| Category | Sub-category | Application | Sub-application | Estimated Number of Communications Nodes to be Deployed for Each Application (e.g. thousands of | Estimated Number of End Point Devices to be Deployed for Each Application (e.g. millions of meters) | Functional Requirements (See Definitions Below) | | | | | | Functional Require | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | AC Independence | Bandwidth Throughput Estimated | Coverage | Latency | Reliability | Security | AC Independence | Bandwidth Throughput Estimated |
| | | | | | | Quantified Estimates | | | | | | Ranking of Relative Importan | |
| Applications | Customer | Advanced Metering | Remote Meter Reading (based on hourly reads) | Cellular network | 5000 | 30 minutes | 19.2K | >90% | <15 sec | >95% | 4 | 1 | 2 |
| | | | Direct Load Control | 22 | 250K | 8 hours | 1K | 100% | <120 sec | >99% | 2 | 1 | 2 |
| | | | Real time pricing | | | | | | | | | | |
| | | Distributed Generation Management | | | | | | | | | | | |
| | | PHEV Integration | At the customer premises | | | | | | | | | | |
| | | | At charging stations | | | | | | | | | | |
| | | Pricing Signals to Smart Appliances | | | | | | | | | | | |
| | | in-Home Display of Customer Usage | | | | | | | | | | | |
| | Distribution | Automated Feeder Switching | | 53 | 1755 | 8 hours | 9600 bps | >90% | 5 sec | <5 per mo. >95% | 5 | 2 | 1 |
| | | Capacitor Bank Control | CBC-5000 | 22 | 2330 | 8 hours | 1K | >60% | 10 sec | >99% | 4 | 1 | 2 |
| | | | CBC-7000 | | 1621 | | | | | | | | |
| | | | LVC | N/A | 638 | 4 hours | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Fault Current Indicator | | | | | | | | | | | |
| | | Transformer Monitoring | | | | | | | | | | | |
| | | Voltage and Current Monitoring | | See comment | | | | | | | | | |
| | | Renewable Energy/Distributed Generation | | | | | | | | | | | |
| | | Network Protection Monitoring | | See comment | | | | | | | | | |
| | Operations | AMI Network Management | | N/A | | | | | | | | | |
| | | Remote Connect/Disconnect | | N/A | | | | | | | | | |
| | | Meter Data Management | | | | | | | | | | | |
| | | Outage Management | | Customer Calls | | | | | | | | | |
| | | Distribution Asset Management | | | | | | | | | | | |
| | | Distribution Network Management | | | | | | | | | | | |
| | | Demand Response | | | | | | | | | | | |
| | ...ion | Wide Area Situational Awareness (PMUs) | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Transmiss** | Line Protection and Control | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
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| **Service Provider** | Billing | | | | | | | | | | | | | | |
| | Customer Information Management | | | | | | | | | | | | | | |
| | Consumer Web Portal | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
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| **Other** | Emergency Response | | | | | | | | | | | | | | |
| | Routine Dispatch | | | | | | | | | | | | | | |
| | Workforce Automation | | | | | | | | | | | | | | |

| | Comments (explain your answers below) | | | |
|---|---|---|---|---|
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| | | | | |
| | See additional entries below | | | |

| | | Definitions (please report your data based on the definitions below) | | |
|---|---|---|---|---|
| **Functional Requirements** | AC Independence | After the loss of electric service what applications need backup power to provide restoration and for how long (measured in minimum hours)? | | |
| | Bandwidth | Estimated or tested data rates are required to support this application during normal and emergency conditions (measured in kilobits per second (kbps)) | | |
| | Coverage | Geographic areas that these networks are required to operate (estimated percentage of service territory). | | |
| | Latency | How quickly does field data need to be updated (measured in milliseconds (ms) from endpoint-to-endpoint (i.e. not roundtrip))? | | |
| | Reliability | How many service interuptions are tolerated and how well must this network provide accurate data (as a percentage of overall traffic (e.g. 99.999%)? | | |
| | Security | How secure must the network be from cyber and physical attacks (one a scale of 1-5 with 1 being low and 5 being high)? | | |
| | | | | |
| | | **Note that when ranking the functional requirements in terms of importance 1-6, rank them from 1 as the lowest and 6 as the most important** | | |
| | | | | |
| | | | | |
| **ications** | Tier 1 – Core Backbone | | | |
| | ons and will typically be architected in a self-healing ring topology or point-to-point with backup circuit redundancy.  The core may have points-of-presence in substations and other company facilities. | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| Tier 2 – Backhaul Distribution | | | | | | | | | | | |
| concentrators, etc. from the field access tier of the network and provide a delivery transport bridge to the core backbone tier. | | | | | | | | | | | |
| Tier 3 – Access | | | | | | | | | | | |
| mile communication or Field Area Network and will be relatively low bandwidth for hand off to the Backhaul Distribution Tier. | | | | | | | | | | | |
| 4 – Home Area Network  (HAN) | | | | | | | | | | | |
| d on a standard but is likely to consist of technologies like ZigBee or Home Plug which may connect directly with communication Tier 3, Tier 2 or Tier 1. | | | | | | | | | | | |

**Technology Options**

| Option | Description |
|---|---|
| Licensed Wireless Radio | Private licensed wireless radio networks operating under Part 90  of the FCC rules |
| Licensed Wireless Microwave | Private licensed wireless microwave networks operating under Part 101  of the FCC rules |
| Unlicensed Wireless | Private unlicensed wireless radio networks operating under Part 15 of the FCC rules (e.g. Wi-Fi, WiMAX, Zigbee) |
| Fiber | Private fiber networks owned or controlled by a utility |
| Other Private Network | Private networks that are neither fiber nor wireless, such as powerline carrier |
| Commercial Wireless Network (Licensed) | Commercial networks that operate using licensed radio under Part 22 of the FCC rules (e.g. Verizon, AT&T, Sprint, etc.) |
| Commercial Wireless Network (Unlicensed) | Commercial networks that operate using unlicensed radio under Part 15 of the FCC rules (e.g. wireless internet service providers (WISPs)) |
| Commercial Wireline Network | Commercial networks that use any wireline technology, including fiber, DSL, coax or traditional twisted pair copper circuits) |
| Satellite | Satellite includes all types of fixed and mobile satellite services, including Very Small Aperture Terminals (VSATs) |

**Note that when ranking the Technology Options in terms of preference 1-9, rank them from 1 as the most preferred and 9 as the least preferred.**

# Other BGE-owned assets not accounted for above

| | | | Estimated Number of Communications Nodes to be Deployed for Each Application (e.g. thousands of | Estimated Number of End Point Devices to be Deployed for Each Application (e.g. millions of meters) | Functional Requirements (See Definitions Below) | | | | | | Functional Require | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AC Independence | Bandwidth Throughput Estimated | Coverage | Latency | Reliability | Security | AC Independence | Bandwidth Throughput Estimated |
| | | | | | Quantified Estimates | | | | | | Ranking of Relative Importan | |
| Other | BGE-owned cellular communications network | | 27 | 6000 | 24 Hrs | 19.2K | >95% | <3 Sec | >99% | 5 | 3 | 6 |
| | MV-90 | | - | 5000 | 8 Hrs | 9.2K | 75% | <5 Sec | >95% | 3 | 3 | 6 |

| ments (See Definitions Below) | | | | Technology Options (Rank preference 1-9 for each below) | | | | | | | | | Technology Options (Rank pref... | | | | |
| Coverage | Latency | Reliability | Security | Licensed Wireless Radio | Licensed Wireless Microwave | Unlicensed Wireless | Fiber | Other Private Network | Commercial Wireless Network (Licensed) | Commercial Wireless Network (Unlicensed) | Commercial Wireline Network | Satellite | Licensed Wireless Radio | Licensed Wireless Microwave | Unlicensed Wireless | Fiber | Other Private Network |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ce of Each Functional Requirement (1-6) | | | | Tier 1 | | | | | | | | | Tier 2 | | | | |
| 6 | 3 | 5 | 4 | N/A | N/A | N/A | N/A | 1 | 2 | N/A | 3 | N/A | N/A | N/A | N/A | N/A | 1 |
| 6 | 3 | 5 | 4 | 3 | N/A | N/A | 1 | 2 | N/A | N/A | 4 | N/A | 1 | N/A | N/A | N/A | 2 |
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| 5 | 3 | 6 | 4 | 3 | N/A | N/A | 2 | 1 | N/A | N/A | 4 | N/A | 1 | N/A | N/A | N/A | N/A |
| 6 | 3 | 5 | 4 | 3 | N/A | N/A | 1 | 2 | N/A | N/A | 4 | N/A | 1 | N/A | N/A | N/A | 2 |
| N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
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| | | | | Technology Options (Rank preference 1-9 for each below) | | | | | | | | | Technology Options (Rank pref |
| ments (See Definitions Below) | | | | Licensed Wireless Radio | Licensed Wireless Microwave | Unlicensed Wireless | Fiber | Other Private Network | Commercial Wireless Network (Licensed) | Commercial Wireless Network (Unlicensed) | Commercial Wireline Network | Satellite | Licensed Wireless Radio | Licensed Wireless Microwave | Unlicensed Wireless | Fiber | Other Private Network |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Coverage | Latency | Reliability | Security | | | | | | | | | | | | | | |
| ce of Each Functional Requirement (1-6) | | | | Tier 1 | | | | | | | | | Tier 2 | | | | |
| | | | | | | | | | | | | | | | | | |
| 1 | 5 | 2 | 4 | | | | | | | | | | | | | | |
| 4 | 5 | 1 | 2 | | | | | | | | | | | | | | |

| Commercial Wireless Network (Licensed) | Commercial Wireless Network (Unlicensed) | Commercial Wireline Network | Satellite | Licensed Wireless Radio | Licensed Wireless Microwave | Unlicensed Wireless | Fiber | Other Private Network | Commercial Wireless Network (Licensed) | Commercial Wireless Network (Unlicensed) | Commercial Wireline Network | Satellite | Licensed Wireless Radio | Licensed Wireless Microwave | Unlicensed Wireless | Fiber | Other Private Network |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | | | | | | Tier 3 | | | | | | | | | | | Tier 4 |
| N/A | N/A | 2 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| N/A | N/A | N/A | N/A | 1 | 4 | 3 | 8 | 2 | 5 | 6 | 7 | 9 | 1 | N/A | N/A | N/A | N/A |
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| N/A | N/A | N/A | N/A | 1 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| N/A | N/A | N/A | N/A | 1 | 4 | 3 | 8 | 2 | 5 | 6 | 7 | 9 | 1 | N/A | N/A | N/A | N/A |
| N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

| erence 1-9 for each below) | | | | Technology Options (Rank preference 1-9 for each below) | | | | | | | | | Technology Options (Rank prefe | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Commercial Wireless Network (Licensed) | Commercial Wireless Network (Unlicensed) | Commercial Wireline Network | Satellite | Licensed Wireless Radio | Licensed Wireless Microwave | Unlicensed Wireless | Fiber | Other Private Network | Commercial Wireless Network (Licensed) | Commercial Wireless Network (Unlicensed) | Commercial Wireline Network | Satellite | Licensed Wireless Radio | Licensed Wireless Microwave | Unlicensed Wireless | Fiber | Other Private Network |
| 2 | | | | | | | | Tier 3 | | | | | | | | | Tier 4 |
| | | | | | | | | | | | | | | | | | |
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| erence 1-9 for each below) | | | |
| Commercial Wireless Network (Licensed) | Commercial Wireless Network (Unlicensed) | Commercial Wireline Network | Satellite |
| --- | --- | --- | --- |
| N/A | N/A | N/A | N/A |
| N/A | N/A | N/A | N/A |
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