

The Ultimate CMTS



The ARRIS® C4 CMTS is the choice of engineers who want the best.

C4® Cable Modem Termination System (CMTS)

The C4® CMTS is a CableLabs® DOCSIS® 3.0 Bronze Qualified CMTS and supports the integrated CMTS (I-CMTS) architecture for DOCSIS 3.0 services. Bronze certification includes DOCSIS 3.0 downstream channel bonding and IPv6 support for cable modem management. The C4 supports high availability and "hitless" RF sparing, provides independent scaling of upstream and downstream channels with dedicated downstream (I6D) and upstream (I2U) Cable Access Modules (CAMs), increases overall system density, and provides increased network-side interface speeds and connections.

DOCSIS 3.0 Channel Bonding for Very High Speed Services

C4 has been qualified as compliant to the DOCSIS 3.0 downstream channel bonding protocol. It will interoperate with any cable modem that has been verified for DOCSIS 3.0 downstream channel bonding interoperability. DOCSIS 3.0 downstream channel bonding allows operators to bond multiple downstream channels together to provide speeds beyond that which are available with a single downstream channel.

Superior Flexibility & Scalability

The C4 CMTS continues its industry reputation of having superior flexibility & scalability with up to 16 RF interface Cable Access Modules (CAMs) per chassis.

- Up to 16 Cable Access Modules (CAMs) per chassis
- Separate downstream CAMs and upstream CAMs enable fully independent scaling of downstream and upstream channels
- High density DOCSIS 3.0 CAMs — Sixteen downstreams per I6D CAM and twelve upstreams per I2U CAM
- The C4 CMTS includes a fully integrated RF switch that enables "hitless" RF sparing for both the upstream CAMs and the downstream CAMs without any external wiring or equipment.

IPv6 Cable Modem Management

C4 CMTS supports IPv6 format addressing for enhanced addressing and scaling in large network deployments. IPv6 is designed to give cable operators more efficient hierarchical addressing and routing capabilities along with Quality of Service improvements.

Carrier-Class Reliability and Operation

The C4 CMTS includes numerous design enhancements for supporting high availability operation. The system is designed for carrier-class reliability and 99.999% system availability. The system architecture ensures a high degree of reliability that traditionally has been associated with voice telecommunications equipment and is now available in a carrier-class IP head-end system for MSOs and cable operators. The carrier-class reliability of the architecture starts with the system chassis design, extends into each hardware component, and most importantly is incorporated in the operational software.

The system chassis utilizes a mid-plane design with active modules in the front of the chassis and physical interface cards inserted directly behind each active module. Redundant communications and data paths between each card slot and the system control complex enhance the reliability.

Each module in the system employs a processor and temperature sensor on-board for system status monitoring. For the IP data path, advanced integrity checks are performed (parity, CRC, loopback, and pings) as a normal part of operations.

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C4 CMTS Architecture

Layer 3 Edge Routing

The C4 system combines a leading edge RF design with a Layer 3 edge routing solution for unprecedented system performance. With the introduction of DOCSIS 3.0 technology, the Router Control Module (RCM) enhances the C4 CMTS forwarding capacity to 25Gbps and adds native support for access control list (ACL) processing and increased network interfaces. The forwarding capacity provides the needed throughput required by the increased number of network side and cable side interfaces supported by the DOCSIS 3.0 C4 CMTS.

- Advanced switch fabric architecture
- Forwarding capacity to 25Gbps
- Patented queuing and congestion control mechanisms
- 10GE and Ten 1GE interfaces per RCM

C4 I-CMTS Chassis Modules

The C4 CMTS system is a 21 slot chassis with a mid-plane based architecture designed for continuous system operation. The C4 system is a carrier-grade integrated Layer 3 edge routing and advanced CMTS combined in a single chassis. Four basic types of modules are included in a complete C4 I-CMTS system:

- SCM – System Control Module
- RCM – Router Control Module
- 16D CAM – Cable Access Module
- 12U CAM – Cable Access Module

These four modules are the active modules in a C4 I-CMTS and each module resides in a front slot of the C4 CMTS chassis for ease of maintenance. For each CAM and SCM, a corresponding Physical Interface Card (PIC) is deployed in the rear of the chassis directly behind the active module. The C4 system is designed for a wire-once approach to RF connections with all physical RF connections in the rear of the chassis. The network-side connections are in the front of the chassis on the RCM for ease of installation of additional network interfaces with "pluggable" SFP and XFP form factor interfaces. All modules in the C4 CMTS are designed for "hot-swap" operation and can be inserted/removed while the system is powered and in continuous operation.

The C4 CMTS includes ten 1Gbit network interfaces and one 10Gbit interface on the Router Control Module (RCM). A variety of small form factor pluggable (SFP) network interfaces for electrical and optical connections are supported on the RCM including:

- 1Gbps - Small Form Factor Pluggable (SFP)
- 10/100/1000Base-TX - SFP Electrical Interface
- 1000Base-SX - SFP Optical Interface
- 1000Base-LX - SFP Optical Interface
- 10Gbps - Small Form Factor Pluggable (XFP)
- 10GBase-SR - XFP Optical Interface
- 10GBase-LR - XFP Optical Interface

Router Control Module (RCM)

The RCM provides edge routing capability and DOCSIS 3.0 services for the ARRIS C4 CMTS. The C4 CMTS with the RCM provides enhanced routing and forwarding, and includes integrated network interfaces for direct connection to a cable operator's IP network. The RCM supports advanced DOCSIS 3.0 services including advanced QoS and service flow classification.

16D Cable Access Module (CAM)

The C4 CMTS 16D Cable Access Module (CAM) comprises sixteen DOCSIS or Euro-DOCSIS 3.0 downstream channels.

These channels are grouped onto four up-converters with each up-converter supporting four of the sixteen channels. The Physical Interface Card (PIC) of the 16D CAM has four connectors with each F-connector connected to the output of one of the up-converters. Each downstream channel on the same up-converter / F-connector must have a unique centre frequency, but the channels are not required to be contiguous. The four downstream channels on a single F-connector can span up to 80MHz of spectrum, allowing an MSO flexibility in choosing DOCSIS downstream frequencies. The 16D CAM supports DOCSIS 3.0 downstream channel bonding with variable size bonding groups. This allows for the aggregation of DOCSIS channels to support ultra high bandwidths. For example, eight bonded channels provide a 320Mbps data stream to a subscriber's DOCSIS 3.0 cable modem.

All channels on the 16D CAM can support DOCSIS 3.0 including channel bonding, DOCSIS 2.0 and 1.x modems at the same time. Further, no external timing server is required thus minimizing total system cost and increasing system availability.

Each downstream channel on a 16D CAM can be associated with any upstream channel on a 12U CAM in the chassis with the limitation that all up streams and down streams in a single MAC domain must be on the same 12U or 16D CAM, respectively. This flexibility allows the operator to "right size" the upstream-to downstream ratio for each service group. It also reduces capital costs as less channels will sit idle compared to a system with a fixed upstream-to-downstream ratio.

12U Cable Access Module (CAM)

The 12U CAM provides DOCSIS 3.0 support for all upstream functions.

The 12U supports flexible upstream to downstream mapping. This provides the ability to match any number of the 12 upstream receivers on a 12U CAM to one of the down streams on a 16D CAM. The result is that operators have many available upstream to downstream ratios available for system configuration (e.g., 8:4, 2:1, 1:1, & 0.5:1 ,etc) which provides the necessary flexibility to meet different requirements of new advanced services such as IP streaming video, IPTV, or business services. The 12U CAM also supports flexible upstream port mapping. This allows any number of upstream receivers to be associated with any of the eight physical RF ports on the 12U CAM. Operators have proven that this flexibility can be used to reduce or even eliminate node splits as traffic requirements change or grow over time.

The 12U CAM provides an all-digital RF front end. The entire available spectrum (5-42 MHz, 5-55 MHz or 5-65 MHz) is digitized on each upstream port upon entry in the CAM. By using digital signal processing techniques, ingress noise cancellations provide a critical adjunct by increasing the immunity of the upstream carriers to ingress noise and the C4 CMTS can report upstream signal-to-noise ratio (SNR) with increased accuracy and on a per-cable modem basis.

No Single Point of Failure

The ARRIS C4 CMTS supports control complex redundancy; hitless RF-sparing, and wideband channel bonding, along with DOCSIS 3.0 enhancements without a costly chassis upgrade for these benefits. This speaks to the life cycle costs performance of the C4 CMTS. The applicable components of systems design for high availability and serviceability considerations include:

- Advanced, active system design with fault detection, management, and recovery

- Integrated RF switching and automatic failover without service degradation and "Hitless" RF failover functionality
- All modules are "hot-swappable" for ease of replacement and servicing
- Control Complex (1 + 1) redundancy
- Flexible redundancy for Cable access modules (N+1)

Full redundancy with no single point of failure is a key element of the carrier-class system design of the C4 I-CMTS for high availability. This flexible approach to DOCSIS 3.0 CAM redundancy results in the system's ability to support sparing groups of N+1 on the up streams and N+1 on the down streams in a single chassis. For voice or IP telephony services, the network availability and redundancy metrics for the C4 CMTS are critical elements in engineering an overall high availability network for time-sensitive services.

A key component for C4 CMTS carrier-grade operation is the integrated RF switch with automatic failover option. The C4 CMTS system is a 21 slot chassis with a mid-plane based architecture designed for continuous system operation. Four types of active modules are included in a complete C4 I-CMTS system (SCM – System Control Module, RCM – Router Control Module, 16D CAM – Cable Access Module, and 12UCAM – Cable Access Module) with each module residing in a front slot of the C4 CMTS chassis.

Flexible Cable Access Module Sparing & Hitless RF Sparing

The CAMs can be operated in an N+1 sparing configuration within the available slots of the system. Up to 16 DOCSIS 16D or 12U CAMs can be deployed in a single C4 chassis, offering a flexible number of upstream to downstream RF connections and channels. These CAMs are deployed in flexible sparing groups with N+1 redundancy where N is either the number of active upstream CAMs or downstream CAMs and are independent sizes in each direction. Flexibility is the key to the redundancy operation that allows an operator to balance the overall systems cost with the services offerings and associated service level guarantees to their customers.

With "hitless" RF sparing, the C4 CMTS supports switching all the cable modems connected from a failed CAM to a spare CAM, if a failure were to occur on a DOCSIS cable access module. The C4 CMTS continues its industry-leading flexible sparing groups that allow an operator to select sparing groups sizes independently plus in the upstream and downstream direction in the same C4 chassis.

Scalability

The C4 CMTS scales up to 16 RF-interface Cable Access Modules (CAMs) per chassis.

Combined with this specified device support is the ability of the C4 CMTS to support up to 16 separate service flows per cable modem device. These service flows can be used for new competitive services offerings of ultra high-speed data with DOCSIS 3.0 channel bonding multi-cast video streams along with current telephony and data service offerings. Rather than offering a single, fixed service level per cable modem, the operator can flexibly deploy multiple, enhanced services on a subscriber-by-subscriber or device-by-device basis minimizing Capex expenditures to only those homes or business subscribing to the advanced services.

