

Router CE para instalações Industriais (CE – Centros Electroprodutores)  
E-Redes



ESPECIFICAÇÕES E CONDIÇÕES TÉCNICAS

(ECT)

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## 1. OBJETIVO

A presente especificação tem por objectivo a definição das especificações e condições técnicas do equipamento e serviços necessários à solução de comunicações para interligação de Centros Electroprodutores (CE) sobre infraestrutura ótica.

Esta solução pressupõe a interligação em fibra ótica da instalação do CE ao ORD (E-Redes).

O router CE, equipamento a instalar e manter pelo CE na sua instalação, deverá garantir a interoperabilidade com a actual Rede IP/MPLS (Multi Protocol Label Switching) da E-Redes à qual se interligará.

Tendo em vista a obrigatoriedade de garantia de uma elevada disponibilidade e funcionalidade, entre os quais o suporte de comunicações SCADA, a solução a apresentar deverá assegurar elevados graus de fiabilidade de forma a garantir muito baixo risco operacional.

## 2. Solução de comunicações

Deve estar contemplada a ligação em Fibra ótica monomodo G.652.D à instalação do ORD (E-Redes) suportada na LN 60 kV, 30kV ou 15kV por cabo OPGW ou ADSS, ou cabo de conduta se rede subterrânea.

O equipamento Router CE, terá como função estabelecer a ligação à Rede IP/MPLS por via ótica, suportar as comunicações de/para o sistema Scada da E-Redes, recolha de ficheiros com os eventos referentes a dados de oscilopertubografia, e eventualmente dados de telecontagem, etc.

O equipamento Router CE será instalado no interior do edifício do CE, em armário adequado para o efeito e respeitando as recomendações de instalação do fabricante.

A topologia de interligação encontra-se abaixo esquematizada (figura 1), contudo os equipamentos e serviços necessários para a ampliação da Rede IP/MPLS da E-Redes serão avaliados e quantificados pontualmente tendo em conta um conjunto de características próprias de cada projeto tais como: o local geográfico, a rede onde se insere, entre outras.

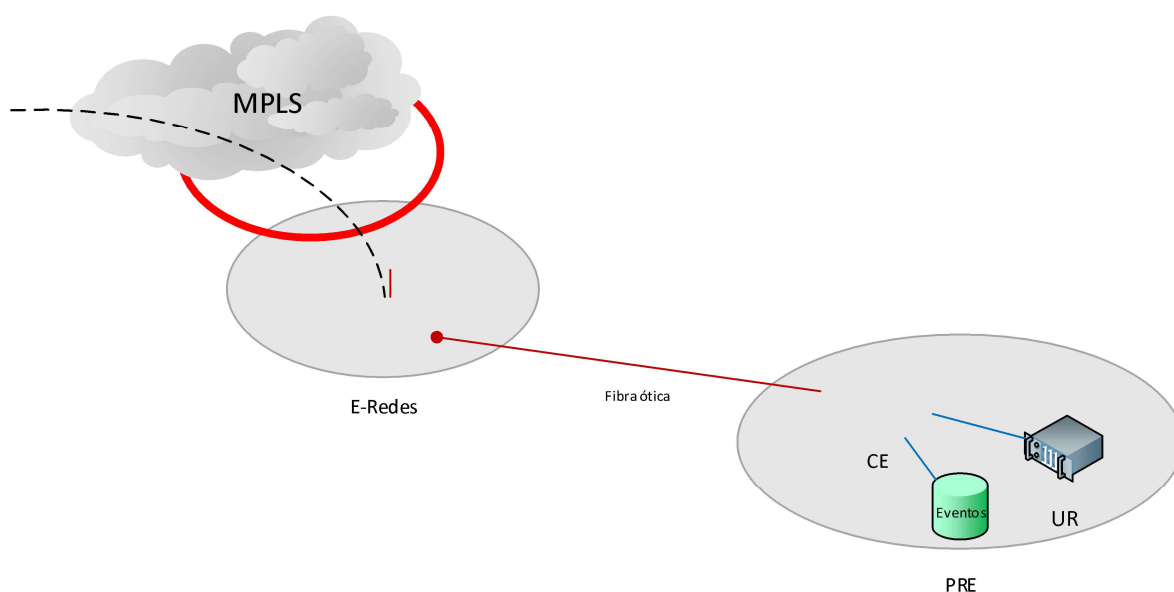


Figura 1

### 3. Equipamento Terminal – Router CE

Equipamento com design industrial robusto, alta disponibilidade, sem ventoinhas ou partes móveis, faixa de temperatura operacional da gama industrial e com mecanismos de segurança integrada (Firewall).

Os equipamentos terminais a considerar na instalação do CE deverão atender aos seguintes requisitos:

#### 3.1.1. Requisitos mínimos obrigatórios

##### ESPECIFICAÇÕES AMBIENTAIS E COMPATIBILIDADE ELECTROMAGNÉTICA

- IEC 61850-3 (EMI, temperature and shock/vibration resistance);
- IEEE 1613 (operate temp (a) –40 °C to +70 °C, Electrostatic Discharge and Surge Class 1 e Class 2)

##### ESPECIFICAÇÕES FÍSICAS:

- Montagem em rack 19” com respetivos acessórios;
- Equipamento modular, mínimo 2 slots para flexibilidade de expansão;

##### INTERFACES:

- LAN - Módulo mínimo de 6 portas Ethernet (10/100 Base T/TX) com auto negociação MDI/MDI-X;
- WAN - Disponibilidade para 2 interfaces ópticos Gigabit para fibras monomodo G.652 (distâncias 5 a 80 km);

##### PROTOCOLOS e STANDARDS:

- Layer 3 MPLS [VPRN];
- IEEE 802.1x;
- VLAN 802.1Q;
- Switching protocols: STP e MST;
- Routing protocols: OSPF, BGP, IS-IS;
- IPSec;
- NAT;
- DHCP;
- IPv4 e IPv6;

##### TRÁFEGO e QoS:

- Classificação de tráfego - Quality of Service (QoS) e Class of Service (CoS);
- Layer 3 VPNs;

##### REDUNDÂNCIA e RESILIÊNCIA

- Funcionamento em anel;
- MPLS tunels;
- Resilient Dual (Boot configuration) and configuration rollback;
- Loop prevention;

##### SINCRONIZAÇÃO

- Suporte em Hardware de sincronismo IEEE 1588v2;

##### SEGURANÇA e GESTÃO

- Autenticação User ID/Password, registo local ou remoto da informação de utilizador;

- Remote Authentication Dial In User Service (RADIUS) e Terminal Access Controller Access-Control System (TACACS);
- Integração em Sistema SNMP (SNMP v2/v3);
- SSH e Telnet;
- Syslog – Captura de logs para local e servidor remoto;
- Firewall;

**REQUISITOS ALIMENTAÇÃO**

- Alimentação -48 Vdc (sem sofrer quaisquer alterações ao seu funcionamento normal para variações de  $\pm$  15% do referido valor nominal);
- Fontes alimentação redundantes “hot swappable”;


**NORMAS DE QUALIDADE e REEE**

- Directivas n.º 2002/95/CE, n.º 2002/96/CE e n.º 2003/108/CE n.º 2002/96/CE e Decreto-Lei n.º 230/2004 relativos aos REEE (Resíduos de equipamentos elétricos e eletrónicos).

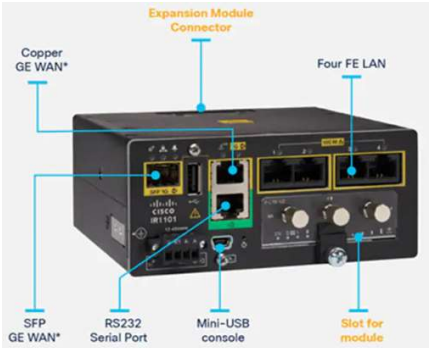
### 3.1.2. Equipamentos qualificados

Os equipamentos utilizados atualmente, e que podem ser considerados no portfólio de routers interoperáveis para interligação com a rede da E-Redes, são:

Cisco CGR2010-SEC/K9 + GRWIC-D-ES-2S-8PC (Ethernet Switch module)

CGR 2010	Description
Primary CGR 2010 ESM features: 	<ul style="list-style-type: none"> <li>Rugged industrial design and substation compliance: IEC-61850-3 and IEEE 1613 for utility substation environments</li> <li>Tools for easy deployment, management, and replacement</li> <li>Extensive instrumentation and remote diagnostic capability</li> <li>Advanced quality of service (QoS) capabilities to support mission-critical substation applications such as Supervisory Control and Data Acquisition (SCADA) and IEC 61850 Generic Object Oriented Substation Events (GOOSE) messaging</li> <li>Comprehensive network security features based on open standards</li> </ul>
<b>Ethernet Switch Module</b> Copper model GRWIC-D-ES-2S-8PC 	Required OS version: 15.2(6)EDA Interfaces (10 ports): <ul style="list-style-type: none"> <li>8x 10/100 Fast Ethernet ports;</li> <li>1x dual-purpose port (10/100/1000 Base-T copper RJ-45 and 100/1000 SFP fiber),</li> <li>1x 100/1000 SFP fiber-only port</li> </ul>
<b>Transceivers</b>	
GLC-LX-SM-RGD	1000Mbps Single Mode Rugged SFP (< 15 km)
GLC-ZX-SM-RGD	1000Mbps Single Mode Rugged SFP (>15km, < 70 km)

Cisco IR1101-SEC/K9

IR1101	Description
Primary IR1101 features: 	<ul style="list-style-type: none"> <li>IR1101 Rugged Series Router (compact industrial)</li> <li>has an integrated 9.6 to 60V DC power input and is designed to withstand hostile environments</li> <li>Allows multiple Ethernet devices (sensors, Remote Terminal Unit [RTU], PLCs) in an industrial environment to connect for visibility and management of assets</li> <li>IEEE 802.1Q VLANs</li> <li>Layer 3 support through VLAN interfaces</li> <li>4KV isolation for Electrostatic Discharge (ESD) protection</li> </ul>
<b>Transceivers</b>	
GLC-LX-SM-RGD	1000Mbps Single Mode Rugged SFP (< 15 km)
GLC-ZX-SM-RGD	1000Mbps Single Mode Rugged SFP (>15km, < 70 km)

### 3.1.3. Requisitos para instalação de equipamento e acessórios

A instalação do equipamento Router CE deve ser realizada sobre as recomendações do fabricante. O equipamento deverá ser instalado no interior de armário com suporte de fixação rack 19", utilização de passa cabos, painéis de terminação com identificação dos serviços e portas Ethernet e óticas, incluindo:

- Deverá existir disjuntores de corte para desligar/ligar a alimentação principal e secundária do equipamento. Disjuntores bipolares de Corrente Contínua e curva de disparo tipo K ou D.
- Circuitos de alimentação principal e redundante socorrido;
- O equipamento, o armário e todos os elementos metálicos (chassis, etc.) ligados à terra;
- Patch-panel para terminação dos interfaces elétricos Ethernet;
- Módulo(s) SFP para interligação ótica ao site(s) E-Redes;
- Cablagem das interfaces óticas do Equipamento terminal para o ODF (repartidor ótico) existente no local (ex. Patch cords de comprimento adequado);  
Os patchs cords óticos devem ser protegidos por tubo corrugado no seu percurso entre o equipamento e o repartidor ótico;

## 4. Operação e Manutenção

O Cliente é responsável pela configuração e manutenção do equipamento instalado nas suas instalações (de acordo com topologia e os serviços a disponibilizar).

Serviços de operação, configuração e manutenção do equipamento:

- Alterações de configuração, ativação de novos serviços;
- Recolha e reposição das configurações dos equipamentos (ex. backups)
- Tarefas operacionais: execução de pedidos de serviço, alterações, provisionamento, rotinas, atualização de firmware;
- Substituição de peças avariadas

## 5. Ensaios

O Cliente deverá criar as condições necessárias e adequadas para a execução dos ensaios, de acordo com o Protocolo de Ensaios que deverá elaborar e apresentar à E-Redes, para validação expressa e por escrito, antes da entrega formal da solução. A E-Redes reserva-se o direito de efetuar ensaios adicionais, não descritos no Protocolo de Ensaios referido e que se enquadrem nos requisitos definidos no presente documento.

A prestação de serviços para Ensaios, compreende todas as ações necessárias à validação integral do sistema, validando todas as funcionalidades e interligações com outros sistemas.

## 6. Responsabilidades

### Responsabilidade da E-Redes

- 1) A E-Redes disponibilizará os recursos humanos que achar necessário para a Definição, Gestão e Acompanhamento do projeto;
- 2) Os elementos designados pela E-Redes assumirão a responsabilidade de coordenar eventuais necessidades de interrupção temporária dos serviços prestados pelos equipamentos;
- 3) A E-Redes facultará a documentação e as informações relevantes para a implementação do projeto (que tem em seu poder) e compromete-se a desenvolver ações para as complementar, caso seja necessário para a implementação do projeto.

### Cliente

- a) Solicitar à E-Redes pré-requisitos que considerem necessários;
- b) Antecipar as eventuais falhas/indisponibilidades dos equipamentos, sistemas e aplicações com medição do impacto das mesmas;
- c) Medir o impacto das alterações (em termos da previsão de indisponibilidade de sistemas/aplicações);
- d) Avaliar e medir o impacto das alterações/configurações na disponibilidade dos equipamentos, sistemas e aplicações;
- e) Resolver de imediato e até completa resolução eventuais maus funcionamentos decorrentes dos serviços prestados.
- f) Deverá garantir que todos os pressupostos são devidamente validados pela E-Redes, caso contrário, não poderão ter impacto financeiro para a E-Redes.



## 7. Anexo I – Listagem de Equipamento (indicativo)

Opção I:

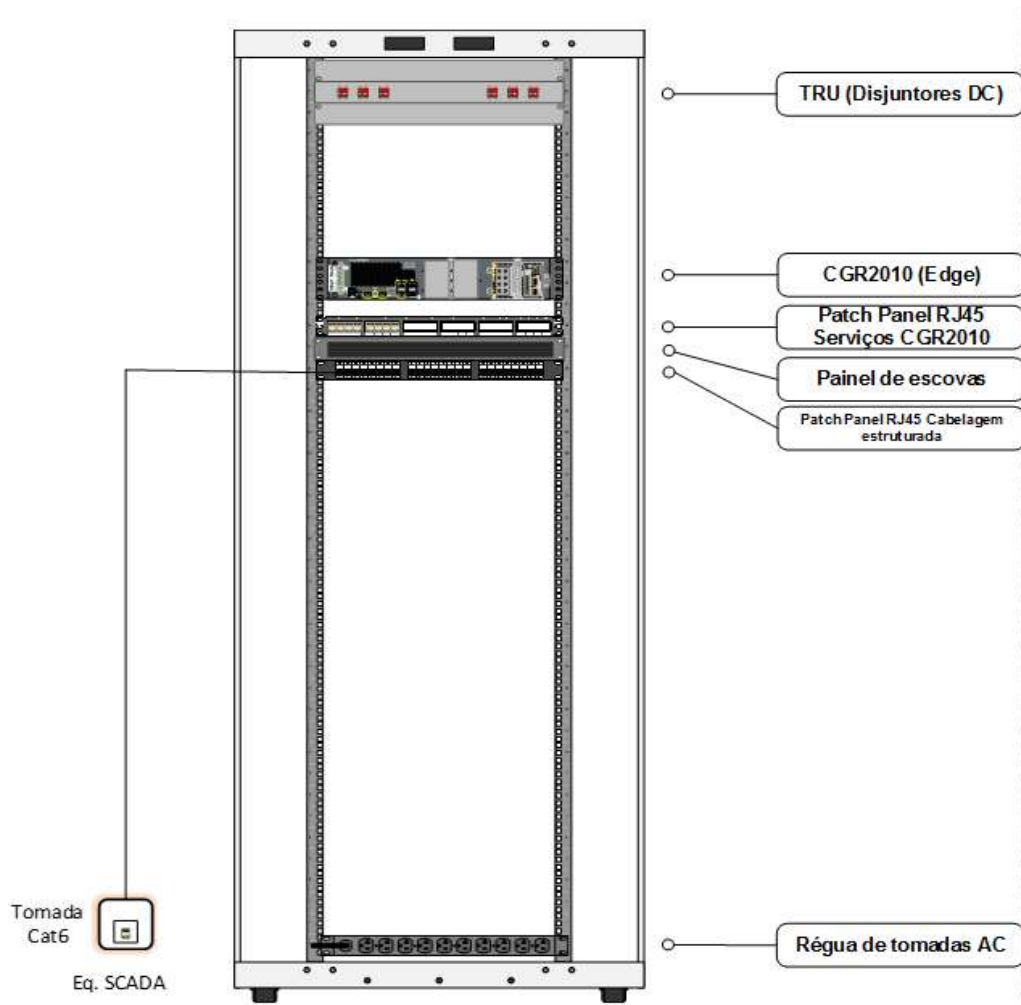
Partnumber	Descrição	Site Cliente
CGR-2010-SEC/K9	Cisco CGR2010 security bundle w/SEC license PACK	1
PWR-RGD-LOW-DC	Low DC (24/48VDC) Power Supply for CGR2010/CGS2520	2
SL-20-IPB-K9	IP Base License (Paper) for Cisco CGR2010	1
GRWIC-D-ES-2S-8PC	EtherSwitch 8x 10/100T (4 PoE) ports + 2 100/1000 SFP	1
SGRWLLK9-15002ED	Cisco GRWIC ESM LAN BASE WITH EXPRESS SETUP	1
SG20UK9-15204M	Cisco 2010 IOS UNIVERSAL	1
SL-20-SEC-K9	Security License (Paper) for Cisco CGR2010	1
Cisco Transceivers		
GLC-LX-SM-RGD	1000BASE-LX SFP Cisco transceiver module SMF RuggedSFP	1
GLC-ZX-SM-RGD	1000BASE-ZX SFP Cisco transceiver module SMF RuggedSFP	

Opção II:

Partnumber	Descrição	Site Cliente
IR1101-K9	IR1101 com licenciamento Network Essentials	1
SL-IR1101-NE	Cisco Network Essentials Software License for IR1101	1
IR1100-P-BLANK	Tampa para slot LTE (obrigatório na ausência de módulo)	1
Cisco Transceivers		
GLC-LX-SM-RGD	1000BASE-LX SFP Cisco transceiver module SMF RuggedSFP	1
GLC-ZX-SM-RGD	1000BASE-ZX SFP Cisco transceiver module SMF RuggedSFP	

- Considera-se ligação ótica entre o CE e instalação da E-Redes com a rede IP/MPLS.
- A conexão física do CE Router à instalação da E-Redes com IP/MPLS será estabelecida por interface ótico gigabit (interface WAN), fibra monomodo G652.D entre RND e o Centro Eletroprodutor.
- O Transceiver a utilizar dependerá do comprimento da ligação, GLC-LX até 15km ou GLC-ZX para distâncias superiores a 15 km.
- Circuitos Alimentação -48Vdc: (recomendado) Fornecimento e implementação de 2 circuitos elétricos de alimentação de corrente contínua -48Vdc, entre o QE corrente contínua socorrido e painel mecanizado 3U a instalar no Armário onde ficará o Router FO. Os circuitos de alimentação entre o CE e o painel mecanizado 3U devem ser corretamente dimensionados e protegidos por disjuntores de corrente contínua.
- Fornecimento e passagem de patch cords óticos protegidos por tubo heliflex. Devem ser considerados patch de comprimento suficiente para ligação dos equipamentos e o ODF (Repartidor ótico), sendo que os conectores do ODF serão do tipo SC/APC (salvo indicação em contrário).

### Layout Equipamento em Armário Rack 19"



(Exemplo da instalação de CGR2010 e painéis de terminação de cabos e acessórios em armário)

## 8. Anexo II – ECT Cisco 2010 Connected Grid Router

The Cisco® Connected Grid portfolio of solutions is designed specifically for the harsh, rugged environments often found in the energy and utility industries. These solutions include the Cisco 2010 Connected Grid Router (CGR 2010) and the Cisco 2520 Connected Grid Switch (CGS 2520), which have been designed to support the communications infrastructure needs of the energy delivery infrastructure across the generation, transmission, and distribution sectors. This infrastructure includes utility- and customer-owned energy infrastructure such as substation applications supporting electrical transmission and distribution, renewable generation, oil and gas, water, distributed generation, co-generation, and trackside operations. The infrastructure also includes communications infrastructure for delivery applications such as transmission pipelines, distribution mains, and service lines for oil and gas and water. Designed for highly secure, reliable, and scalable infrastructure, the CGR 2010 and CGS 2520 are an ideal platform to support the Smart Grid and other energy delivery infrastructure needs of customers. These ruggedized products have been extensively tested and are KEMA certified to meet challenging substation compliance standards, including IEEE 1613 and IEC 61850-3.

The Cisco CGR 2010 is a rugged router optimized for use in the multitude of different communication networks found in the energy and utility industries (Figure 1). One example application for the Cisco CGR 2010 is for substation networks in harsh environments common in utility transmission and distribution substations. The CGR 2010 provides operators with the benefits of improved security, manageability, and network reliability. The CGR 2010 uses Cisco IOS® Software, which is the operating system powering millions of Cisco routers deployed worldwide. Cisco IOS Software delivers the benefits of integrated security for North American Electric Reliability Corporation/Critical Infrastructure Protection (NERC/CIP) compliance, quality of service, and network management to help ensure integrity and priority of operational data communications.

Primary Cisco CGR 2010 features:

- Rugged industrial design, featuring no fans or moving parts, and an extended operational temperature range
- Substation compliance with IEC-61850-3 and IEEE 1613 for utility substation environments
- Integrated security to help address compliance with critical infrastructure protection mandates
- High availability design for maximum network uptime and redundancy
- Network and device management tools for deployments, upgrades, and remote monitoring
- Advanced quality of service (QoS) capabilities to support mission-critical communications such as substation communications such as SCADA (Supervisory Control and Data Acquisition)
- Comprehensive network security features based on open standards

### Cisco CGR 2010: Cable Side View



### Cisco CGR 2010: Power Supply Side View



Figure 1. Cisco CGR 2010

#### Networking Solutions and the Cisco CGR 2010: Substation Automation Example

Substation automation promises to bring more automation and intelligence to the power grid network to address a myriad of utility challenges. Utilities are focused on how to improve grid reliability, enhance network security to meet regulatory requirements, and reduce operational expenses. The Cisco Connected Grid Router and Switch offer utilities a rugged networking solution to enable reliable and secure two-way communication for substation automation. Figure 2 shows a converged end-to-end IP network from the data center to the home. The CGR 2010 and the CGR 2520 are deployed in both transmission and distribution substations. Networking these points of presence provides network operators with greater visibility into grid assets and helps identify, isolate, and restore outages more efficiently.

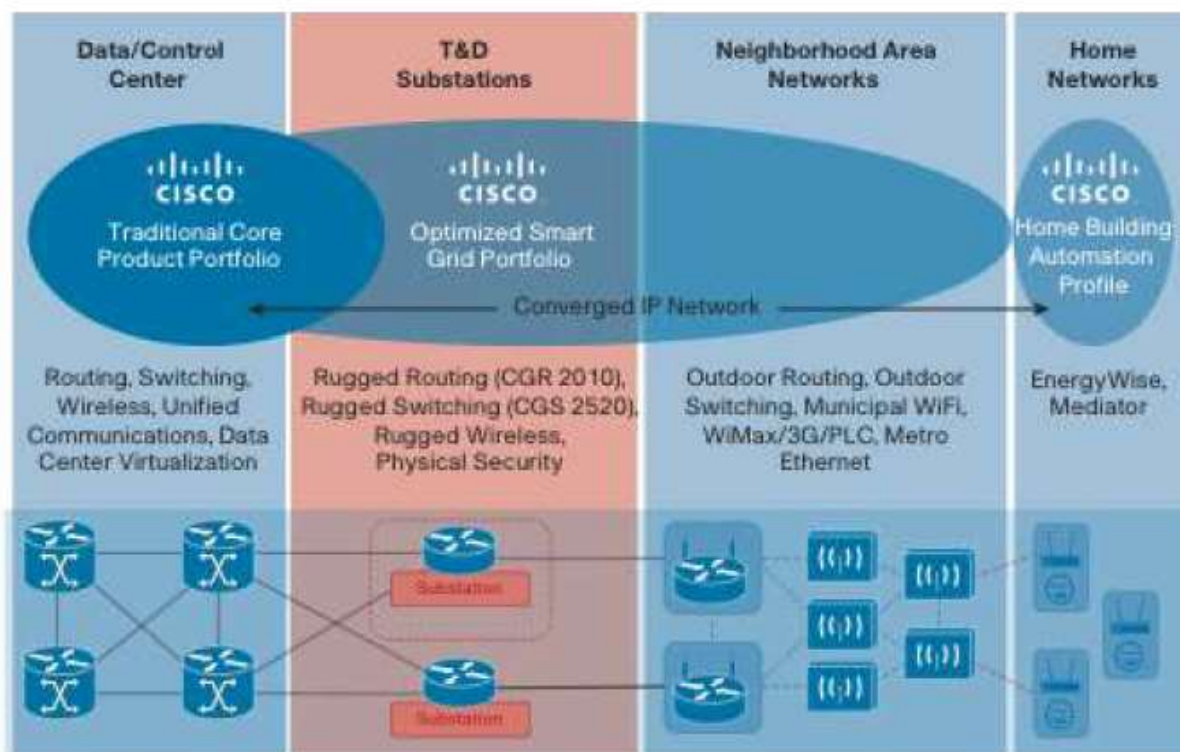


Figure 2. Places in the Network

**Product Overview**

The Cisco CGR 2010 builds upon the award-winning Integrated Services Router G2 (ISR G2) platform to deliver high-quality routing, security, management, and network intelligence. With embedded hardware encryption acceleration, optional firewall, and intrusion prevention, the CGR 2010 provides integrated security to protect energy-related communication networks. Specifically for utilities, the CGR 2010 complies with cyber security requirements such as the NERC/CIP mandates. In addition, the platform supports T1/E1 WAN interfaces with integrated CSU/DSU interfaces, synchronous and asynchronous serial RS-232 interfaces, and copper and fiber Gigabit Ethernet.

**Key Business Benefits**

The CGR 2010 is designed for network security, scalability, durability, and investment protection. The modular architecture facilitates upgrades to your energy networks without requiring a complete equipment upgrade of the routing platform. New modules can be added over time as communications requirements change. Table 1 lists the business benefits of the CGR 2010.



Benefits	Description
Services integration	<ul style="list-style-type: none"> <li>• CGR 2010 offers integrated services, including advanced data routing, firewall, traffic shaping, quality of service, and network segmentation</li> </ul>
Ruggedized for substation compliance	<ul style="list-style-type: none"> <li>• Compliant with IEEE 1613 and IEC 61850-3 substation standards for ruggedization</li> <li>• Natural convection cooled, with no moving parts or fans for maximum reliability</li> <li>• Extended EMI and surge protection for protection in substation environments</li> </ul>
Services on demand	<ul style="list-style-type: none"> <li>• A single Cisco IOS® Universal Software image is installed on each CGR 2010. The Universal image contains all of the Cisco IOS technology sets that can be activated with a software license. This allows your business to quickly deploy advanced features without downloading a new IOS image. Additionally, larger default memory is included to support the new capabilities.</li> </ul>
Network management	<ul style="list-style-type: none"> <li>• CiscoWorks LMS and Cisco Configuration Profession (CCP) network management tools to help provision and diagnose network issues</li> <li>• Embedded management tools capable of event detection and recovery, offered directly in a Cisco IOS Software device. For more information, please see Tables 5 and 6 for details on Cisco network management solutions offered with the CGR 2010.</li> </ul>
Network agility	<ul style="list-style-type: none"> <li>• Designed to address customer business requirements, the CGR 2010 Series modular architecture offers increased capacity and performance as your network needs grow.</li> <li>• Modular interfaces and power supplies offer increased bandwidth, a diversity of connection options, and network resiliency.</li> <li>• Modular, hot-swappable power supplies supported on both the Cisco CGR 2010 and the Cisco CGS 2520</li> <li>• Modular design allows ease of serviceability with spare components</li> <li>• Supports front or reverse cabling for maximum installation flexibility</li> </ul>
Energy efficiency	<ul style="list-style-type: none"> <li>• The CGR 2010 architecture provides energy-saving features that include the following:</li> <li>• Services integration and modularity on a single platform performing multiple functions, optimizes raw materials consumption and energy usage.</li> <li>• Platform flexibility and ongoing development of both hardware and software capabilities lead to a longer product lifecycle, lowering all aspects of the total cost of ownership, including materials and energy use.</li> <li>• High-efficiency power supplies are provided with each platform.</li> <li>• Natural convection uses no power for cooling</li> </ul>
Investment protection	<ul style="list-style-type: none"> <li>• CGR 2010 maximizes investment protection:</li> <li>• Modular design, supporting current and future interface cards</li> <li>• Flexible design, capable of hosting network applications</li> </ul>

Table 1. Key Business Benefits of the CGR 2010

### Platform Architecture and Modularity

The CGR 2010 is designed to meet the demanding environments of energy and utility communication networks, while offering reliable network services and performance required across the energy network. A modular design allows for forward flexibility to support future applications and interfaces for maximum investment protection. The modular architecture is designed to support increasing bandwidth requirements, various interface types, and fully integrated power distribution. Table 2 lists the architectural features and benefits of the CGR 2010.

Architectural Feature	Benefits
Substation hardened design	<ul style="list-style-type: none"> <li>Industrial-grade components used in the design of platform</li> <li>Hardware design and architecture developed to meet strict environmental, surge, and EMI requirements of IEC 61850-3 and IEEE 1613.</li> </ul>
High availability	<ul style="list-style-type: none"> <li>Cisco CGR 2010 is a highly modular platform, with four 4 slots to accommodate field-replaceable Grid Router WAN Interface Cards (GRWIC) to add connectivity and services for substation communications.</li> <li>CGR offers LAN and WAN connectivity options for redundant communications to substations.</li> <li>Hot-standby capabilities in dual-router configurations</li> <li>Modular design accommodates field upgrades for existing and/or future technologies without requiring a platform replacement.</li> <li>Performance Routing (PFR) improves application performance and availability by selecting the best path for each application based upon advanced criteria such as reachability, delay, loss, jitter, and Mean Opinion Score (MOS).</li> <li>Bidirectional Forwarding Detection provides a low-overhead, sub-second capability of detecting failures in the forwarding path between two routers, allowing for minimal disruptions from failover scenarios.</li> <li>Dual hot-swap power supplies allow for network redundancy and maximum uptime.</li> <li>Power supplies supported across Cisco's portfolio of rugged routing and switching products. Power supplies used with the CGR 2010 are also used on the Cisco Connected Grid Switch 2520 for ease of serviceability.</li> </ul>
Processors	<ul style="list-style-type: none"> <li>CGR 2010 platform is powered by a high-performance multicore processor that can support high-speed WAN connections while also running multiple concurrent services.</li> </ul>
Embedded IP security with Security Sockets Layer (IPSec/SSL) VPN hardware acceleration	<ul style="list-style-type: none"> <li>Embedded hardware encryption acceleration is enhanced to provide higher scalability, which combined with an optional Cisco IOS Security license, enables WAN link security and VPN services (both IPSec and SSL acceleration).</li> </ul>
Integrated Gigabit Ethernet ports	<ul style="list-style-type: none"> <li>Dual Gigabit Ethernet WAN interfaces, supporting two GE Fiber, or two GE Copper, or one of each interface.</li> <li>All onboard WAN ports are Gigabit Ethernet WAN routed ports.</li> <li>Both Ethernet WAN ports on the CGR 2010 support the Small Form-Factor Pluggable (SFP)-based connectivity in lieu of a RJ-45 port.</li> </ul>
Innovative universal-serial-bus (USB)-based console access	<ul style="list-style-type: none"> <li>New, innovative USB console port offers management connectivity for devices without a serial port such as modern laptop computers.</li> <li>Traditional console and auxiliary ports are also available.</li> </ul>
Wide range of power supply options	<ul style="list-style-type: none"> <li>Supports a low-voltage DC power supply (24-60 VDC) and a high-voltage AC or DC power supply (88-300 VDC, 85-264 VAC)</li> <li>Load-sharing power supplies in a dual power supply configuration; a single power supply is capable of supporting a fully configured router</li> <li>CGR 2010 platform provides maximum flexibility, allowing the user to choose a single power supply or any combination of power supplies for the system.</li> <li>Power supply capable of supporting inline power (802.3af-compliant PoE and Cisco Inline Power)</li> <li>Both power supplies are universally interchangeable with the Cisco CGS 2520.</li> </ul>
Designed for flexible deployments	<ul style="list-style-type: none"> <li>Reverse mounting options provide flexibility of providing rear cabling mounting options.</li> <li>LEDs are duplicated on both ends of the CGR 2010 to provide ease of use in either mounting option.</li> </ul>

Table 2. Architectural Features and Benefits

### Modularity Features and Benefits

The Cisco CGR 2010 provides modular capabilities (refer to Table 3), offering investment protection for customers. With the advent of a new family of Grid Router WAN Interface Cards (GRWIC), customers will have the capability to interchange modules and interfaces to meet their future requirements. Services and additional interface options enabled by current and future modules will help provide customers with flexible and robust options to upgrade their networks to meet increasing needs for greater bandwidth and intelligence within energy networks.



Modules & Switch Platforms	Benefits
Cisco Grid Router WAN Interface Card (GRWIC) Slots	<ul style="list-style-type: none"> <li>The GRWIC builds upon the popular High Speed WAN Interface Card (HWIC) architecture, available on the Cisco ISR G2 family to provide enhanced high throughput and hardening requirements needed within many energy networks.</li> <li>CGR 2010 accommodates up to four GRWIC modules, providing flexibility for a combination of WAN and LAN interfaces. Through the GRWICs, the CGR 2010 platform has the capability to provide T1/E1 WAN interface options, as well as Async/Sync RS-232 serial ports for serial connectivity to RTUs, relays, and other serial-based devices within the substation.</li> <li>Flexibility to support double-wide GRWIC modules is enabled by combining adjacent GRWIC slots. Slots 0 and 1 and slots 2 and 3 are capable of supporting double-wide modules in the future.</li> </ul>
GRWIC modules	<ul style="list-style-type: none"> <li>CGR 2010 supports 1 and 2 port T1/E1 CSU modules. For more information on the T1/E1 GRWICs, please visit the T1/E1 CSU/DSU GRWIC datasheets at the following URL <a href="http://www.cisco.com/go/cgr2000">http://www.cisco.com/go/cgr2000</a>.</li> <li>CGR 2010 supports an 8-port async/sync RS-232 serial module. This provides users with an interface between the CGR 2010 and legacy serial devices in the energy network.</li> </ul>
Compact flash slots	<ul style="list-style-type: none"> <li>Two external Compact Flash slots are available on the CGR 2010. Each slot can support rugged, high-speed storage compact flash cards upgradeable to 4 GB in density.</li> <li>First compact Flash slot supports the Cisco IOS Software and configuration.</li> <li>Second compact flash is available for additional memory storage.</li> </ul>
USB 2.0 ports	<ul style="list-style-type: none"> <li>Two high-speed USB 2.0 ports are supported. The USB ports enable secure token capabilities and additional storage.</li> </ul>

Table 3. Modularity Features and Benefits

### Cisco IOS Software

The CGR 2010 delivers innovative technologies running on industry-leading Cisco IOS Software. Developed for wide deployment in the world's most demanding, harsh environments, the CGR 2010 platform is supported on Cisco IOS Software release 15.1T. Release 15.1(1)T provides support for a comprehensive portfolio of Cisco technologies, including the functionality and features delivered in releases 12.4 and 12.4T. New innovations in 15.1(1)T span multiple technology areas, including security, high availability, IP routing and multicast, quality of service (QoS), Multiprotocol Label Switching (MPLS), VPNs, and embedded management.

### Cisco IOS Software Licensing and Packaging

A single Cisco IOS Universal image, encompassing all IOS technology feature sets, is delivered with the platforms. You can enable advanced features by activating a software license on the Universal image. Technology packages and feature licenses, enabled through the Cisco software licensing infrastructure, simplify software delivery and decrease the operational costs of deploying new features.

Three major technology licenses are available on the CGR 2010 platform; you can activate the licenses through the Cisco software activation process identified at <http://www.cisco.com/go/sa>. The three licenses are as follows:

- IP Base: This technology package is available as default.
- Data
- Security (SEC) or Security with No Payload Encryption (SEC-NPE)

### Integrated Network Security

Cyber security is critical to the reliability of energy networks. Operators must help ensure data communications used to operate energy infrastructure take priority and are not compromised by cyber attacks. Cisco has created a full suite of security features designed to help ensure the integrity of grid communications.

The Cisco IOS Software Security technology package for the CGR 2010 offers a wide array of common security features, such as advanced application inspection and control, threat protection, and encryption architectures for enabling more scalable and manageable VPN networks. The CGR 2010 offers onboard hardware-based encryption acceleration to provide greater IPsec throughput with less overhead for the route processor when compared with software-based encryption solutions. The CGR 2010 offers a comprehensive and adaptable security solution for energy networks that includes features such as:

- Secure connectivity: Secure collaborative communications with Group Encrypted Transport VPN,



Dynamic Multipoint VPN (DMVPN), or Enhanced Easy VPN

- Integrated threat control: Responding to sophisticated network attacks and threats, using Cisco IOS Firewall, Cisco IOS Zone-Based Firewall, Cisco IOS Intrusion Prevention System (IPS), Cisco IOS Content Filtering, and Flexible Packet Matching (FPM)
- Identity management: Intelligently protecting endpoints using technologies such as authentication, authorization, and accounting (AAA) and public key infrastructure (PKI)

### Combination Gigabit Ethernet Ports

The CGR 2010 supports two on-board Gigabit Ethernet interfaces for WAN and LAN connectivity. The CGR 2010 comes standard with two 10/100/1000 Gigabit Ethernet copper interfaces and two 100/1000 Mbps Fiber Ethernet interfaces. Of the four GE ports available, the CGR 2010 can be configured with a maximum of two GE ports in any combination of Ethernet copper or fiber. Both Layer 2 and Layer 3 (IP routing) features are supported on these interfaces for maximum flexibility. For expanded Ethernet port requirements, the Cisco CGR 2520 supports up to 24 ports of copper and/or fiber, depending on the model chosen.

### Application Acceleration

The CGR 2010 smoothly combines industry-leading security, Cisco IOS Software-based traffic control, and visibility with Cisco application acceleration solutions. Cisco IOS Software features such as NBAR, IP SLA, and Netflow provide visibility and monitoring of traffic patterns and application performance, while IOS features such as Quality of Service (QoS), Access Control Lists (ACLs), and Performance Routing (PfR) intelligently control the traffic to maximize the quality of the user experience and employee productivity.

### Managing Your Connected Grid Router

Network management applications are instrumental in lowering operating expenses (OpEx), while improving network availability by simplifying and automating many of the day-to-day tasks associated with managing an end-to-end network. Day-one device support provides immediate manageability support for the CGR 2010, enabling quick and easy deployment, monitoring, and troubleshooting from Cisco and third-party applications.

Organizations rely on Cisco-, third-party-, and in-house-developed network management applications to achieve their OpEx and productivity goals. Underpinning those applications are the embedded management features available in every Connected Grid Router. These routers incorporate deep manageability features, such as IP service-level agreement (IP SLA), Cisco IOS Embedded Event Manager (EEM), and NetFlow, which allow you to know the status of your network at all times. These features, along with Simple Network Management Protocol (SNMP) and syslog, enable your organization's management applications.

Refer to Tables 4 and 5 below for details about network management and manageability support on the Cisco CGR 2010.

Protocols	IPv4, IPv6, static routes, Open Shortest Path First (OSPF), Enhanced IGRP (EIGRP), Border Gateway Protocol (BGP), BGP Router Reflector, Intermediate System-to-Intermediate System (IS-IS), Multicast Internet Group Management Protocol (IGMPv3), Protocol Independent Multicast sparse mode (PIM SM), PIM Source Specific Multicast (SSM), Distance Vector Multicast Routing Protocol (DVMRP), IPSec, Generic Routing Encapsulation (GRE), Bi-Directional Forwarding Detection (BFD), IPv4-to-IPv6 Multicast, MPLS, L2TPv3, IEEE 802.1ag, IEEE 802.3ah, and L2 and L3 VPN
Encapsulations	Ethernet, IEEE 802.1q VLAN, Point-to-Point Protocol (PPP), Multilink Point-to-Point Protocol (MLPPP), Frame Relay, Multilink Frame Relay (MLFR) (FR.15 and FR.16), High-Level Data Link Control (HDLC), Serial (RS-232, Point-to-Point Protocol over Ethernet (PPPoE), and ATM, DNP3, and MODBUS SCADA Tunneling (BSTUN)
Traffic management	QoS, Class-Based Weighted Fair Queuing (CBWFQ), Weighted Random Early Detection (WRED), Hierarchical QoS, Policy-Based Routing (PBR), Performance Routing (PfR), and Network-Based Advanced Routing (NBAR)

Table 4. Cisco Connected Grid Router IOS Software Features and Protocols Support

Table 5 lists the embedded management features available with Cisco IOS Software.

Feature	Description
<a href="#">WSMA</a>	The Web Services Management Agent (WSMA) defines a mechanism through which you can manage a network device, retrieve configuration data information, and upload and manipulate new configuration data. WSMA uses XML-based data encoding that is transported by the Simple Object Access Protocol (SOAP) for the configuration data and protocol messages.
<a href="#">EEM</a>	Cisco IOS Embedded Event Manager (EEM) is a distributed and customized approach to event detection and recovery offered directly in a Cisco IOS Software device. It offers the ability to monitor events and take informational, corrective, or any desired EEM action when the monitored events occur or when a threshold is reached.
<a href="#">IPSLA</a>	Cisco IOS IP Service-Level Agreements (SLAs) enable you to help ensure new business-critical IP applications, as well as IP services that use data, voice, and video in an IP network.
<a href="#">SNMP</a> , <a href="#">RMON</a> , <a href="#">Syslog</a> , <a href="#">NetFlow</a> , and <a href="#">TR-069</a>	CGR 2010 also supports SNMP, Remote Monitoring (RMON), syslog, NetFlow, and TR-069 in addition to the embedded management features previously mentioned.

Table 5. Embedded Management Features Available with Cisco IOS Software

The Cisco network management applications listed in Table 6 are standalone products that you can download or purchase to manage your Cisco network devices. The applications are built specifically for the different operational phases; you can select the ones that best fit your needs.

Operational Phase	Application	Description
Device staging and configuration	<a href="#">Cisco Configuration Professional</a>	Cisco Configuration Professional is a GUI device-management tool for Cisco IOS Software-based access routers. This tool simplifies router, security, WAN, and basic LAN configuration through easy-to-use wizards.
Network wide deployment, configuration, monitoring, and troubleshooting	<a href="#">CiscoWorks LMS</a>	CiscoWorks LAN Management Solution (LMS) is a suite of integrated applications for simplifying day-to-day management of a Cisco end-to-end network, lowering OpEx while increasing network availability. CiscoWorks LMS offers network managers an easy-to-use web-based interface for configuring, administering, and troubleshooting the CGR 2010, using new instrumentation such as Cisco IOS EEM Generic Online Diagnostics (GOLD).
Operational Phase	Application	Description
Network-wide staging, configuration, and compliance	<a href="#">CiscoWorks NCM</a>	CiscoWorks Network Compliance Manager (NCM) tracks and regulates configuration and software changes throughout a multivendor network infrastructure. It provides superior visibility into network changes and can track compliance with a broad variety of regulatory, IT, corporate governance, and technology requirements.
Staging, deployment, and changes of licenses	<a href="#">Cisco License Manager</a>	Secure client-server application Cisco License Manager allows users to easily manage Cisco IOS Software activation and licenses for a wide range of Cisco platforms running Cisco IOS Software, as well as other operating systems.
Staging, deployment, and changes to configuration and image files	<a href="#">Cisco Configuration Engine</a>	Cisco Configuration Engine is a secure network management product that provides zero-touch image and configuration distribution through centralized, template-based management.

Table 6. Network Management Applications

### Summary

As your business strives to lower the total cost of ownership in running your network, you will need more intelligent communication solutions to empower the workforce managing the network. The CGR 2010 offers these solutions by providing enhanced performance and increased modular density to support multiple services. The CGR 2010 is designed to consolidate the functions of many separate devices into a single, compact system.

Feature	Specification
Substation hardening compliance	IEC 61850-3 IEEE1613
Embedded hardware-based cryptography acceleration (IPSec + SSL)	Yes
Total onboard Ethernet WAN Ports	2
RJ-45-based ports (10/100/1000)	2
SFP-based ports (use of SFP port disables the corresponding RJ-45 port)	2 SFP slots supporting 100 mbps or 1000 mbps rugged SFPs
Grid Router WAN Interface Card (GRWIC) slots	4
Double-wide capable GRWIC slots (use of a double-wide GRWIC slot will consume two GRWIC slots)	2
Memory DDR2 ECC DRAM - default	1 GB
Rugged compact flash	slot 0: 256 MB (Default) slot 1: 256 MB (Optional Expansion for storage)
External USB 2.0 flash memory slots (Type A)	2
USB Console port (Type B) (up to 115.2 kbps)	1
Serial console port	1
Serial auxiliary port	1
Power supply options	Two power supply options: <ul style="list-style-type: none"> <li>• Low-voltage DC power supply (available in late 2010)</li> <li>• AC or high-voltage DC power supply</li> </ul> Any combination of power supplies can be inserted into the chassis. Dual power supply configurations are load sharing in redundancy mode, although a single power supply is sufficient for supporting power needs for the system.
<b>Power specifications</b>	
AC input voltage (Power Supply Unit 1)	Nominal Range: 100 - 240 VAC Operating Range: 85 -264 VAC AC supply also accepts a DC input with an operating range of 88 - 300 VDC
DC input voltage (Power Supply Unit 2)	Nominal Range: 24 - 60 VDC Operating Range: 20 - 75 VDC



Feature	Specification
AC input frequency	47 to 63 Hz
AC input current range for AC power supply (maximum)	2 A
AC input surge current	<50 A
DC input voltage	24 - 60 VDC, extended 88-300 VDC (on separate power supply)
System power consumption (with no modules) (Watts)	30 Watts
Grid Router WIC power consumption	Typical: 4.5 Watts Maximum: 6 Watts
<b>Physical specifications</b>	
Dimensions (H x W x D)	3.5 x 17.25 x 15 in. (88.9 x 438.2 x 381 mm)
Rack height	2 RU (rack unit)
Rack-mount 19 in. (48.3 cm) EIA	Included
Wall-mount	Yes
Weight with 1 power supply (no modules)	19 lbs (8.6kg)
Typical weight fully configured with 2 power supplies and 4 GRWICs	25 lbs (11.4 kg)
Airflow	Convection and conduction cooling (no fans)
<b>Environmental Specifications</b>	
<b>Operating Conditions</b>	
Operating Temperature	-40 °F to 140°F (-40 to +60°C) continuous operating temperature range -40 °F to 185°F (-40 to +85°C) type test for 100 hours at 85°C
Shock/Vib	30G @11 ms
Altitude	10,000 ft (3,048 m) Max operating temp is de-rated with increasing altitude per IEEE 1613a-2008
Relative humidity	5 to 95% non-condensing
<b>Non-operating conditions</b>	
Temperature	-40°F to 185°F (-40°C to 85°C)
Relative humidity	5 to 95% non-condensing
Altitude	16,000 ft (4,876 m) Max operating temp is de-rated with increasing altitude per IEEE 1613a-2008
Non-Op Free Fall Drop	4 in. (100 mm) per ENG-339611
Operating seismic/earthquake	NEBS GR-63 (5.4.1)
Non-op shock/vib	40-50G (3.26 m/s minimum)
<b>Regulatory compliance*</b>	
Environmental substation compliance	IEC-61850-3 IEEE1613
Immunity	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

Feature	Specification
EMC	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	USA: UL 60950-1 Canada: CAN/CSA C22.2 No. 60950-1 Europe: EN 60950-1 China: GB 60950-1 Australia/New Zealand: AS/NZS 60950-1 Rest of World: IEC 60950-1 CSA certified to UL/CSA 60950-1, 2nd Ed. CB report to IEC60950-1, 2nd Ed., covering all group differences and national deviations
Telecom	US: TIA-968-A CA: CS-03 EU: TBR1, 2, 4, 12, 13 RTTE Directive Australia: AS/ASIF S016, S038 Japan: JATE
Telecom interface standards	T1/E1 GRWIC: ITU-T G.703, G.704, G.706, G.823, ANSI T1.403 8-port Asyn/Sync RS-232 GRWIC: RS232, ITU-T V.11

\* For more information, consult the Product Approval Database <http://tools.cisco.com/cse/prdapp> or consult your local Cisco representative (Cisco.com login required)

#### Part Numbers:

SKU Name	SKU Description
<b>Connected Grid Router</b>	
CGR 2010/K9	Cisco CGR2010 w/2GE, 4 GRWIC slots, 256 MB CF, 1 GB DRAM, IPB
CGR 2010-SEC/K9	Cisco CGR2010 security bundle w/SEC license PAK
<b>Connected Grid Router WIC</b>	
GRWIC-1CE1T1-PRI	1 port channelized T1/E1 and PRI GRWIC (data only)
GRWIC-2CE1T1-PRI	2 port channelized T1/E1 and PRI GRWIC (data only)
GRWIC-8A/S-232	8-Port Async/Sync Serial GRWIC, EIA-232
<b>Connected Grid Power Supplies</b>	
PWR-RGD-AC-DC=	High AC/DC (88-300VDC/85-264VAC) power supply for Cisco CGR2010 and CGS2520 switch, Spare
PWR-RGD-LOW-DC=	Low DC (24-60VDC) power supply module for the Cisco CGR 2010 and CGS 2520 switch (available in late 2010)

#### Small Form-Factor Pluggable SFP's for CGR 2010

The CGR 2010 only supports rugged SFPs. These SFPs are not available as part of the system order and should be ordered as spares if needed. The CGR-2010/K9 provides 2 SFP slots supporting 100mbps or 1000mbps rugged fiber SFPs. Both Ethernet WAN ports on the CGR 2010 are dual purpose ports and can support either two Small Form-Factor Pluggable (SFP)-ports, two 10/100/1000mbps copper ports, or one of each.

Ordering SKU	Description
GLC-FE-100FX-RGD=	100Base-FX Multi Mode Rugged SFP (Spare only)
GLC-FE-100LX-RGD=	100Mbps Single Mode Rugged SFP (Spare only)
GLC-SX-MM-RGD=	1000Mbps Multi-Mode Rugged SFP (Spare only)
GLC-LX-SM-RGD=	1000Mbps Single Mode Rugged SFP (Spare only)
GLC-ZX-SM-RGD=	1000BASE-ZX Single Mode Rugged SFP (Spare only)

Table 8. SFP options for the Cisco CGR 2010 router (Spare Only)

**Ordering Information**

These products can be ordered by a Cisco authorized partner. For more information about product availability, please contact your Cisco representative.

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