

- **Use of wireless communication is restricted to prevent interference with aircraft controllers, radars, etc.**
- **Wireless channels/bands must be selected in coordination with spectrum coordinators and security managers**
- **Technology must be available for remote shutdown of data transmitters from the DAS when spectrum coordinators demand**



UNIQUE CHALLENGES OF NAVY AMI PROJECT

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INFORMATION ASSURANCE:

- **Unique DoD information assurance (IA) requirements and security requirements**
- **Data accreditation, and intrusion detection systems are required**

UTILITY/ENERGY MANAGEMENT:

- **Arrangement with about 100 utilities throughout the world, and their policies on metering/data management**
- **Arrangement with multiple commanders and various energy management practices at different FECs and bases**
- **All Navy AMI meters are Commercial & Industrial type**
- **The project deals with many commodities: electric, steam, water, HP/LP air, sewage, HP/LP gas**

LESSONS LEARNED THUS FAR

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- **Enterprise wide objectives, strategy, and performance metrics**
- **Mix of technology based on local / regional requirements (no silver bullet)**
- **The optimum communication solution is usually a combination of wired and wireless technologies**
- **Flexible data architecture and distribution**
- **Regular program reviews on status, success and roadblocks**
- **Incorporate security early in the functional requirements & systems design efforts**
- **Flexible implementation schedule to accommodate funding changes**
- **To get the MACC Contractors involved in some decision making process under SCAN supervision**

Different task orders or sites require different solutions, that can be designed and planned by Navy-Contractors team work

SITE CHARACTERIZATION EFFORT

- Performed in Southwest and Southeast Regions
- URS/KEMA team has performed site surveys and communicate with government employees to gather and organize as much information as possible
- As the result, accurate assumptions are presented to AMI MACC contractors as a part of the RFTOP
- Most suitable communication solutions, available metering data, maps, drawings, critical point of contacts, installation parameters… have been processed through the project
- Site Characterization has determined what percentage of metering equipment at each base can be reused

PARTNERSHIP WITH UTILITIES ON COMMON GOALS

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- **Meetings have been held between the Navy and utilities such as Southern California Edison, San Diego Gas and Electric, and ENDESA, Spain**
- **Partnership necessary to arrange ongoing Navy AMI effort, share lessons learned, and participate in utilities' demand response and Smart Grid projects**
- **SCE to assist NAVFAC ESC in demand response programs; and Endesa to work with Navy on HAN and Smart Grid implementations**
- **Partnership will also be evaluated with *Google PowerMeter* program*, NIST Smart Grid* effort, and similar initiatives**

SmartGrid NIST National Institute of Standards and Technology

endesa

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