CISCO UBR7100 SERIES UNIVERSAL BROADBAND ROUTER

PRODUCT SUMMARY

The Cisco uBR7100 series universal broadband router delivers a feature-rich cable modem termination system (CMTS) for evolving Tier 2 or Tier 3 cable networks. The product offers cable operators, multi-unit businesses, and Internet service providers a cost-effective, high-speed data package that includes:

- A combined router and CMTS with routing, bridging, and PPPoE termination modes supported
- Integrated upconverter on the cable interface
- Embedded dual 10/100 BaseT Ethernet interface with additional network interfaces orderable and configurable by customers

The Cisco uBR7100 Series is Data Over Cable Service Interface Specifications (DOCSIS®) 1.1 and 1.0-qualified. The product supports EuroDOCSIS 1.1 and is EuroDOCSIS 1.0-qualified.

The product also supports CableLabs® CableLabs® OpenCable™ DOCSIS Set-Top Gateway (DSG) specification. DSG enables cable operators to transport upstream and downstream video traffic directly through the CMTS versus through a proprietary, standalone video server. Incorporating out-of-band (OOB) messaging in DOCSIS digitally modulated carriers, cable operators can consolidate cable modem and set-top box data traffic on a shared DOCSIS channel.

The Cisco uBR7100 Series requires exceptionally low capital investment and minimal setup time to provide high-speed data services. The product supports up to 2,000 subscribers.

FEATURE-RICH, COST-EFFECTIVE, AND EASY-TO-USE CABLE MODEM TERMINATION SYSTEM

The Cisco uBR7100 series universal broadband router provides a complete, easy-to-use product that allows cable operators, Internet service providers (ISPs), and multi-unit (MxU) businesses such as universities, hotels, convention centers, and apartment owners to offer high-speed data services including e-mail, Internet access, and digital video. For cable operators and ISPs, the product delivers a cost-effective solution that combines a router, supporting high-performance backbone technologies, with a CMTS that contains line cards with integrated upconverters. For MxU businesses, the product promotes “plug and play”, offering a number of hardware and software choices that support quick and easy deployment of a cable headend—the central location that injects broadcast signals and enables data connectivity to and from subscribers. Subscriber devices supported include cable modems, set top boxes (STBs), and Cisco cable enterprise and customer premises equipment.

Figure 1 Cisco uBR7100 Series Universal Broadband Router
The Cisco uBR7100 series offers hardware configurations, optimized for the specific network topology and application:

- The Cisco uBR7111 and uBR7111E contain one downstream (traffic from the headend to the subscriber) port and one upstream (traffic from the subscriber to the headend) port:
  - The Cisco uBR7111 and uBR7111E models support bi-directional cable traffic
  - The Cisco uBR7111 supports fast downstream access via the cable system with upstream connectivity via dial-up modems connected to the Public Switched Telephone Network (PSTN)

- The Cisco uBR7114 and uBR7114E contain one downstream and four upstream ports:
  - The Cisco uBR7114 and uBR7114E support bi-directional cable traffic; four upstream ports increase capacity and offer greater flexibility when partitioning services
  - The Cisco uBR7114 supports fast downstream cable access with upstream PSTN connections; For cable companies planning to upgrade their one-way system, this model provides Internet-generating services immediately using telephone-return, with easy conversion to two-way cable operations when ready

For cable plants using North American channel plans, the Cisco uBR7111 and uBR7114 support downstream and upstream traffic to and from two-way DOCSIS-based cable modems supporting 6 MHz National Television Systems Committee (NTSC) operations. For NTSC cable plants that have not been fully upgraded to two-way transmission, the Cisco uBR7111 and uBR7114 work with dial-up access products to support upstream traffic from DOCSIS-based telco-return cable interfaces.

For international cable plants using 8 MHz channel widths, the Cisco uBR7100 series supports Phase Alternating Line (PAL) and Systeme Electronique Couleur Avec Memoire (SECAM) channel plans. The Cisco uBR7111E and uBR7114E operate with EuroDOCSIS-based cable modems and STB units with integrated EuroDOCSIS modems.

The Cisco uBR7100 series is based on open standards and brings the power and proven reliability of the industry-leading Cisco uBR7246VXR universal broadband router within reach of all cable operators. The Cisco uBR7100 series offers feature-rich software. Cisco IOS® Software—the accepted standard networking software—guarantees end-to-end Internet connectivity and includes options to ensure secure communications over the cable and IP network.

### Table 1 Cisco uBR7100 Series Features and Benefits

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete Package</td>
<td>• Includes integrated upconverters, network interfaces, and default configuration files to fully provision hosts and cable modems in simple high-speed data configurations</td>
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<tr>
<td></td>
<td>• Allows customers to quickly build a service-enabled broadband cable network that delivers Internet billable services</td>
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<tr>
<td>Standards-based</td>
<td>• Supports DOCSIS, and EuroDOCSIS standards to protect investment and promote interoperability</td>
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<td></td>
<td>• Supports DSG, enabling cable operators to migrate from proprietary to open set-top technology and benefit from technical advantages and continued innovation of DOCSIS</td>
</tr>
<tr>
<td>Reliable Operation and Spectrum Management</td>
<td>• Enables cable operators to capture the full potential of their cable spectrum and DOCSIS HFC networks.</td>
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<td>• Alerts operators to fluctuations before critical conditions occur</td>
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<td>• Supports proactive resolution while the system remains on line</td>
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<tr>
<td></td>
<td>• Offers spectrum management features that include the ability to specify configurable frequency hop parameters: assign frequency subbands and input power levels in a spectrum group, reassign frequency based on day/time patterns, and reassign frequency based on the number of lost station messages from subscriber devices that exceed a threshold</td>
</tr>
</tbody>
</table>
Routing and Bridging Operating Mode Support

The Cisco uBR7100 series supports the following modes of operation:

- **Routing mode**—This is the default mode for the Cisco uBR7100 Series. This mode offers a wide spectrum of advanced Cisco IOS routing features.

- **Transparent bridging mode** supported using Cisco IOS Release 12.1(7)EC or greater—This mode supports bridging between cable and network interfaces. This mode is effective in MxU environments where the CMTS is replacing an existing bridging network or in CMTS environments with a limited number of CPE devices. Bridging is not typically used in DOCSIS CMTS installations because of potential performance and security issues.

- **Integrated Routing and Bridging (IRB)** supported using Cisco IOS Release 12.1(7)EC or greater—IRB operation allows bridging within a specific segment of networks or hosts, yet also allows these hosts to connect to devices on other, routed networks without having to use a separate router to interconnect the two networks.

DSG Support

Traditionally, physical transport of OOB messaging is carried over dedicated channels as defined by the Society of Cable Telecommunication Engineers Digital Video Subcommittee (SCTE DVS) 167 and SCTE DVS 178. DSG allows the Cisco uBR7100 Series to deliver OOB messages with just a software upgrade using Cisco IOS Release 12.2(15)BC2 or higher. Based on CableLabs OpenCable standards, DSG is a technology that bridges the old video world with what can be considered next generation out-of-band (OOB). DSG moves away from traditional OOB transport, incorporating it into DOCSIS digitally modulated carriers now used for cable modem service. The CMTS transports digital video OOB messaging/signaling between video headend and subscriber digital set-top boxes. Consolidating cable modem and STB traffic over a common DOCSIS network enables cable operators to support new features and technology with minimal hardware change and offers a smarter and lasting network infrastructure that increases return-on-investment and reduces operating expenses. DSG adds the power of DOCSIS technology for new services, accelerating rollout of bandwidth-intensive, interactive video services such as online gaming, T-commerce, and targeted advertising. Migration of OOB messaging traffic to an operationally superior and higher bandwidth DOCSIS channel is critical to adoption of interactive services. For these services, the traditional OOB mechanism (DVS 167 and DVS 178) is inefficient and provides insufficient bandwidth at a higher cost point.

### Table 1  Cisco uBR7100 Series Features and Benefits

<table>
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<th>Features</th>
<th>Benefits</th>
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<tr>
<td>Easy Upgrades and Management</td>
<td>• Enables fast, reliable software and micro-code upgrades</td>
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<td></td>
<td>• Supports single, centralized point of administration for remote device that includes the capability to download files to remote subscriber devices</td>
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<tr>
<td>Choice of Models</td>
<td>• Supports deployment of two-way cable and telephone return on same downstream channel based on model ordered</td>
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<tr>
<td></td>
<td>• Meets diverse needs and simplifies hardware configuration</td>
</tr>
<tr>
<td>Cisco IOS</td>
<td>• Offers best-of-breed software</td>
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<tr>
<td></td>
<td>• Includes diverse routing protocols, quality of service (QoS) and policy routing features to support differentiated services configuration features such as Dynamic Hierarchical Configuration Protocol (DHCP) and Trivial File Transfer Protocol (TFTP); DOCSIS Baseline Privacy Interface (BPI) security</td>
</tr>
<tr>
<td><strong>Table 2</strong> Hardware Specifications</td>
<td></td>
</tr>
<tr>
<td>------------------------------------</td>
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</tr>
<tr>
<td><strong>Embedded Processor</strong></td>
<td>MIPS RISC5271/ RM7000, 75 MHz Bus</td>
</tr>
<tr>
<td><strong>Throughput of Services</strong></td>
<td>50 Mbps</td>
</tr>
</tbody>
</table>
| **System Memory** | 64 MB packet / 64 MB system memory default  
Memory expandable to 256 MB |
| **Line Cards with Integrated Upconverters/Modulators (Cable Plant Interfaces)** | Fixed based on product/ordered:  
DOCSIS Annex B, 6 MHz operation:  
Cisco uBR7111 with 1 downstream & 1 upstream  
Cisco uBR7114 with 1 downstream & 4 upstreams  
The downstream uses a 6 MHz channel width in the 85 to 860 MHz frequency range.  
The upstream supports the 5 to 42 MHz frequency range.  
DOCSIS Annex A, 8 MHz operation:  
Cisco uBR7111E with 1 downstream & 1 upstream  
Cisco uBR7114E with 1 downstream & 4 upstreams  
The downstream uses an 8 MHz channel width in the 85 to 860 MHz frequency range.  
The upstream supports multiple channel widths in the 5 to 65 MHz frequency range.  

Integrated Upconverter Specifications:  
High level output: +61 dBmV, 53 to 857 MHz  
Optimized for 64 and 256 Quadrature Amplitude Modulation (QAM)  
Software configurable from +45 to +61 dBmV output power in units of dBmV  
Calibration accuracy range: +50 to +60 dBmV  
Software selectable output frequency in 12.5 kHz step size  
Out-of-band noise performance: <-12 dBmV / -30 dBmV / 6 MHz and 8 MHz  
Digital slope compensation to achieve < +/- 0.3 dB slope over any channel  
Excellent in-band noise performance  
Radio Frequency (RF) output mutes when changing output configuration  
High reliability, state-of-the-art design using microstrip MMIC and surface mount technology  
Conservative component de-rating and 100% burn-in to help ensure reliable operation  
Low power consumption  
All local oscillators are frequency synthesized and locked to a common internal high stability reference.  
NOTE: Also see “Downstream Cable Physical Layer” and “Upstream Cable Physical Layer” specification sections |
| **Port Adapters (WAN or Backbone Interfaces)** | Embedded dual 10/100 BaseT Ethernet (TX FE) provided  
Supports one additional PA; options include:  
Ethernet—PA-FE-TX, PA-FE-TX, PA-FE-FX, PA-4E  
Serial—PA-4T, PA-4T+  
HSSI—PA-2H  
ATM—PA-A3-OC3MM |
| **AC Power Supply Included** | Single: 100 to 240 VAC input voltage  
Output 20 watts  
50-60 Hz frequency  
0.80 to 0.95 power factor  
525W (maximum) input AC power  
AC-input cable: 18-QEG4 3-wire cable with a 3-lead IEC-320 receptacle on the power supply end & country-dependent plug on power source end |
Table 2 Hardware Specifications

| Compact Design: Suitable for Rack-Mount (2 Rack Unit) or Desktop Installation | Dimensions of 17.5 x 18.25 x 3.5 in. (44.45 x 46.36 x 8.89 cm) (H x W x D) 32 lbs (14.5 kg) |

Table 3 Physical and Environmental Specifications

| Operating Temperature | 32˚ to 104˚ F (0˚ to 40˚ C) operating; -4˚ to 149˚ F (20˚ to 65˚ C) nonoperating |
| Airflow | ~120 cfm5 |
| Humidity | 10 to 90% noncondensing |
| Heat Dissipation | 370W (1262 Btu1) |
| Safety Approvals | Compliance: CE Marking, FCC Part 68, UL 1950, CSA 22.2 No.950, EN60950, AUSTEL TS001, AS/NZS 3260, IEC 950 |
| Emissions | FCC Class A (47 CFR, Part 15), ICES-003 Class A, EN55022 Class B, CISPR22 Class B, AS/NRZ 3548 Class B, VCCI Class B, IEC-1000-4-2, IEC-1000-4-3, IEC-1000-4-4, IEC-1000-4-5, IEC-1000-4-6, IEC-1000-4-11, IEC 1000-3-2 |

Table 4 Downstream Cable Physical Layer, Cisco uBR7111 and uBR7114

- Downstream physical layer enhanced ITU J.83, Annex B, with convolutional and Reed-Solomon Forward Error Correction (FEC)
- Variable depth interleaving, (I, J)=(8, 16), (32, 4), (64, 2), (128, 1)
- DOCSIS physical layer parameters in a 6 MHz channel
- Output impedance: 75 ohms nominal
- Cable Fixed Line Card Connector: F-connector

| 64 QAM | 5.056941 Mbps Symbol Rate | 12% Nyquist Filter (square root raised cosine) | 30.34 Mbps line bit rate | 27 Mbps Effective Bit Rate |
| 256 QAM | 5.36057 Mbps Symbol Rate | 18% Nyquist Filter (square root raised cosine) | 42.88 Mbps line bit rate | 39 Mbps Effective Bit Rate |

Table 5 Upstream Cable Physical Layer, Cisco uBR7111 and uBR7114

Cisco uBR7100 series upstream cable interfaces support following values from cable modems or set top boxes:

- Symbol rates of 160, 320, 640, 1280, 2560 ksym/sec
- Modulation: Quadrature Phase Shift Keying (QPSK) and 16 QAM
- Upstream Frequency Range: 5 to 42 MHz edge-to-edge with FEC length (T=0 to T=10)
- Calibrated and widely adjustable upstream voltage level
- Total input power: less than 35 dBmV
- Operating power range: Bursts within 6 dB of commanded level
- Radio Frequency (RF) performance stable to 1.5 dB across -5˚ to +50˚ C
- RF Spurs less than 5 V on all inputs and outputs
- Cable Fixed Line Card Connector: F-connector

| 160 ksym/sec Symbol Rate | 200 kHz Channel Bandwidth | 290 kbps QPSK bit rate | 580 kbps 16 QAM bit rate | -6 to +14 dBmV input power ranges |
Table 5  Upstream Cable Physical Layer, Cisco uBR7111 and uBR7114

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- RF Spurs less than 5 V on all inputs and outputs
- Cable Fixed Line Card Connector: F-connector

<table>
<thead>
<tr>
<th>320 ksym/sec</th>
<th>Symbol Rate</th>
<th>400 kHz</th>
<th>580 kbps</th>
<th>1160 kbps</th>
<th>-13 to +117 dBmV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Channel Bandwidth</td>
<td>QPSK bit rate</td>
<td>16 QAM bit rate</td>
<td>input power ranges</td>
<td></td>
</tr>
<tr>
<td>640 ksym/sec</td>
<td></td>
<td>800 kHz</td>
<td>1150 kbps</td>
<td>2300 kbps</td>
<td>-10 to +20 dBmV</td>
</tr>
<tr>
<td>Symbol Rate</td>
<td></td>
<td></td>
<td>QPSK bit rate</td>
<td>16 QAM bit rate</td>
<td>input power ranges</td>
</tr>
<tr>
<td>1280 ksym/sec</td>
<td></td>
<td>1600 kHz</td>
<td>2300 kbps</td>
<td>4600 kbps</td>
<td>-7 to +23 dBmV</td>
</tr>
<tr>
<td>Symbol Rate</td>
<td></td>
<td></td>
<td>QPSK bit rate</td>
<td>16 QAM bit rate</td>
<td>input power ranges</td>
</tr>
<tr>
<td>2560 ksym/sec</td>
<td></td>
<td>3200 kHz</td>
<td>4600 kbps</td>
<td>9200 kbps</td>
<td>-4 to +26 dBmV</td>
</tr>
<tr>
<td>Symbol Rate</td>
<td></td>
<td></td>
<td>QPSK bit rate</td>
<td>16 QAM bit rate</td>
<td>input power ranges</td>
</tr>
</tbody>
</table>

Table 6  Downstream Cable Physical Layer, Cisco uBR7111E and uBR7114E

- Downstream physical layer enhanced ITU J.83, Annex A, with convolutional and Reed-Solomon Forward Error Correction (FEC)
- Variable depth interleaving, (I, J)=(8, 16), (16, 8), (32, 4), (64, 2), (128, 1)
- DOCSIS physical layer parameters in a 6 MHz channel
- Output impedance: 75 ohms nominal
- Cable Fixed Line Card Connector: F-connector

<table>
<thead>
<tr>
<th>64 QAM</th>
<th>(6 bits/sym)</th>
<th>40.44 MHz</th>
<th>36 Mbps</th>
</tr>
</thead>
<tbody>
<tr>
<td>256 QAM</td>
<td>(8 bits/sym)</td>
<td>57.2 MHz</td>
<td>57 Mbps</td>
</tr>
</tbody>
</table>

Table 7  Upstream Cable Physical Layer, Cisco uBR7111E and uBR7114E

- Symbol rates of 160, 320, 640, 1280, and 2560 ksym/sec
- Modulation: Quadratic phase shift keying (QPSK) and 16 QAM
- Upstream frequency range: 5 to 65 MHz, edge-to-edge
- FEC length (T = 0 to 10)
- Calibrated and widely adjustable upstream voltage level
- Total input power: less than 35 dBmV
- Operating power range: Bursts within 6 dB of commanded level
- RF performance stable to 1.5 dB across -5˚ to +50˚ C
- RF Spur less than 5 mV on all inputs and outputs

<table>
<thead>
<tr>
<th>160 ksym/sec</th>
<th>Symbol Rate</th>
<th>200 kHz</th>
<th>290 kbps</th>
<th>580 kbps</th>
<th>-16 to +14 dBmV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Channel Bandwidth</td>
<td></td>
<td></td>
<td></td>
<td>input power ranges</td>
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<tr>
<td>320 ksym/sec</td>
<td></td>
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<td>580 kbps</td>
<td>1160 kbps</td>
<td>-13 to +17 dBmV</td>
</tr>
</tbody>
</table>

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DSG Specifications

The DOCSIS Set-Top Gateway feature is based on SP-DSG-I01-020228, http://www.cablelabs.com. This specification is in draft form and is expected to change. Cisco IOS Release 12.2(15)BC2—the first release that supports DSG—supports the following:

- Up to four separate conditional access (CA) vendors per router; vendor names must be unique and limited to a maximum of 7 characters
- A maximum of eight DSG tunnels (as identified by the well-known MAC address) per CA vendor, for a maximum possible total of 32 DSG tunnels per router
- Multiple CA vendors cannot use the same DSG tunnel (that is, two vendors cannot use a tunnel with the same IP multicast address).
- Each vendor must use a unique set of IP multicast addresses, and after an IP multicast address is assigned to a DSG tunnel, that same address cannot be used for any other purpose. However, all other multicast addresses and groups can still be used on the interface for other multicast applications.
- DSG-related IP unicast traffic is supported only by configuring Network Address Translation (NAT) on the cable and WAN interfaces, as described in the “DOCSIS Set-Top Gateway for the Cisco CMTS” feature module.
- DSG traffic should be less than 2.048 Mbps per vendor, so as to conform to the DSG specifications.
- If using bundled interfaces, operators must configure DSG configurations on the master interface only. When DSG is configured properly on the master interface, DSG traffic can flow across both master and slave interfaces.

Table 7  Upstream Cable Physical Layer, Cisco uBR7111E and uBR71114E

<table>
<thead>
<tr>
<th>Symbol rates (ksym/sec)</th>
<th>Modulation</th>
<th>Upstream frequency range (MHz)</th>
<th>FEC length (T = 0 to 10)</th>
<th>Calibrated and widely adjustable upstream voltage level</th>
<th>Total input power: less than 35 dBmV</th>
<th>Operating power range: bursts within -6 dB of commanded level</th>
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<tr>
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