

Cisco 1000 Series Connected Grid Routers

The Cisco® 1000 Series Connected Grid Routers (CGR 1000 Series) are versatile communications platforms purpose-built to meet the communication infrastructure needs of electric, gas and water utilities. The multi-service capabilities of these platforms allow customers to converge multiple applications such as Advanced Metering Infrastructure (AMI), Distribution Automation (DA), Integration of Distributed Energy Resources (DER) and Remote Workforce Automation on to a single platform.

The CGR 1000 Series is the latest addition to Cisco's Connected Grid portfolio designed for utilities to provide a highly secure, reliable, and scalable communication infrastructure. These ruggedized products are certified to meet harsh environmental standards, including IEEE 1613 and IEC 61850. The CGR 1000 platforms supports wireless network interfaces such as IEEE 802.15.4 g/e wireless personal area network (WPAN), 2G/3G cellular and IEEE 802.16e WiMAX.

The Cisco CGR 1000 routers are powered by Connected Grid Operating System (CG-OS) that is built upon Cisco's world class networking technologies and adapted to the needs of energy utilities. This software delivers grid operators with the benefits of open standards-based, multi-service networking, strong network security, robust manageability, and high reliability. The distributed intelligence capabilities integrated into CG-OS software allows customers to run applications such as Supervisory Control and Data Acquisition (SCADA) protocol translation on the routers directly eliminating the need for additional device.

The Cisco CGR 1000 Series offers two platforms, shown in Figure 1. They include: The Cisco 1120 Connected Grid Router (CGR 1120), which is designed for indoor deployments; and the Cisco 1240 Connected Grid Router (CGR 1240), which is a weatherproof router in a NEMA Type 4 enclosure for outdoor deployments.

Figure 1. Cisco 1000 Series Connected Grid Routers



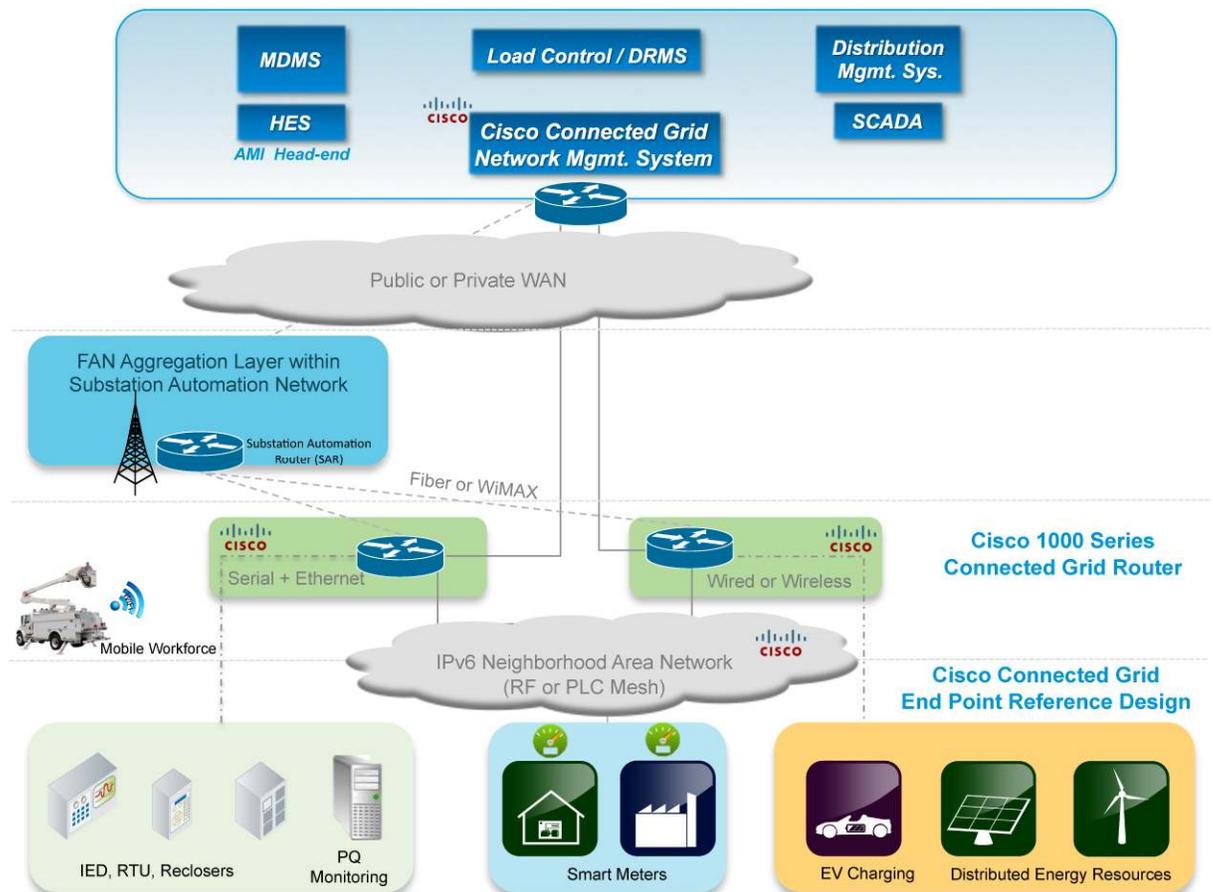
Connected Grid FAN Solution and CGR 1000 Series

Utilities all over the world are undergoing significant transition in their grids—from transmission to consumption. Regulatory mandates are advancing initiatives around smart metering, grid reliability, and integration of solar and wind farms into the distribution grid. This in turn, imposes a unique set of challenges for utilities to build a bi-directional communications field area network (FAN) that enables these diverse applications and also scales across millions of endpoints.

Cisco's Connected Grid FAN solution has been specifically developed to meet these challenges, using design principles from industry-leading Cisco GridBlocks architecture. Under the GridBlocks architecture, a typical communications network for the distribution grid is a two-tier architecture with Neighborhood Area Network (NAN) and Wide Area Network (WAN).

The NAN provides network connectivity to end points such as smart meters and DA devices. These endpoints form a mesh network based on radio frequency (RF) or power-line communications (PLC) technologies. The mesh network is aggregated at an intelligent device such as a field area router (FAR) mounted on pole-tops or in secondary substations. The WAN tier provides network connectivity from the FAR to the utility's control center over either a public 2G/3G network, or over a utility-owned (private) WiMAX or Ethernet fiber network. Figure 2 displays the solution's inclusion within the network.

Figure 2. Cisco Connected Grid Field Area Network Solution



The Connected Grid FAN solution comprises of the following products: Cisco 1000 Series Connected Grid Routers, Connected Grid Device Manager (CG-DM), Connected Grid Network Management System (CG-NMS) and Connected Grid End Point reference design (CG-EP), an open standards-based IPv6 networking stack that can be embedded in a variety of smart grid end points, such as smart meters.

Finally, CG-NMS is a software platform for managing multi-service communication networks and security infrastructure for smart grids. CG-NMS is a scalable, secure, modular open platform with pluggable architecture designed to help enable an ecosystem of multi-vendor capabilities for interoperability across not only communications networks, but also legacy and next-generation power grid equipment, over time.

Primary Business Benefits and Architectural Features

The CGR 1000 Series Routers leverage Cisco's core IP networking technologies with purpose-built hardware and software to create an open platform for utilities to build multi-service, secure and reliable Field Area Network that lowers their total cost of ownership.

Converged Multi-Service Network Architecture

The CGR 1000 Series is a flexible modular platform supporting various wired and wireless interfaces. The CGR 1000 Series router supports a 900 MHz IPv6 RF Mesh that can aggregate up to 5,000 end devices such as smart meters. The router has integrated ethernet and serial interfaces to connect to DA devices such as sensors, capacitor bank controllers, recloser controllers, and remote terminal units. SCADA protocol (serial to IP) translation features allow customers to easily integrate legacy (non-IP) devices on to an IP network. Integrated Wi-Fi port enables remote workforce automation and secure wireless console access while integrated GPS enables location mapping of the router. The modular design provides an easy upgrade path to future communication interfaces without platform replacement.

The CGR 1000 Series portfolio of routers offers platforms for both indoor and outdoor deployments. These platforms come with flexible mounting kits that allow utilities to deploy the routers on a broad array of existing assets such as distribution poles, walls, and inside pad-mounted enclosures. In addition, the CGR 1000 Series offers a wide range of external antenna choices to meet coverage, throughput, and range requirements.

Connected Grid OS provides a set of network and application layer services to help enable customers run multiple applications on a converged communication network. The network segmentation and quality of service (QoS) features allow customers to logically separate different application traffic and to apply specific constraints on each traffic flow. In addition, CG-OS is capable of integrating and hosting utility-specific third-party applications. This allows customers to eliminate cost, space, power, and complexity of deploying and managing single-purpose devices. Customers can also add more applications over time to meet future business needs.

Security

Cisco integrates security as a fundamental building block of the field area network (FAN) architecture. The CGR 1000 Series offers strong security capabilities that are based on Cisco's Connected Grid security principles and widely adopted cryptographic and security standards.

| Security Principle | CGR 1000 Features and capabilities |
|-----------------------|---|
| Access Control | <ul style="list-style-type: none"> • Mutual authentication and authorization of all nodes connected to the network • IEEE 802.1x-based authentication, Role-Based Access Control • Certificate-based identity, strong username and passwords |

| | |
|--|---|
| Data Integrity, Confidentiality and Privacy | <ul style="list-style-type: none"> • Link-layer encryption in the NAN mesh (AES-128) • Network-layer encryption in the WAN (IPsec) • Scalable key management – generation, exchange & revocation of encryption keys |
| Threat Detection and Mitigation | <ul style="list-style-type: none"> • Network segmentation of users, devices and applications in NAN and WAN • Access-lists on field area router to filter traffic between users and devices • High-performance firewall in the control-center to protect critical assets |
| Device and Platform Integrity | <ul style="list-style-type: none"> • Tamper-resistant mechanical design, security alerts generated if compromised • Hardware chip to store router's X.509 certificate, other security credentials • Tamper-proof secure storage of router configuration and data |

Network Reliability and High Availability

The CGR 1000 Series Routers have been designed with both device level and network level reliability to meet harsh physical environments. The CGR 1000 Series is built to meet stringent compliance standards such as IEEE 1613 and IEC 61850-3. The enhanced thermal design and conduction cooling with no moving parts allows support for extended temperature support. Additionally, the routers offer mechanisms for backup power to help ensure uptime for mission-critical applications in the event of power outages. Finally, the support for multiple WAN communication modules, and the network resiliency and routing features in CG-OS, allows utilities to deploy enterprise-class high availability in their communication networks for the distribution grid.

Network Management

A complete suite of network management tools is critical for lowering operating expenses (OpEx) while improving network availability. They do so by simplifying and automating many of the day-to-day tasks associated with managing such challenging network requirements. The embedded management features available in the CGR 1000 Series, Connected Grid Device Manager (CG-DM), and the Connected Grid Network Management System (CG-NMS) allow customers to effectively meet these requirements.

The Cisco FAN solution provides operators with extensive instrumentation and diagnostic information for geographic locations, wireless interfaces, battery management, and other grid-specific details. This information can be fed into the CG-NMS for day-to-day operations, operator dashboards, and real-time troubleshooting. Ease-of-use features such as secure zero touch deployment and a graphical field tool help enable non-IT field technicians to deploy and manage FAN communication equipment effectively. In addition to the utility-specific functionality, the Cisco solution provides customers with true enterprise-class fault, configuration, accounting, performance, and security (FCAPS) functionality such as a programmatic XML interface based on the Network Configuration Protocol (NETCONF) industry standard, Role-Based Access Control (RBAC), over-the-air software upgrades, and security management functionality.

Open Standards

Cisco's strategy is to encourage the creation and adoption of open communication standards for the smart grid. This in turn encourages the growth of an ecosystem of standards-based, interoperable devices and applications from different vendors while reducing the risk of adopting new technologies for utilities.

The Cisco Connected Grid solution is based on a series of open standards, many of them adopted from IP-based technologies such as IPv6. By use of these standards, customers are able to architect and design their network independent of the application layer or physical layer infrastructure. This protects any existing investment while lowering the total cost of ownership for the network over time.

Cisco Connected Grid Modules for CGR 1000 Series

There is not a single technology—wireless or wireline—that will be able to satisfy utilities’ requirements for field area network applications. Different technologies may offer the best solution in terms of geography, performance, cost and other constraints, such as regulation, existing and planned infrastructure, coverage and SLA requirements. Customers also need the flexibility to upgrade to new communication technologies in the future while protecting their investment in the platforms deployed today. The CGR 1000 Series routers meet these requirements by use of module slots that accommodate Connected Grid Modules (CGM) offering a diverse range of connectivity options. Table 1 identifies Connected Grid Modules for the CGR 1000 Series.

Table 1. Connected Grid Modules for CGR 1000 Series

| | |
|--|---|
| Connected Grid Module (CGM) Slots | <ul style="list-style-type: none"> • The CGR 1120 accommodates 2 modules • The CGR 1240 accommodates 4 modules |
| Connected Grid Modules (CGM) Families | <ul style="list-style-type: none"> • IEEE 802.15.4g/e WPAN (900 MHz RF Mesh) • Cellular: 2G/3G (Global System for Mobile Communications [GSM] and Code Division Multiple Access [CDMA]) • IEEE 802.16e WiMAX |

Cisco’s Connected Grid Wireless Personal Area Network (WPAN) Module

Cisco’s Wireless Personal Area Network (WPAN) Connected Grid Module provides utilities with an IPv6 based, IEEE 802.15.4 g/e compliant wireless connectivity solution for FAN Applications. The CGR1000 series provides dynamic network discovery and self-healing networking. In addition, the multi-hop mesh networking provides a high endpoint to collector ratio. Table 2 outlines the RF characteristics of the Cisco Connected Grid Module—WPAN.

Table 2. Technical Specifications of Connected Grid WPAN Module

| | |
|---|--|
| Channels | 902-928 MHz unlicensed ISM |
| Frequency Hopping Spread Spectrum (FHSS) | 64 channels, 400 KHz per channel |
| Transmitter Power | 26 dBm |
| Link Budget | Over 134 dB |
| Receiver Sensitivity | -112 dBm |
| Standards Compliance | <ul style="list-style-type: none"> • IEEE 802.15.4 g/e • IETF 6LOWPAN • IPv6 • IETF RPL. |
| Robust Security | <ul style="list-style-type: none"> • AES 128-bit encryption • IEEE 802.1x |

Cisco Connected Grid Third-Generation (3G) Cellular Module

Cisco’s Connected Grid 3G Cellular Module for the Cisco 1000 Series Connected Grid Routers supports the latest 3G standards (High-Speed Packet Access [HSPA] and Evolve-Data Optimized [EVDO] Rev A) and is backward-compatible with Universal Mobile Telecommunications Service (UMTS), Enhanced Data Rates for Global Evolution (EDGE), General Packet Radio Service (GPRS), and EVDO Rev 0/1xRTT. The 3G modules have two variants:

- Global System for Mobile Communications (GSM) and UMTS version is based on 3G Partnership Project (3GPP), and supports HSPA (High-Speed Uplink Packet Access (HSUPA) and High-Speed Downlink Packet Access (HSDPA)), UMTS, EDGE, and GPRS

- Code Division Multiple Access (CDMA) version is based on 3GPP2, and supports EVDO Rev A/Rev 0 and 1xRTT

Table 3 lists the 2G/3G cellular Connected Grid Modules for the CGR 1000 Series

Table 3. 2G/3G Cellular Connected Grid Modules for CGR 1000 Series

| | |
|--|---|
| Cisco Connected Grid Module 3G GSM Module: CGM-3G-HSPA | <ul style="list-style-type: none"> • HSPA+: 850, 900, 1900, and 2100 MHz (forward link up to 7.2 Mbps; reverse link up to 2.0 Mbps) • Backward compatibility: <ul style="list-style-type: none"> ◦ HSDPA: 850, 1900, and 2100 MHz (forward link up to 7.2 Mbps; reverse link up to 384 kbps) ◦ UMTS: 850, 900, 1900, and 2100 MHz (forward link up to 2.0 Mbps; reverse link up to 384 kbps) ◦ EDGE: 850, 900, 1800, and 1900 MHz (forward link up to 236 kbps; reverse link up to 124 kbps) • GPRS: 850, 900, 1800, and 1900 MHz (forward link up to 80 kbps; reverse link up to 42 kbps) |
| Cisco Connected Grid Module 3G CDMA Module: CGM-3G-EVDO | <ul style="list-style-type: none"> • CDMA 1xEV-DO Rev A (forward link up to 3.1 Mbps; reverse link up to 1.8 Mbps) • Backward compatibility: <ul style="list-style-type: none"> ◦ CDMA 1xEV-DO Rel 0 (forward link up to 2.4 Mbps; reverse link up to 153.6 kbps) • CDMA 1xRTT (forward link up to 153.6 kbps; reverse link up to 153.6 kbps) |

Cisco’s Connected Grid WiMAX Modules

Cisco’s IEEE 802.16e-compliant WiMAX Connected Grid Module for the CGR 1000 routers provides utilities with reliable, robust, and secure connectivity solutions. WiMAX has been deployed by utilities worldwide as an alternative to using a service provider-based 2G/3G cellular network. A WiMAX based solution provides the utility network managers with greater control over the communication network infrastructure, deployment, management, and performance. Table 4 displays the Technical specifications of the Cisco Connected Grid WiMAX Modules.

Table 4. Technical Specifications of Connected Grid WiMAX Modules

| | |
|---------------------------------------|--|
| Access Scheme | IEEE802.16e-2009 |
| Operation Mode | TDD |
| Frequency Spectrum | Choice of flexible spectrum offerings in the licensed, lightly licensed and unlicensed bands <ul style="list-style-type: none"> • CGM-WIMAX-1.8GHZ: 1.8 GHz Band: 1800–1830 MHz • CGM-WIMAX-2.3GHZ: 2.3 GHz Band: 2300–2400 MHz • CGM-WIMAX-2.5GHZ: 2.5 GHz Band: 2496–2690 MHz • CGM-WIMAX-3.4GHZ: 3.4 GHz Band: 3300–3600 MHz • CGM-WIMAX-3.6GHZ: 3.6 GHz Band: 3500–3800 MHz |
| Channel Bandwidth | 3.5, 5.0, 10 MHz |
| Output Power (Average) | 23 dBm for 64QAM 5/6 |
| Transport Options | <ul style="list-style-type: none"> • IP CS • ETH CS |
| Standards Based WIMAX Security | <ul style="list-style-type: none"> • PMKv2 • AES-128 • EAP-TLS • Support for X.509 digital certificates |
| QoS | Five (5) QoS classes: UGS, RT, eRT, nRT, BE |
| Modem Diagnostics | Tx power, received signal strength indication (RSSI), carrier-to-interference-plus-noise-reduction (CINR), modem state, base station ID (if connected), frequency (if connected) |
| Base Station Scanning | Configurable list of base stations (up to 10 base stations) |

Cisco 1000 Series Connected Grid Routers Specifications

Table 5 lists hardware specifications and Table 6 lists the software features for the CGR 1000 Series routers

Table 5. Cisco CGR 1000 Series Hardware Specifications

| | CGR 1240 (Pole-mount) | CGR 1120 (Din-rail Mount) |
|---|--|--|
| Physical Specifications | | |
| Dimensions (H x W x D) | 28.7 cm x 24.6 cm x 21.6 cm 11.3 in. x 9.7 in. x 8.5 in. (without Antennas) | 8.9 cm x 22.9 cm (W) x 20 cm 3.5 in. x 9.0 in. x 7.8 in. |
| Rack Height | N/A | 2 RU |
| Pole Mount | Yes | No |
| Wall-mount | Yes | Yes |
| Din-rail Mount | No | Yes |
| Typical Weight Fully Configured | 23 lbs (10.4 kg) Unit weight includes base chassis with four communication modules, AC power supply, and 8-Amp-hr battery backup unit | 8 lbs (3.6 kg) Unit weight includes base chassis with four communication modules, AC power supply, and 8-Amp-hr battery backup unit |
| Operating Temperature ¹ | -40°C to +70°C (-40°F to 158°F) with type test to 85°C (185°F) for 16 hours | -25°C to +60°C (-25°F to 140°F) with type test up to 85°C (185°F) for 16 hours |
| Communication Modules | | |
| IEEE 802.15.4 WPAN ² | Yes | Yes |
| 3.5G AT&T HSPA+/UMTS/GSM/GPRS/EDGE | Yes | Yes |
| 3.5G (Non-US) HSPA+/UMTS/GSM/GPRS/EDGE | Yes | Yes |
| CDMA EV-DO Rev A/0/1xRTT—Verizon | Yes | Yes |
| CDMA EV-DO Rev A/0/1xRTT—Sprint ² | Yes | Yes |
| CDMA EV-DO Rev A/0/1xRTT—Generic ² | Yes | Yes |
| WiMAX: IEEE 802.16e- 2.3 GHz | Yes | Yes |
| WiMAX: IEEE 802.16e- 3.6 GHz ² | Yes | Yes |
| WiMAX: IEEE 802.16e- 1.8 GHz ² | Yes | Yes |
| WiMAX: IEEE 802.16e- 3.4 GHz ² | Yes | Yes |
| WiMAX: IEEE 802.16e- 2.5 GHz ² | Yes | Yes |
| On-board Interfaces | | |
| Gigabit Ethernet Combination Ports (10/100/1000 Copper, 100/1000 SFP) | 2 | 2 |
| 10 /100 Fast Ethernet Copper Ports | 4 | 6 |
| Wi-Fi (IEEE 802.11 b/g/n) | Yes (Autonomous) | Yes (Autonomous) |
| Serial (RS-232/RS-485) ² | 2 | 2 |
| GPS for Location | Yes | Yes |
| IRIG-B ³ | BNC connector | No |
| Digital Alarm Inputs ³ | 2 | 4 |
| Digital Alarm Outputs ³ | 2 | 1 |
| USB Type A host ports ³ | 2 | 1 |
| Console and AUX Port (RJ-45) | 1 | 1 |

¹ Operating temperature range is impacted by choice of communication modules and battery backup options.

² Target Availability: 2H CY2012

³ Interfaces built into platform hardware. Software support in future release

| | CGR 1240 (Pole-mount) | CGR 1120 (Din-rail Mount) |
|---------------------------------------|---|---|
| SD Flash Slot (Memory) | 1 (2 GB) | 1 (2 GB) |
| Power Options | | |
| Power Supply | AC Power supply: <ul style="list-style-type: none"> • 100 - 240 VAC | Integrated AC/DC power supply: <ul style="list-style-type: none"> • 3-phase AC power supply: 100 - 240 VAC • 9-60 VDC |
| Battery Backup Options ^{4 5} | Integrated battery backup unit (BBU) and smart charging and monitoring system. <ul style="list-style-type: none"> • Run time: 8 hours • Estimated life: 5 years | N/A |
| Power Options for Third-Party Radios | The CGR 1240 provides support for powering third-party radios: <ul style="list-style-type: none"> • Voltage output: 12VDC ± 5 percent • Power output: 12 W (continuous) | N/A |
| Regulatory Compliance | | |
| Environmental Compliance | <ul style="list-style-type: none"> • IEC-61850-3 • IEEE1613 | <ul style="list-style-type: none"> • IEC-61850-3 • IEEE1613 |
| Immunity | <ul style="list-style-type: none"> • EN61000-6-2 • EN61000-4-2 (ESD) • EN61000-4-3 (RF) • EN61000-4-4 (EFT) • EN61000-4-5 (SURGE) • EN61000-4-6 (CRF) • EN61000-4-11 (VDI) • EN 55024, CISPR 24 • EN50082-1 | <ul style="list-style-type: none"> • EN61000-6-2 • EN61000-4-2 (ESD) • EN61000-4-3 (RF) • EN61000-4-4 (EFT) • EN61000-4-5 (SURGE) • EN61000-4-6 (CRF) • EN61000-4-11 (VDI) • EN 55024, CISPR 24 • EN50082-1 |
| EMC | <ul style="list-style-type: none"> • 47 CFR, Part 15 • ICES-003 Class A • EN55022 Class A • CISPR22 Class A • AS/NZS 3548 Class A • VCCI V-3 • CNS 13438 • EN 300-386 | <ul style="list-style-type: none"> • 47 CFR, Part 15 • ICES-003 Class A • EN55022 Class A • CISPR22 Class A • AS/NZS 3548 Class A • VCCI V-3 • CNS 13438 • EN 300-386 |
| Safety | <ul style="list-style-type: none"> • USA: UL 60950-1 • Canada: CAN/CSA C22.2 No. 60950-1 • Europe: EN 60950-1 • China: GB 4943 • Australia/New Zealand: AS/NZS 60950.1 • Rest of World: IEC 60950-1 • UL certified to UL/CSA 60950-1, 2nd Ed. • CB report to IEC60950-1, 2nd Ed., covering all group differences and national deviations. | <ul style="list-style-type: none"> • USA: UL 60950-1 • Canada: CAN/CSA C22.2 No. 60950-1 • Europe: EN 60950-1 • China: GB 4943 • Australia/New Zealand: AS/NZS 60950.1 • Rest of World: IEC 60950-1 • UL certified to UL/CSA 60950-1, 2nd Ed. • CB report to IEC60950-1, 2nd Ed., covering all group differences and national deviations. |

Table 6. Cisco Connected Grid Router Network Services: Features and Protocols Support

| Protocols |
|--|
| IPv4, IPv6, Static Routes, Open Shortest Path First (OSPF) |
| Multicast: Internet Group Management Protocol (IGMPv3), Protocol Independent Multicast (PIM) |

⁴ Run time calculated based on router configuration with two (2) communications modules (WPAN and 2G / 3G). Actual battery time will vary depending on several factors, including traffic volume, the number of radios installed, temperature, and auxiliary device power draw.

⁵ All measurements for battery capacity, run time and estimated life assume ambient temperature of 25°C

| |
|---|
| IPSec, Generic Routing Encapsulation (GRE), DHCP |
| IEEE 802.15.4 ⁶ , IETF 6LOWPAN ⁶ , IETF RPL ⁶ , IETF CoAP ⁶ |
| Ethernet, Serial (RS-232/485) ⁶ |
| SCADA Protocol Support: IEC 60870-5-101/104 ⁶ |
| Security |
| Encryption: IPSec VPN, Key-based Mesh Encryption, WPA2 for WiFi |
| Device Identity: IEEE 802.1AR |
| Role-based Access Control for Device Configuration |
| L3-L4 ACLs |
| Authentication, Authorization: EAP TLS |
| Mesh Security Solution ⁶ |
| QoS |
| Classification and Marking: ACLs, Layer3-IP Precedence, Differentiated Services Code Point (DSCP) |
| Congestion Management: Priority Queuing (PQ) |
| Embedded Management |
| Programmatic XML Interface (NETCONF), HTTPS, SSH |
| Secure Zero Touch Deployment |
| Battery Health Monitoring (n/a for CGR 1120) |
| Door Tamper Detection |

For More Information

For more information on the Cisco 1000 Series Connected Grid Routers visit <http://www.cisco.com/go/cgr1000>

For more information on the Cisco Field Area Network solution visit <http://www.cisco.com/go/fan>

⁶ Target Availability: 2H CY2012



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