

Smart Grid Spectrum Development & Planning Tool



Micronet White Paper #11-501

**DATABASE OF USE CASES DEVELOPED BY SG-NETWORKS
TASK FORCE WITHIN OPEN SG, COMBINED WITH CENSUS
BUREAU DEMOGRAPHIC ANALYSIS, DEPARTMENT OF
ENERGY DATA ON UTILITY SALES AND OPERATIONAL
GUIDELINES**

SG-Networks Database



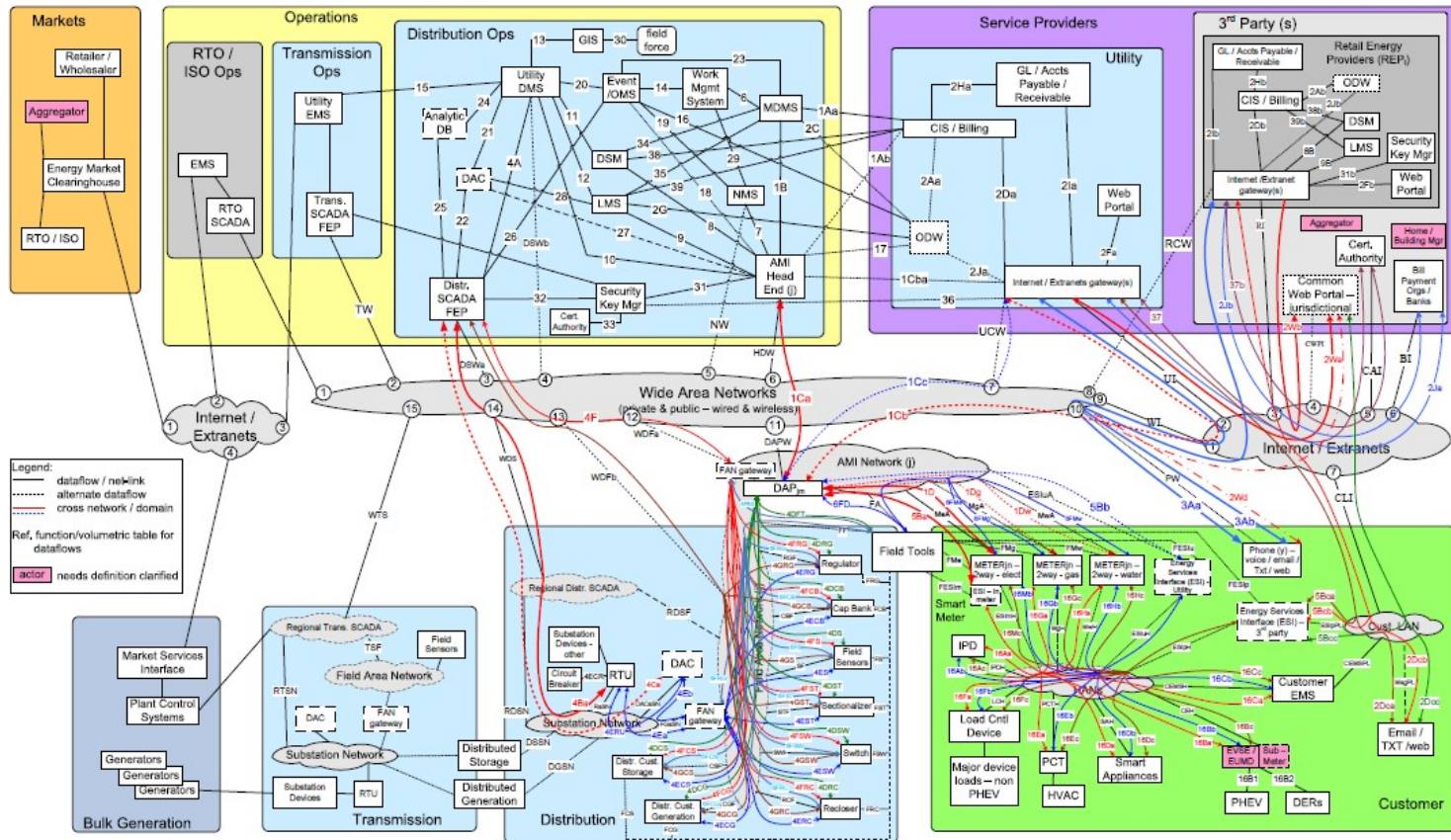
- This presentation starts with a description of the SG-Networks Database and its extension into a planning tool for Spectrum Requirements Analysis on a regional basis
- The tool is being designed to support the case for dedicated spectrum allocations to the Utility Industry for Smart Grid applications

System Diagram



Smart Grid Conceptual Actors / Data Flow Diagram – Cross Domain Network Focused – OpenSG / SG-Network TF

DRAFT 11Apr2011
Base – file SG-NET-diagram-0,7b.vsd
page size: ANSI-D



System Requirements Specification



SG Network System Requirements Specification v5.0-draft1a.xls [Compatibility Mode] - Microsoft Excel

| | A | B | C | D | E | F | G | H | I | J | K | L |
|----|-----------|-----------|---|-----------------------------|-----------------------|---------------|---|---|-------------------------------|---------------------|--|---|
| | Reqmt Ref | Flow Type | Data Flow Ref (min set that includes opts) - SG-Net Diag | Data Flow from Actor | Data Flow to Actor | Use Case F | Requirements (assumed electrical unless noted otherwise) | Payload Name - Specific Data/Mesg (Logical - info cont) | Payload Type (cmd, ack, resp) | Daily Clock Periods | How Often | Reliability |
| 1 | MR-001 | P | IAa | CIS/Billing - Utility | MDMS | Meter Reading | CIS/Billing - Utility shall be able to send bulk meter read information requests to MDMS | bulk_mtr-read_cmd | cmd | 6PM - 6AM | typically performed in x batches of y number meters z times per day; (x) * (y) = total 2-Way Meters deployed per named utility | > 99.5% |
| 2 | MR-005 | P | IB | MDMS | AMI Head-End | Meter Reading | MDMS shall be able to send bulk meter read information requests to AMI Head-End | bulk_mtr-read_cmd | cmd | 6PM - 6AM | typically performed in x batches of y number meters z times per day; (x) * (y) = total 2-Way Meters deployed per named utility | > 99.5% |
| 3 | MR-006 | P | IAa | MDMS | CIS/Billing - Utility | Meter Reading | MDMS shall be able to process & send bulk meter read information data to CIS/Billing - Utility | bulk_mtr-read_resp-data | resp-data | 6PM - 6AM | typically performed in x batches of y number meters z times per day; (x) * (y) = total 2-Way Meters deployed per named utility | > 99.5% |
| 4 | MR-013 | P | IB | AMI Head-End | MDMS | Meter Reading | AMI Head-End shall be able to process & forward on-demand meter read data to MDMS | bulk_mtr-read_resp-data | resp-data | 6PM - 6AM | typically performed in x batches of y number meters z times per day; (x) * (y) = total 2-Way Meters deployed per named utility | > 99.5% |
| 5 | MR-036 | P | [IDg or (16Ga + 5Ba) or (16Gb + 5Bb)] + [ICa or (1Cb + 1Cba) or (1Co + 1Cba)] | 2-Way Meter - Gas C/I | AMI Head-End | Meter Reading | 2-Way Meter - Gas (Commercial/Industrial) shall be able to send multi interval-data meter reads data to AMI Head-End | Mtr-read_multi-interval-data_resp-data | resp-data | 24x7 | 1-6 trans per day per gas C/I meter. Max have 15min vs 1hr interval data | 90% success every 4-6 hours, 98% success over a day, > 99.5% over two days |
| 6 | MR-037 | P | [IDg or (16Ga + 5Ba) or (16Gb + 5Bb)] + [ICa or (1Cb + 1Cba) or (1Co + 1Cba)] | 2-Way Meter - Gas Resdnt | AMI Head-End | Meter Reading | 2-Way Meter - Gas (Residential) shall be able to send multi interval-data meter reads data to AMI Head-End | Mtr-read_multi-interval-data_resp-data | resp-data | 24x7 | 1-6 trans per day per gas resdnt meter, with 4hr - 24h interval data | 90% success every 4-6 hours, 98% success over a day, > 99.5% over two days |
| 16 | MR-038 | P | ID + [ICa or (1Cb + 1Cba) or (1Co + 1Cba)] | 2-Way Meter - Electr C/I | AMI Head-End | Meter Reading | 2-Way Meter - Electric (Commercial/Industrial) shall be able to send multi interval-data meter reads data to AMI Head-End | Mtr-read_multi-interval-data_resp-data | resp-data | 24x7 | 12-24 trans per day per electric C/I meter, Intervals of 15min to 1hr, 4-20 data points per interval | > 98% success every 2 hours, > 99.5% success over 2 days, > 99.5% over two days |
| 26 | MR-039 | P | ID + [ICa or (1Cb + 1Cba) or (1Co + 1Cba)] | 2-Way Meter - Electr Resdnt | AMI Head-End | Meter Reading | 2-Way Meter - Electric (Residential) shall be able to send multi interval-data meter reads data to AMI Head-End | Mtr-read_multi-interval-data_resp-data | resp-data | 24x7 | 4-6 trans per day per electric resdnt meter, Intervals of 15min to 1hr, 4-8 data points per interval | 90% success every 4-6 hours, 98% success over a day, > 99.5% over two days |
| 32 | MR-113 | P | [IDw or (16Ha + 5Ba) or (16Hb + 5Bb)] + [ICa or (1Cb + 1Cba) or (1Co + 1Cba)] | 2-Way Meter - Water | AMI Head-End | Meter Reading | 2-Way Meter - Water shall be able to send meter read data to AMI Head-End | Mtr-read_data_resp-data | resp-data | 24x7 | 1 trans per day per water meter, with days data | 98% success over a day, > 99.5% over two days |
| 38 | MR-007 | P | IB + [ICa or (1Cb + 1Cba) or (1Cba + 1CB)] + IB + [ICa or (1Cb + 1Cba) or (1Cba + 1CB)] | MDMS | 2-Way Meter - Electr | Meter Reading | MDMS may be able to send multiple interval meter reading request to 2-Way Meter - Electr | Mtr-read_multi-interval-data_cmd | cmd | 7AM - 6PM | 25 trans per 1000 electr mtrs per day | > 98% |
| 48 | MR-123 | P | IB + [ICa or (1Cb + 1Cba) or (1Cba + 1CB)] + IB + [ICa or (1Cb + 1Cba) or (1Cba + 1CB)] | MDMS | 2-Way Meter - Meter | Meter Reading | MDMS may be able to send multiple interval meter reading request to 2-Way Meter - Meter | Mtr-read_multi-interval-data_cmd | cmd | 7AM - 6PM | 25 trans per 1000 gas mtrs per day | > 98% |

Ready | Reqmts-Combined | Payload_attrib_LIC_CIA_rtn-WIP | draft1-usecase-per-payload | payload-mtr-splits | 75%



SG-Networks Database

The first and primary role is to document the work of SG-Networks, and extend by showing individual route options for Application Level Connections between Source Actors with Target Actors

- The database was originally conceived as a vehicle for making the SG-Networks Use Case data searchable and more useable.
- At this instant in time, the number of individual records is over 7000 and growing based on the 19 Use Cases shown
- The objective of SG-Networks is to document approximately 30 Use Cases

Use Cases Modeled



Use Case Descriptions

- Customer Information & Messaging
- Demand Response – Direct Load Control (DR-DLC)
- Dispatch Distributed Customer Storage
- Distribution System Demand Response (DSDR)
- Fault-Clear-Isolate-Reconfigure (FCIR) – Distributed Data Acquisition and Control (DAC)
- FCIR – Distribution Management System (DMS)
- Field Distribution Automation (DA) Maintenance

Use Case Descriptions

- Firmware/Program Update
- Islanded Distributed Customer Storage
- Meter Events
- Meter Reading
- Outage Restoration Management (ORM)
- Plug-In Electric Vehicles
- Premise Network Administration
- Prepay
- Price
- Service Switch
- Volt/Var-Centralized Control



SG-Networks Database

This overview focuses on content and derivation of content within the database

- The database starts with a copy of the System Requirements Specification
- Tables of Actors, Use Cases, Payloads, Payload Types, etc. were added
- A table of Network Cloud Crossings was established from the System Diagram
- Traffic Analysis combines the Payload information with transmission timing information from the ***How Often*** column of the Requirements Specification
- Addition of a User Profile section allows multiple users to generate and save analysis data



Traffic Analysis

While the mechanics of traffic analysis are described here, a key issue is the fact that messages are directed from a Single Source Actor to a Single Target Actor

- Individual Records contain Payload Length in Bytes, Source Actor and Target Actor
- Payload data contains no protocol overhead of any kind
- The How Often column provides details of when the message is sent, and on what basis
- Software routines have been written to parse the *How Often* column and allow the aggregation of traffic on a uniform basis

Application Level Query (Connects Source Actor to Target Actor)

This query shows the connection between two actors at Level 7, and includes in the DataFlowRef column, a complex statement of all possible routes that a payload may take.

User Profiles
MICRONET-1

Use Case Records

| RqmtRef | DataFlowRef | Source Actor | Target Actor | Use Case | Requirements |
|---------|----------------|--------------|---------------------|--------------------|---|
| MR-005 | 1B | MDMS | AMI Head-End | Meter Reading | MDMS shall be able to send bulk meter read information requests to |
| FPU-001 | [1Ca or 1Cba + | AMI Head-End | 2-Way Meter | Firmware / Program | AMI Head-End shall be able to process & send metrology firmware up |
| FPU-007 | [1Ca or 1Cba + | AMI Head-End | 2-Way Meter | Firmware / Program | AMI Head-End may be able to process & send metrology firmware up |
| FPU-013 | [1Ca or 1Cba + | AMI Head-End | 2-Way Meter | Firmware / Program | AMI Head-End may be able to process & send metrology firmware up |
| FPU-026 | [1Ca or 1Cba + | AMI Head-End | 2-Way Meter | Firmware / Program | AMI Head-End shall be able to process & send NIC firmware update i |
| FPU-032 | [1Ca or 1Cba + | AMI Head-End | 2-Way Meter | Firmware / Program | AMI Head-End may be able to process & send NIC firmware update b |
| FPU-038 | [1Ca or 1Cba + | AMI Head-End | 2-Way Meter | Firmware / Program | AMI Head-End may be able to process & send NIC firmware update r |
| FPU-051 | [1Ca or 1Cba + | AMI Head-End | ESI - In Meter, ESI | Firmware / Program | AMI Head-End shall be able to process & send ESI firmware update r |
| FPU-057 | [1Ca or 1Cba + | AMI Head-End | ESI - In Meter, ESI | Firmware / Program | AMI Head-End may be able to process & ESI-In-Utility firmware updat |
| FPU-063 | [1Ca or 1Cba + | AMI Head-End | ESI - In Meter, ESI | Firmware / Program | AMI Head-End may be able to process & ESI-In-Utility firmware updat |
| FPU-076 | [1Ca or 1Cba + | AMI Head-End | DAP | Firmware / Program | AMI Head-End shall be able to process & send DAP firmware update |
| FPU-087 | [1Ca or 1Cba + | AMI Head-End | 2-Way Meter | Firmware / Program | AMI Head-End shall be able to process & send metrology program up |
| FPU-093 | [1Ca or 1Cba + | AMI Head-End | 2-Way Meter | Firmware / Program | AMI Head-End may be able to process & send metrology program up |
| FPU-099 | [1Ca or 1Cba + | AMI Head-End | 2-Way Meter | Firmware / Program | AMI Head-End may be able to process & send metrology program up |
| FPU-112 | [1Ca or 1Cba + | AMI Head-End | 2-Way Meter | Firmware / Program | AMI Head-End shall be able to process & send NIC program update r |
| FPU-118 | [1Ca or 1Cba + | AMI Head-End | 2-Way Meter | Firmware / Program | AMI Head-End may be able to process & send NIC program update b |

Use Cases
Cust. Info / Mmsg'ng
Demand Response System
Dispatch Distr Storage - Batts
DR-DLC
DSDR - Centralized Control
Fault Management System
FCIR - Distr DAC
FCIR - DMS

Actors
2-Way Meter - Electr
2-Way Meter - Electr C/I
2-Way Meter - Gas C/I
2-Way Meter - Gas Resdnt
2-Way Meter - Water
AMI Head-End
Analytic DB
Bill Payment Orgs/Banks

Payload Name
Audit_Application_Event
batt_pwr_notification
btry_pwr_notification
bulk_Cust_Subset_Acct_Info_REP_data
bulk_Cust_Subset_Acct_Info_Util_data
bulk_Cust_Subset_Acct_Premise_Info_REP_data
bulk_Cust_Subset_Acct_Premise_Info_Util_data

Payload Types
acct_data
ack
alarm
alert
cmd
cmd-err
comm-err

Networks/Clouds
Internet/Extranets
WAN
AMI
PSN_Cellular
FAN
Substation
Transmission_SCADA
Distribution_SCADA

Buttons: Run Query!, Save to Current User Profile, Generate Report, Export to CSV

Network Level Query

(Actor to Actor Direct Connections As Elements of the Statement of All Possible Paths That a Payload May Take Across the Grid)



Network Query Analysis

User Profiles: MICRONET-1

Use Case Records

| RqmtRef | DataFlowRef | Source Actor | Target Actor | Use Case | Requirements |
|----------|-------------|-------------------|-------------------|------------------|---|
| FCIR-S-0 | 4ERC | Feeder Recloser | FAN gateway - sub | FCIR - Distr DAC | Feeder Recloser shall be able to send fault lock out alarm to FAN gateway - sub |
| FCIR-S-0 | 4Eb | FAN gateway - sub | DAC - sub | FCIR - Distr DAC | FAN gateway - sub shall be able to process & forward fault lock out alarm to DAC - sub |
| FCIR-S-0 | 4ECR | Circuit Breaker | RTU | FCIR - Distr DAC | Circuit Breaker shall be able to send fault lock out alarm to RTU |
| FCIR-S-0 | 4ERU | RTU | DAC - sub | FCIR - Distr DAC | RTU shall be able to process + forward fault lock out alarm to DAC - sub |
| FCIR-S-0 | 4Ca | DAC - sub | Distr SCADA FEP | FCIR - Distr DAC | DAC - sub shall be able to process & forward fault lock out alarm to Distr SCADA FEP |
| FCIR-S-0 | 4A | Distr SCADA FEP | DMS | FCIR - Distr DAC | Distr SCADA FEP shall be able to process & forward fault lock out alarm to DMS |
| FCIR-S-0 | 26 | Distr SCADA FEP | DMS | FCIR - Distr DAC | Distr SCADA FEP may be able to process & forward fault lock out alarm to DMS |
| FCIR-S-0 | 25 | Distr SCADA FEP | Analytic DB | FCIR - Distr DAC | Distr SCADA FEP may be able to process & forward fault lock out alarm to Analytic DB |
| FCIR-S-0 | 20 | DMS | QMS | FCIR - Distr DAC | DMS may be able to process & send fault lock out alarm to QMS |
| FCIR-S-0 | 24 | DMS | Analytic DB | FCIR - Distr DAC | DMS may be able to process & send fault lock out alarm to Analytic DB |
| FCIR-S-0 | 4Eb | DAC - sub | FAN gateway - sub | FCIR - Distr DAC | DAC - sub shall be able to process & send device status request to FAN gateway - sub |
| FCIR-S-0 | 4ERC | FAN gateway - sub | Feeder Recloser | FCIR - Distr DAC | FAN gateway - sub shall be able to process & forward device status request to Feeder Recloser |
| FCIR-S-0 | 4ESW | FAN gateway - sub | Feeder Switch | FCIR - Distr DAC | FAN gateway - sub shall be able to process & forward device status request to Feeder Switch |
| FCIR-S-0 | 4EST | FAN gateway - sub | Sectionalizer | FCIR - Distr DAC | FAN gateway - sub shall be able to process & forward device status request to Sectionalizer |
| FCIR-S-0 | 4ERU | DAC - sub | RTU | FCIR - Distr DAC | DAC - sub shall be able to process + forward device status request to RTU |
| FCIR-S-0 | 4ECR | RTU | Circuit Breaker | FCIR - Distr DAC | RTU shall be able to send device status request to Circuit Breaker |

Actors:

- 2-Way Meter - Electr
- 2-Way Meter - Electr C/I
- 2-Way Meter - Gas C/I
- 2-Way Meter - Gas Resdnt
- 2-Way Meter - Water
- AMI Head-End
- Analytic DB
- Bill Payment Orgs/Banks

Payload Name:

- Audit_Application_Event
- batt_pwr_notification
- btry_pwr_notification
- bulk_Cust_Subset_Acct_Info_REP_data
- bulk_Cust_Subset_Acct_Info_Util_data
- bulk_Cust_Subset_Acct_Premise_Info_REP_data
- bulk_Cust_Subset_Acct_Premise_Info_Util_data
- bulk_Cust_Subset_meter_comm_Info_Util_data
- bulk_Cust_Subset_meter_Info_Util_data

Payload Types:

- acct_data
- ack
- alarm
- alert
- cmd
- cmd-err
- comm-err
- evnt_data
- fault

Networks/Clouds:

- Internet/Extranets
- WAN
- AMI
- PSN_Cellular
- FAN
- Substation
- Transmission_SCADA
- Distribution_SCADA
- Distr_Scada

Buttons:

- Run Query
- Save to Current User Profile
- Generate Report
- Export to CSV

Alternate Path Application Level Query

The same query on AMI traffic, where a single transit path is specified, cuts down on the amount of traffic considerably that a given utility will have to accommodate.

Use Case Records

| RqmtRef | Selected Path | DataFlowRef | Source Actor | Target Actor | Use Case | Requirements |
|---------|---------------|-------------------|-------------------|--------------|---------------|--|
| MR-036 | True | 16Ga+5Ba+1Cb+1Cba | 2-Way Meter - Gas | AMI Head-End | Meter Reading | 2-Way Meter - Gas (Commercial/Industrial) st |
| MR-037 | True | 16Ga+5Ba+1Cb+1Cba | 2-Way Meter - Gas | AMI Head-End | Meter Reading | 2-Way Meter - Gas (Residential) st |

Network Crossing Paths

| DataFlowRef | SourceActor | TargetActor |
|-------------------|-----------------------|--------------|
| 1Dg+1Cb+1Cba | 2-Way Meter - Gas C/I | AMI Head-End |
| 1Dg+1Cc+1Cba | 2-Way Meter - Gas C/I | AMI Head-End |
| 16Ga+5Ba+1Ca | 2-Way Meter - Gas C/I | AMI Head-End |
| 16Ga+5Ba+1Cb+1Cba | 2-Way Meter - Gas C/I | AMI Head-End |
| 16Ga+5Ba+1Cc+1Cba | 2-Way Meter - Gas C/I | AMI Head-End |
| 16Gb+5Bb+1Ca | 2-Way Meter - Gas C/I | AMI Head-End |
| 16Cb+5Bb+1Cb+1Cba | 2-Way Meter - Gas C/I | AMI Head-End |

Note: Source and Target Actors are provided here for reference only. Since multiple actors may share this same path across the network, and only one record is displayed for a given path in this selection, the Source and Target Actors displayed here may not match the corresponding actors shown in the Use Case Records table above.

The User Profile

A User Profile has been established to allow a detailed specification of payload messaging for various use cases. A uniform area infrastructure analysis is included for estimates of equipment densities.



UtilityProfile

MICRONET-1 Export to CSV Report Save to Utility Profile

Note: Data Entries in this demonstration version of the planning tool are assigned strictly for the purpose of development, test and checkout. They do not reflect any specific Utility Network.

Infrastructure Customer Metering Substations and Field Devices DSDR/DA Field Maintenance - Centralized Control

| UTILITY | |
|-------------------------------------|-------------|
| Project | MICRONET-1 |
| Author | Jerry Armes |
| Company | Micronet |
| Utility Service Area (Square Miles) | 9286 |

| ELECTRIC METERS | |
|--|---------|
| Total Number Electric Meters | 2250000 |
| Average Number Electric Meters Per Square Mile | 242.3 |
| Average Meter to Meter Separation Distance (Miles) | .1 |
| Average Coverage Area (Square Feet) Per Meter | .004 |
| Average Radius (Miles) of Each Meter Coverage Area | .1 |

| GAS METERS | |
|-------------------------------|-------|
| Number C/I Gas Meters | 4000 |
| Number Residential Gas Meters | 4900 |
| Total Number Gas Meters | 12000 |

| TOTAL METERS | |
|---------------------|---------|
| Total Number Meters | 2262000 |

| SYSTEM PARAMETERS | |
|------------------------------------|------|
| Number Firmware Upgrades Per Month | 5 |
| Number DAP Update Events Per Day | 6800 |

| SUBSTATIONS | |
|--|------|
| Total Number Substations | 1200 |
| Average Number Substations Per Square Mile | .1 |
| Average Substation to Substation Separation Distance (Miles) | 6.3 |
| Average Coverage Area Per Substation (Square Miles) | 7.7 |
| Average Substation Service Area Radius (Miles) | 3.1 |

| PHEV | |
|---|--|
| Total Number PHEV | |
| Average Number PHEV Per Square Mile | |
| Average PHEV Coverage Area | |
| Average Distance Between PHEV Locations | |
| Average Number PHEV per DAP | |

| DATA AGGREGATION POINTS (DAPS) | |
|--|--------|
| Total Number DAPS | 300 |
| Average Number Meters Per DAP | 7540.0 |
| Average Number DAPS Per Square Mile | .032 |
| Average Coverage Area Per DAP (Square Miles) | 31.0 |
| Average Radius (Miles) of Each DAP Coverage Area | 6.3 |
| Average Distance (Miles) Between DAP Locations | 12.6 |

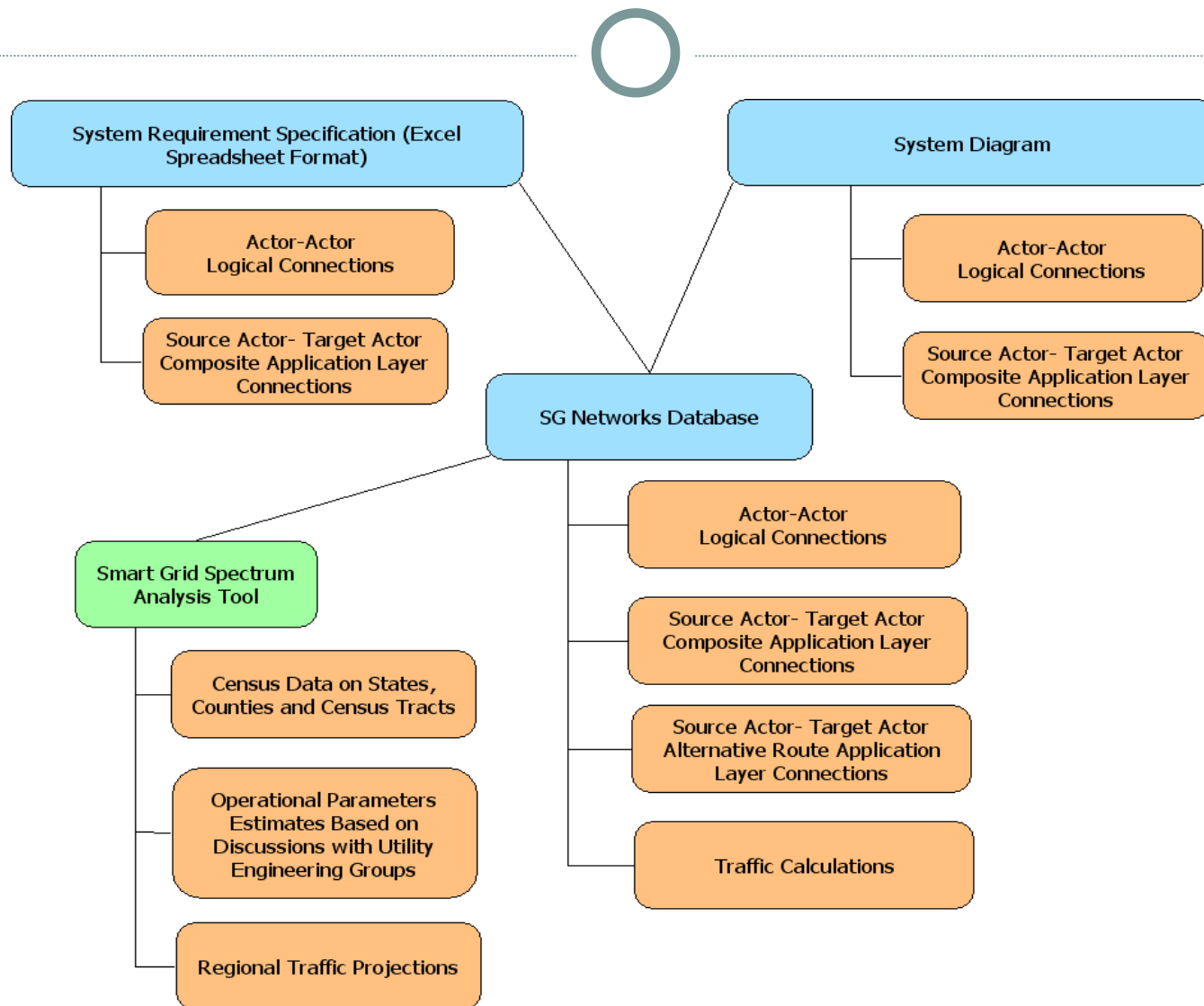
Record: 1 of 1 No Filter Search

A Spectrum Analysis Application



- Currently, the FCC has allocated no dedicated spectrum to the Utility Community
- A Spectrum Analysis Tool developed around the database is a key instrument in making the necessary engineering calculations
 - A combination of Smart Grid traffic queries is a good starting point
 - However, considering that the database defines Actor-Actor Connections, it becomes necessary to address specific geographic areas to define aggregate traffic levels

Spectrum Analysis Tool Heritage



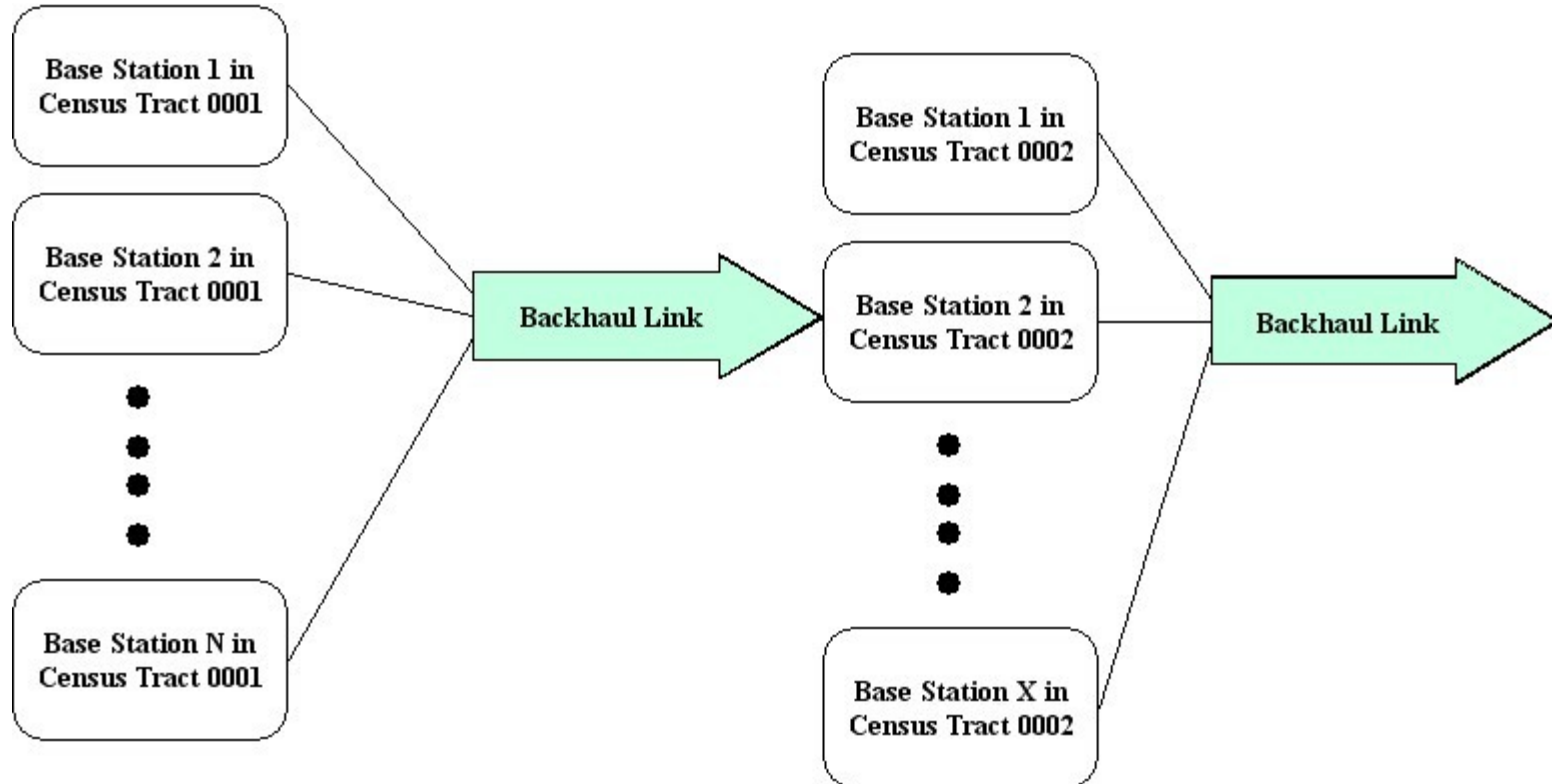


Spectrum Analysis

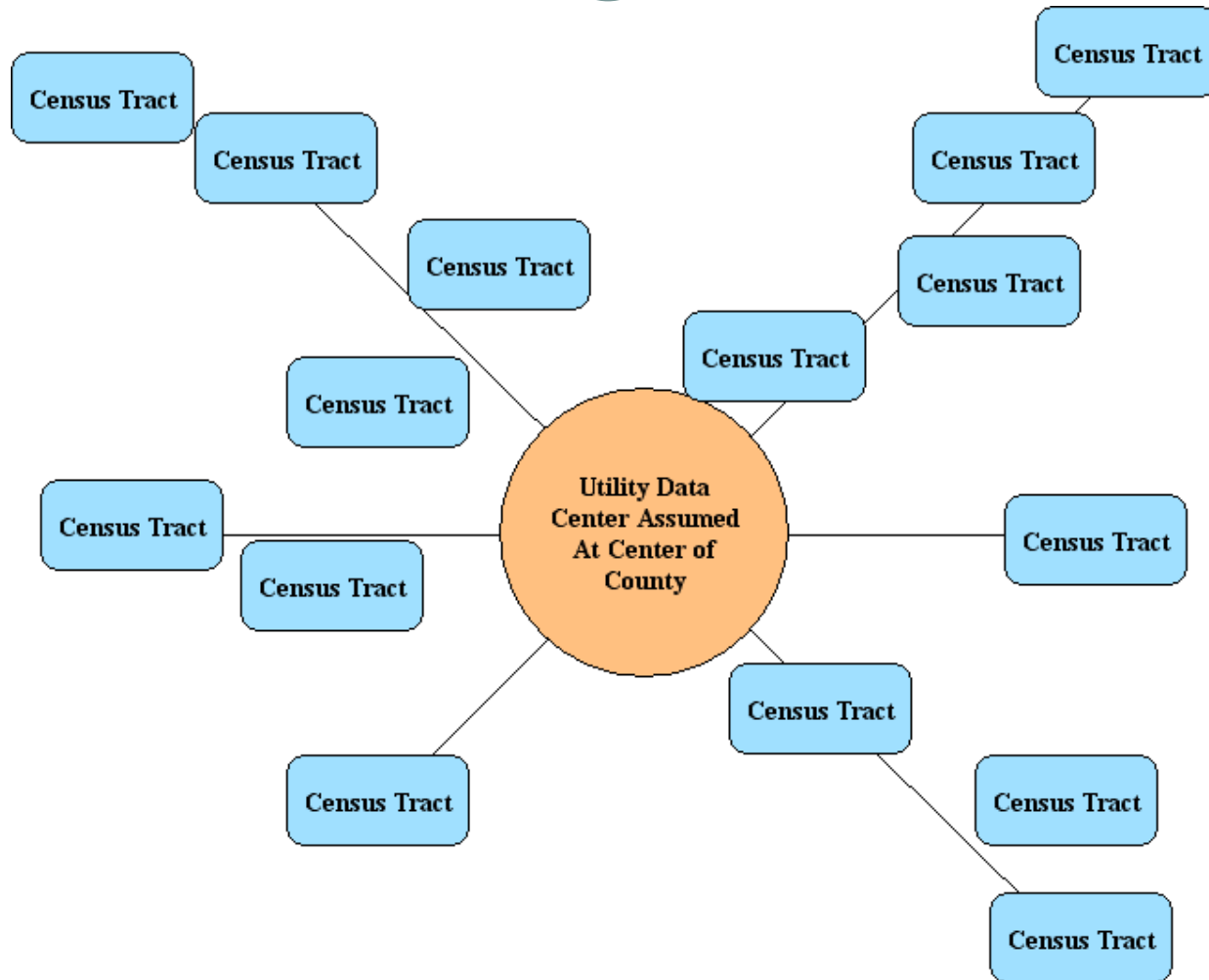
The modeling approach is to identify traffic to a Census Tract level, which can then be aggregated to a County Level rather easily.

- Having established that the SG-Networks Database defines traffic between a single Source Actor and a single Target Actor, the challenge then becomes to scale the traffic data in a way that accounts for regional differences
- As the data is being scaled to represent the User Community, the analysis also provides insight into technologies for system implementation

Data Aggregation at Census Tract Level



Data Aggregation at County Level



Spectrum Scenarios

- The first step is providing a way to build Spectrum Scenarios consisting of selected States and Counties of Interest. The application will analyze the demographics of each Census Tract, calculate azimuth angles and distances from the county center to the center of each census tract.

Spectrum Analysis Data Input

Select Utility Profile: MICRONET-1

Spectrum Scenarios: Alaska

Spectrum Scenario Name: Alaska

Save Spectrum Scenario

Select One or More States:

| | |
|----|-------------|
| AL | Alabama |
| AK | Alaska |
| AZ | Arizona |
| AR | Arkansas |
| CA | California |
| CO | Colorado |
| CT | Connecticut |
| DE | Delaware |
| FL | Florida |
| GA | Georgia |

Populate Counties

Select One or More Counties:

| | |
|------------------------------|----|
| Aleutians East Borough | AK |
| Aleutians West Census Area | AK |
| Anchorage Municipality | AK |
| Bethel Census Area | AK |
| Bristol Bay Borough | AK |
| Denali Borough | AK |
| Dillingham Census Area | AK |
| Fairbanks North Star Borough | AK |
| Haines Borough | AK |

Census Tracts Included in the Analysis:

| | | | |
|--------|----|-----------|-------------|
| 000100 | AK | 55.125713 | -162.030237 |
| 000100 | AK | 60.422785 | -162.453761 |
| 000200 | AK | 60.788983 | -161.777619 |
| 000300 | AK | 61.698128 | -158.428577 |

Census Tract Analysis

| Cou | CTNumber | CTAreaSqM | CountyLat | CountyLon | CTLat | CTLon | CTDistMiles | CTAzDeg | NumberRes | NumberCor | NumberInd | TotalEndPo | TotalKVALo | NumberFee | NumberSub | NumberSwi | NumberC |
|-----|----------|-----------|-----------|-----------|--------|----------|-------------|---------|-----------|-----------|-----------|------------|------------|-----------|-----------|-----------|---------|
| 201 | 000100 | 6988.1 | 55.126 | -162.03 | 55.126 | -162.03 | 0 | 306.9 | 72 | 11 | 0.21 | 83 | 24218 | 0.06 | 0.02 | 0.06 | 108.86 |
| 205 | 000100 | 21362 | 60.889 | -161.191 | 60.423 | -162.454 | 53.5 | 306.9 | 249 | 38.2 | 0.72 | 287 | 83756 | 0.21 | 0.08 | 0.21 | 376.47 |
| 205 | 000200 | 218.6 | 60.889 | -161.191 | 60.789 | -161.778 | 20.9 | 306.9 | 201 | 30.8 | 0.58 | 232 | 67610 | 0.17 | 0.07 | 0.17 | 303.9 |
| 205 | 000300 | 19052.7 | 60.889 | -161.191 | 61.698 | -158.429 | 107.3 | 57.4 | 68 | 10.4 | 0.2 | 78 | 22873 | 0.06 | 0.02 | 0.06 | 102.81 |

User Scenario Scaling Parameters



A feature similar to the User Profile allows Users to specify scaling parameters that fit their particular service area in order to make the transition from demographic data to grid end points and field devices.

User Selections

| | | | |
|-----------------------------|---|---------------------------|----------------------------------|
| User Profile Options | Wireless Area Coverage Frequency Band Selection | Spectrum Scenario Options | |
| MICRONET-1 | 3650 - 3700 | Alaska | Report |
| Propagation Model Selection | Backhaul Frequency Band Selection | | Export to CSV |
| Hata | Lower 6 GHz | | Save Spectrum Scaling Parameters |

| | |
|----------|-------------|
| Scenario | Alaska |
| Project | MICRONET-1 |
| Author | Jerry Armes |
| Company | Micronet |

| | |
|--|------|
| Average Number Feeders Per Sub | 2.5 |
| Number of End Points Per Feeder | 1400 |
| Number Redosers Per Feeder | 2 |
| Number Switches Per Feeder | 1 |
| Uncorrected Residential Power Factor (%) | 85 |
| Uncorrected Commercial Power Factor (%) | 90 |
| Corrected Power Factor Objective (%) | 95 |
| Average Capacitor Bank Rating (KVAR) | 12.5 |
| Ratio of Capacitor Banks to Voltage Regulators | 3 |

Specification of Traffic Across the Grid

A query of the SG-Net database produces records describing the payloads that cross the grid. In this example, a specific set of network paths have been packed into one of multiple selectable options. The database also supports complete user freedom in these selections.

Alternate Path Queries | Traffic Analysis

Use Profiles: MICRONET-1 | Use Spectrum Scenarios For Demographic Scaling: | Representative Network Crossing Options: Option A

Use Cases

| Cust. Info / Msg'n | RqmtRef | DataFlowRef | ActorA | ActorB | UseCase | Requirements | PayloadT | PayloadS | DailyCloc | HowOftr |
|--------------------------------|---------|-------------|------------------|-----------------------|--------------------|--|-----------|-----------|-----------|-------------|
| Demand Response System | MR-356 | MgH + CWMSI | 2-Way Meter | Cust. EMS | Meter Reading | 2-Way Meter - Gas shall be able to report & send | resp-data | Intgrt | 7AM - 10 | 1 trans p |
| Dispatch Distr Storage - Batts | MR-370 | MwH + CWMSI | 2-Way Meter | Cust. EMS | Meter Reading | 2-Way Meter - Water shall be able to report & se | resp-data | Intgrt | 7AM - 10 | 1 trans p |
| DR-DLC | MR-227 | MgH + CWMSI | 2-Way Meter | Cust. EMS | Meter Reading | 2-Way Meter - Gas shall be able to report & send | cmd-err | Intgrt | 7AM - 10 | 1 trans p |
| DSDR - Centralized Control | MR-241 | MwH + CWMSI | 2-Way Meter | Cust. EMS | Meter Reading | 2-Way Meter - Water shall be able to report & se | cmd-err | Intgrt | 7AM - 10 | 1 trans p |
| Fault Management System | td-1179 | MgH + CWMSI | 2-Way Meter | Cust. EMS | PrePay | 2-Way Meter - Gas shall be able to report & send | resp-data | Intgrt | 7AM - 10 | 1 trans p |
| FCIR - Distr DAC | td-1193 | MwH + CWMSI | 2-Way Meter | Cust. EMS | PrePay | 2-Way Meter - Water shall be able to report & se | resp-data | Intgrt | 7AM - 10 | 1 trans p |
| FCIR - nmc | PP-252 | 16Ca | 2-Way Meter | Cust. EMS | PrePay | ESI - In Meter shall be able to report & send Mete | cmd-err | Intgrt | 7AM - 10 | 1 trans p |
| | td-1245 | MgH + CWMSI | 2-Way Meter | Cust. EMS | PrePay | 2-Way Meter - Gas shall be able to report & send | cmd-err | Intgrt | 7AM - 10 | 1 trans p |
| | td-1259 | MwH + CWMSI | 2-Way Meter | Cust. EMS | PrePay | 2-Way Meter - Water shall be able to report & se | cmd-err | Intgrt | 7AM - 10 | 1 trans p |
| | FPU-077 | 1Ca | AMI Head-End | DAP | Firmware / Program | AMI Head-End shall be able to process & send DA | cmd | Native or | 7AM - 6P | 2 trans p |
| | FPU-138 | 1Ca | AMI Head-End | DAP | Firmware / Program | AMI Head-End shall be able to process & send DA | cmd | Native or | 7AM - 6P | x trans p |
| | FPU-225 | 6FD | Field Tool | DAP | Firmware / Program | Field Tool shall be able to process & send DAP firm | cmd | Native or | 7AM - 6P | x trans p |
| | FPU-228 | 6FD | Field Tool | DAP | Firmware / Program | Field Tool shall be able to process & send DAP prc | cmd | Native or | 7AM - 6P | x trans p |
| | MR-001 | 1Aa | CIS/Billing - Ut | MDMS | Meter Reading | CIS/Billing - Utility shall be able to send bulk meter | cmd | Intgrt | 6PM - 6A | typically 1 |
| | MR-006 | 1Aa | MDMS | CIS/Billing - Utility | Meter Reading | MDMS shall be able to process & send bulk meter | resp-data | Intgrt | 6PM - 6A | typically 1 |
| | MR-036 | 1Dg+1Ca | 2-Way Meter | AMI Head-End | Meter Reading | 2-Way Meter - Gas (Commercial/Industrial) shall b | resp-data | Native or | 24x7 | 1-6 trans p |
| | MR-031 | 1Ca + 4ESW | DMS | Feeder/CBC | Network Control | DMS shall be able to send Feeder/CBC new confi | cmd | Native or | 24x7 | Average |

Actors

- 2-Way Meter - Electr
- 2-Way Meter - Electr C/I
- 2-Way Meter - Gas C/I
- 2-Way Meter - Gas Resndt
- 2-Way Meter - Water
- AMI Head-End
- Analytic DB
- Bill Payment Orgs/Banks

Payload Name

- Audit_Application_Event
- batt_pwr_notification
- btv_pwr_notification
- bulk_Cust_Subset_Acct_Info_REP_data
- bulk_Cust_Subset_Acct_Info_Util_data
- bulk_Cust_Subset_Acct_Premise_Info_REP_data
- bulk_Cust_Subset_Acct_Premise_Info_Util_data

Payload Types

- acct_data
- ack
- alarm
- alert
- cmd
- cmd-err
- comm-err

Network Crossing Paths

| DataFlowRef | SourceActor | TargetActor |
|------------------|-------------------|---------------|
| 4Eb+4ESW | DAC - sub | Feeder Switch |
| 4Eb+4ERC | DAC - sub | Feeder Switch |
| 4Eb+4EST | DAC - sub | Feeder Switch |
| 22+4Ba+4Ea+4HERC | DAC - Regnl | Feeder Switch |
| 22+4Ba+4Ea+4ESW | DAC - Regnl | Feeder Switch |
| 22+4Ba+4Ea+4HEST | DAC - Regnl | Feeder Switch |
| MwH + CWMSI | 2-Way Meter - Gas | Cust. EMS |

Run Query

Save to Current User Profile

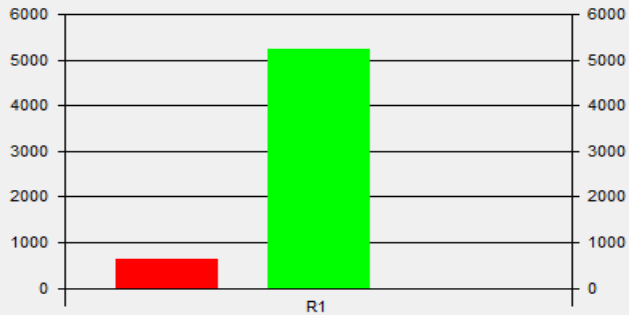
Generate Report

Export to CSV

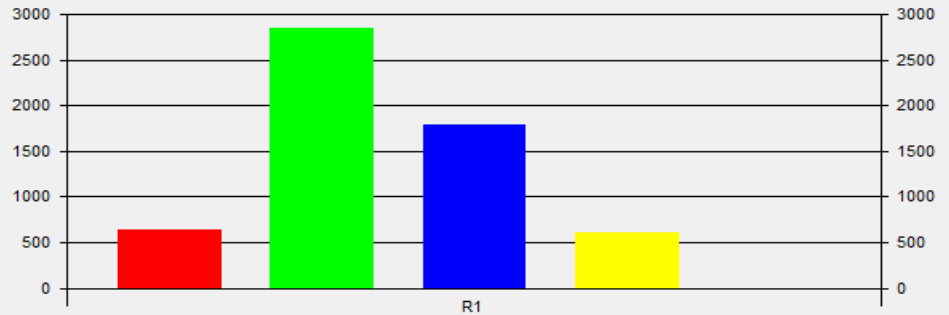
Traffic Calculations By County and Census Tract



Average Daily Traffic (KBytes) By County



Average Daily Traffic (KBytes) By Census Tract



List of Counties, Their Respective State and Their Respective Traffic Levels in KBytes Per Day

| CountyF1 | State | CountyName | TrafficKBytes | LandArea | HousingUnits | Pop |
|----------|-------|------------------------|---------------|----------|--------------|-----|
| 2013 | AK | Aleutians East Borough | 638.3 | 6988.1 | 72 | 269 |
| 2050 | AK | Bethel Census Area | 5230.2 | 40633.3 | 518 | 160 |

List of Census Tracts, Their Related County and State and Their Respective Traffic Levels in KBytes Per Day

| CTCode | CountyName | State | CTTraffic |
|--------|------------------------|-------|-----------|
| 000100 | Aleutians East Borough | AK | 638.3 |
| 000100 | Bethel Census Area | AK | 2845.8 |
| 000200 | Bethel Census Area | AK | 1783.4 |
| 000300 | Bethel Census Area | AK | 601.1 |

In Closing



- This database and planning tool is based on countless hours of work by members of the SG-Net Task Force within Open SG. The broad guidelines for the work were established and codified in Priority Action Plan #2 (PAP2) by the National Institute for Science and Technology (NIST)
- The tool is evolving as the work of the task force goes on, but has already reached a state where it offers very real insights into Smart Grid communications planning efforts
- For questions or comments regarding any part of the tool, please contact Jerry Armes at Micronet Communications on (972) 422-7200 or by e-mail at jarmes@micronetcom.com