



CHAPTER 1

Cisco MWR 2941-DC Router Overview

The Cisco MWR 2941-DC Mobile Wireless Router is a cell-site access platform specifically designed to optimize, aggregate, and transport mixed-generation radio access network (RAN) traffic. The router is used at the cell site edge as a part of a 2G, 3G, or 4G radio access network (RAN).

The Cisco MWR 2941-DC helps enable a variety of RAN solutions by extending IP connectivity to devices using Global System for Mobile Communications (GSM), General Packet Radio Service (GPRS), Node Bs using HSPA or LTE, base transceiver stations (BTSs) using Enhanced Data Rates for GSM Evolution (EDGE), Division Multiple Access (CDMA), CDMA-2000, EVDO, or WiMAX, and other cell-site equipment. It transparently and efficiently transports cell-site voice, data, and signaling traffic over IP using traditional T1/E1 circuits, including leased line, microwave, and satellite, as well as alternative backhaul networks, including Carrier Ethernet, DSL, Ethernet in the First Mile (EFM), and WiMAX. It also supports standards-based Internet Engineering Task Force (IETF) Internet protocols over the RAN transport network, including those standardized at the Third-Generation Partnership Project (3GPP) for IP RAN transport.

Custom designed for the cell site, the Cisco MWR 2941-DC features a small form factor, extended operating temperature, and cell-site DC input voltages.

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- [Introduction, page 1-1](#)
- [Cisco IOS Software Features, page 1-6](#)
- [MIB Support, page 1-11](#)
- [Limitations and Restrictions, page 1-11](#)
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Introduction

A typical RAN is composed of thousands of base transceiver stations (BTSs)/Node Bs, hundreds of base station controllers/radio network controllers (BSCs/RNCs), and several mobile switching centers (MSCs). The BTS/Node Bs and BSC/RNC are often separated by large geographic distances, with the BTSs/Node Bs located in cell sites uniformly distributed throughout a region, and the BSCs, RNCs, and MSCs located at suitably chosen Central Offices (CO) or mobile telephone switching offices (MTSO).

The traffic generated by a BTS/Node B is transported to the corresponding BSC/RNC across a network, referred to as the backhaul network, which is often a hub-and-spoke topology with hundreds of BTS/Node Bs connected to a BSC/RNC by point-to-point time division multiplexing (TDM) trunks. These TDM trunks may be leased-line T1/E1s or their logical equivalents, such as microwave links or satellite channels.

RAN Transport Solutions

The Cisco MWR 2941-DC Mobile Wireless Router supports a variety of RAN transport solutions, including the following:

- Optimized RAN transport over IP: Maximizes voice and data call density per T1/E1 over the RAN transport network for standards including GSM, GPRS, EDGE, HSPA, and fourth-generation (4G). Optimization helps reduce backhaul transmission costs, which are typically the largest operational expenses in the network.
- IP/Multiprotocol Label Switching (MPLS) RAN backhaul: Allows you to create a high-speed backhaul for a variety of traffic types, including GSM, CDMA, HSPA/LTE, CDMA, EVDO, and WiMAX networks.
- Cell-site operations support networks: Facilitates telemetry to cell sites for remote operations and network element management.
- Cell-site IP points of presence (POPs): Allows you to offer IP services and applications at cell sites.

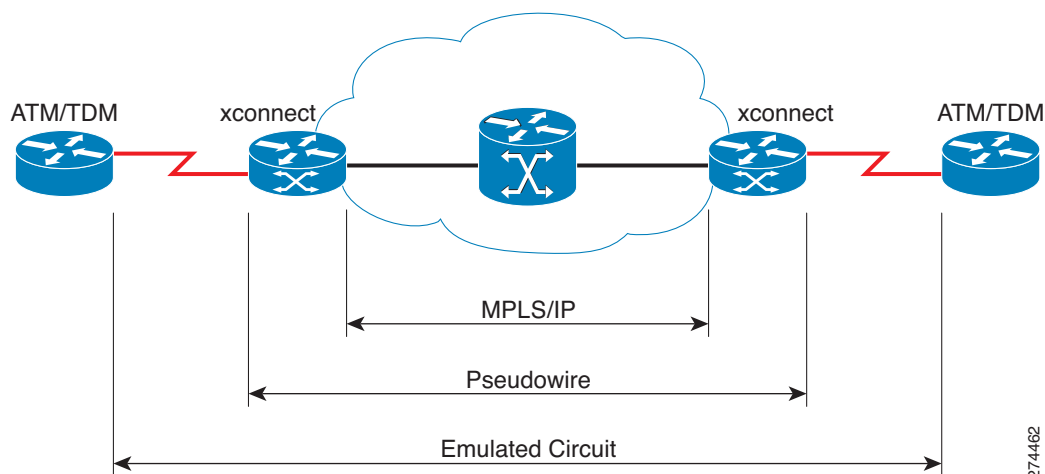
Features

The following sections describe the features available in the Cisco MWR 2941-DC router.

Cisco Pseudowire Emulation Edge-to-Edge

Cisco Pseudowire Emulation Edge-to-Edge (PWE3) is a mechanism that emulates the essential attributes of a service, such as EI/T1 ([Figure 1-1](#)).

Figure 1-1 Cisco MWR 2941-DC Router in a PWE3—Example



The required functions of pseudowires (PWs) include encapsulating service-specific packet data units (PDUs) arriving at an ingress port and carrying them across a path or tunnel, managing their timing and order, and other operations required to emulate the behavior of the service efficiently.

PW is perceived as an unshared link or circuit of the chosen service. However, there may be deficiencies that impede some applications from being carried on a PW. These limitations should be fully described in the appropriate service-specific documents and applicability statements.

Cisco supports standards-based PWE3 as defined by:

- [Structure-agnostic TDM over Packet, page 1-3](#)
- [Structure-aware TDM Circuit Emulation Service over Packet-Switched Network, page 1-3](#)
- [Transportation of Service Using ATM over MPLS, page 1-3](#)

A PW is a connection between two provider edge (PE) devices, which connects two attachment circuits (ACs). An AC can be a VPI/VCI or an T1/E1 link.

Structure-agnostic TDM over Packet

SAToP encapsulates TDM bit-streams (T1, E1, T3, E3) as PWs over PSNs. It disregards any structure that may be imposed on streams, in particular the structure imposed by the standard TDM framing.

The protocol used for emulation of these services does not depend on the method in which attachment circuits are delivered to the PEs. For example, a T1 attachment circuit is treated the same way for all delivery methods, including: PE on copper, multiplex in a T3 circuit, mapped into a virtual tributary of a SONET/SDH circuit, or carried over a network using unstructured Circuit Emulation Service (CES). Termination of specific carrier layers used between the PE and circuit emulation (CE) is performed by an appropriate network service provider (NSP).

For instructions on how to configure SAToP, see [Configuring Structure-Agnostic TDM over Packet \(SAToP\), page 4-15](#). For a sample SAToP configuration, see [TDM over MPLS Configuration, page B-21](#).

Structure-aware TDM Circuit Emulation Service over Packet-Switched Network

CESoPSN encapsulates structured (NxDS0) TDM signals as PWs over PSNs. It complements similar work for structure-agnostic emulation of TDM bit-streams, such as PWE3-SAToP.

Emulation of NxDS0 circuits saves PSN bandwidth and supports DS0-level grooming and distributed cross-connect applications. It also enhances resilience of CE devices due to the effects of loss of packets in the PSN.

For instructions on how to configure SAToP, see [Configuring Circuit Emulation Service over Packet-Switched Network \(CESoPSN\), page 4-15](#). For a sample CESoPSN configuration, see [TDM over MPLS Configuration, page B-21](#).

Transportation of Service Using ATM over MPLS

An Asynchronous Transfer Mode (ATM) PW is used to carry ATM cells over an MPLS network. It is an evolutionary technology that allows you to migrate packet networks from legacy networks, yet provides transport for legacy applications. ATM over MPLS is particularly useful for transporting 3G voice traffic over MPLS networks.

You can configure ATM over MPLS in the following modes:

- N-to-1 Cell Mode—Maps one or more ATM virtual channel connections (VCCs) or virtual permanent connection (VPCs) to a single pseudowire.
- 1-to-1 Cell Mode—Maps a single ATM VCC or VPC to a single pseudowire.
- Port Mode—Map one physical port to a single pseudowire connection.

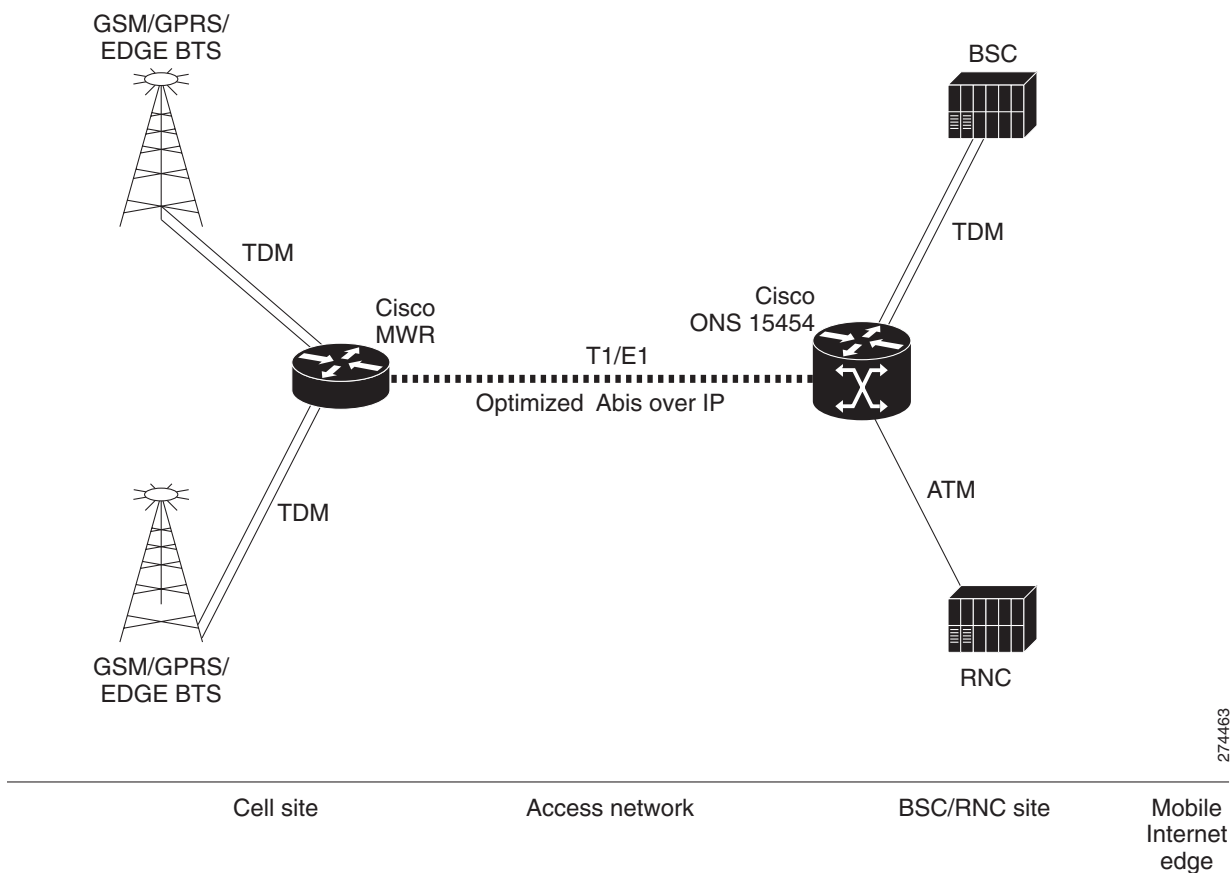
The Cisco MWR 2941-DC also supports cell packing and PVC mapping for ATM over MPLS pseudowires.

For more information about how to configure ATM over MPLS, see [“Configuring Transportation of Service Using ATM over MPLS”](#) section on page 4-16. For sample ATM over MPLS configurations, see [“ATM over MPLS Configuration”](#) section on page B-25.

GSM Abis Optimization over IP Implementation

GSM Abis refers to the interface between the BTS and BSC in GSM system (the same term is used for CDMA systems). The Cisco MWR 2941-DC implementation of GSM Abis optimization over IP allows carriers to optimize voice and data traffic and maximize effective utilization of E1/T1 backhaul connections. [Figure 1-2](#) shows a Cisco MWR 2941-DC router in a network using GSM Abis Optimization over IP.

Figure 1-2 Cisco MWR 2941-DC Router in a GSM Abis Optimization over IP—Example



The Cisco GSM Abis optimization solution increases the T1/E1 bandwidth efficiency by as much as 50 percent:

1. Traffic loads can be carried using half as many T1/E1 trunks as previously used, allowing more voice and data calls to be carried over the existing RAN backhaul network.
2. The need to add new T1/E1 trunks is eliminated as traffic demands grow.
3. Existing trunks can be decommissioned (ending recurring costs).

Excess capacity is available in the existing RAN backhaul network. The operator can reallocate recovered bandwidth to carry traffic from other radios, such as GPRS, EDGE, 1xEV-DO, PWLANs, and other data overlays. The operator avoids costs of supplementing backhaul capacity. It also accelerates time to revenue from deployments of new radio technologies, as there is no need for the operator to be delayed until additional microwave licenses or leased-lines are supplied.

The Cisco MWR 2941-DC complies with 3GPP2 and 3GPP R5 and R6 transport standards. Cisco converts CDMA transport networks into 3 GPP2-compliant IP RAN transport networks, and GSM transport networks into R5/R6 IP RAN transport networks—and adds multiradio backhaul compression. Mobile wireless operators can leverage the benefits of IP transport in GSM RANs.

Bidirectional Forwarding Detection

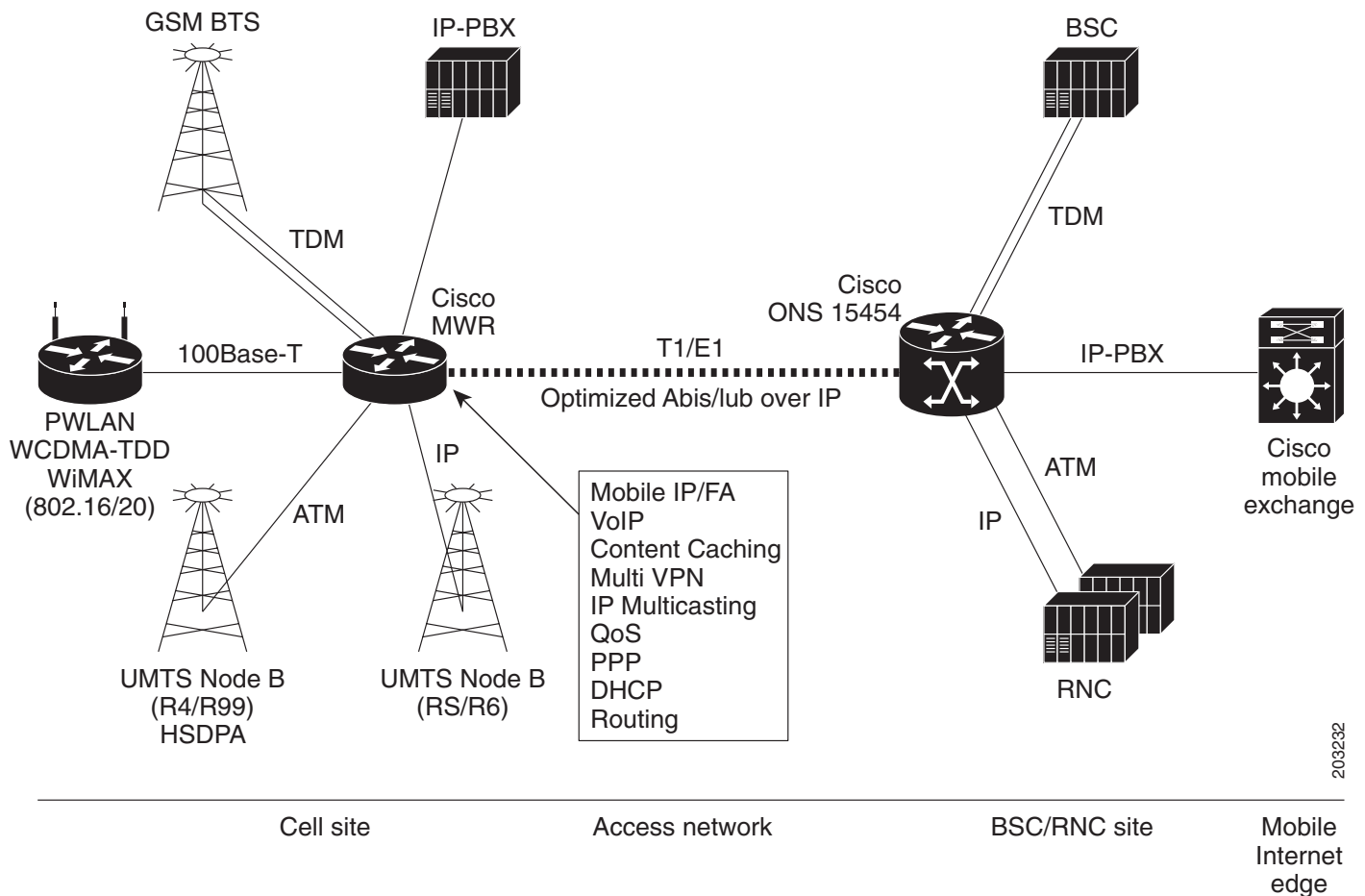
Bidirectional Forwarding Detection (BFD) provides a low-overhead, short-duration method of detecting failures in the forwarding path between two adjacent routers, including the interfaces, data links, and forwarding planes. BFD is a detection protocol that you enable at the interface and routing protocol levels. For instructions on how to configure BFD, see the [“Configuring BFD” section on page 4-40](#).

Intelligent Cell Site IP Services

The Cisco RAN-O and IP-RAN solutions allow you to deliver profit-enhancing services. This is achieved through the set of IP networking features supported in Cisco IOS software that extends to the cell site (see [Figure 1-3 on page 1-6](#)).

Cell Site Points-of-Presence

The cell site becomes a physical Point-of-Presence (POP) from which to offer hotspot services, or voice and wired ISP services, to nearby enterprises and residences. Because many cell sites are located in and around downtown areas, hotels, airports, and convention centers, they make attractive sites for co-locating public wireless LAN (PWLAN) access points and other wireless data overlays. Many of these wireless data radios are IP-based. IP networking features, like Mobile IP, VoIP, IP Multicast, VPN, and content caching, enable delivery of new revenue-generating services over these radios. The corresponding traffic “rides for free” on the spare backhaul bandwidth made available by Cisco Abis optimization solutions ([Figure 1-3](#)).

Figure 1-3 Cisco MWR 2941-DC Router in a Cell Site POP—Example**Note**

The Cisco MWR 2941-DC router does not currently support UMTS Iub optimization.

RAN-Optimization Implementation

In RAN-Optimization (RAN-O), the Cisco MWR 2941-DC router extends IP connectivity to the cell site and base transceiver station (BTS). The router provides bandwidth-efficient IP transport of GSM and UMTS voice and data bearer traffic, as well as maintenance, control, and signaling traffic, over the leased-line backhaul network between the BTS and leased-line termination and aggregation node through compression (cRTP/cUDP) and packet multiplexing (Multilink PPP).

Cisco IOS Software Features

One version of the software is required for implementing the Cisco MWR 2941-DC router.

Software Features

Standard Cisco IOS software features supported in the Cisco MWR 2941-DC router include:

Simple Services

- DHCP
- PPP
- NAT
- OSPF
- RIP

Intelligent Services

- QoS
- IP Multicast
- MPLS

Additional Services

- ACFC and PFC handling during PPP negotiation
- SNMP
- NTP
- PTP and pseudowire-based timing
- TDM/PWE3 packet reordering

Configuration Statements for CISCO-IP-RAN-BACKHAUL-MIB

This section describes how to enable notifications provided by the CISCO-IP-RAN-BACKHAUL-MIB.

In Cisco IOS Release 12.4(19)MR2, the Cisco MWR 2941-DC router supports the CISCO-IP-RAN-BACKHAUL-MIB.

This MIB is compatible with Cisco Mobile Wireless Transport Manager (MWTM) Version 5.0 or later, and provides information on the optimization of the following traffic types:

- GSM—Provides information between a Base Transceiver Station (BTS) and the corresponding Base Station Controller (BSC)
- UMTS—Provides information on optimization between a Node Band the corresponding Radio Network Controllers (RNC).

**Note**

The Cisco MWR 2941-DC does not currently support UMTS Iub optimization.

Notifications

The notifications described in this section provide information on alarms, backhaul utilization, devices, and control generation. For more information on these notifications, see [Appendix A, “Cisco MWR 2941-DC Router RAN-O Command Reference.”](#)

- **ciscoIpRanBackHaulGsmAlarm**

The **ciscoIpRanBackHaulGsmAlarm** notification provides information alarms associated with GSM-Abis interfaces. It only enables GSM Abis.

Example:

```
conf t
  snmp-server enable traps ipran alarm-gsm
```

- **ciscoIpRanBackHaulUmtsAlarm**

The **ciscoIpRanBackHaulUmtsAlarm** notification provides information alarms associated with UMTS-Iub interfaces. Only enables UMTS Iub.

Example:

```
conf t
  snmp-server enable traps ipran alarm-umts
```

- **ciscoIpRanBackHaulRcvdUtil + ciscoIpRanBackHaulSentUtil**

The **ciscoIpRanBackHaulRcvdUtil + ciscoIpRanBackHaulSentUtil** notification provides information on backhaul utilization. It only enables backhaul utilization.

Example:

```
conf t
  snmp-server enable traps ipran util
```



Note The **snmp-server enable traps ipran util** command is obsolete. Command line interface (CLI) accepts the command to maintain compatibility.

To specify all notifications, specify the component name.

Example:

```
conf t
  snmp-server enable traps ipran
```

The following commands (configuration statements) are used to provide additional information about device and control generation of notifications:

Command	Purpose
ipran-mib backhaul-notify-interval	Interval for backhaul utilization (Obsolete. Provided only to maintain compatibility.)
ipran-mib location	Location of device
ipran-mib snmp-access	Specify type SNMP connectivity
ipran-mib threshold-acceptable	Acceptable utilization threshold (Obsolete. Provided to maintain compatibility.)

Command	Purpose
ipran-mib threshold-overloaded	Overloaded utilization threshold (Obsolete. Provided to maintain compatibility.)
ipran-mib threshold-warning	Warning utilization threshold (Obsolete. Provided to maintain compatibility.)

Network Management Features

This section provides an overview of the network management features for the Cisco MWR 2941-DC. For more information about management features on the Cisco MWR 2941-DC, see “[Monitoring and Managing the Cisco MWR 2941-DC Router](#)” section on page 4-44.

Cisco Mobile Wireless Transport Manager (MWTM)

You can use Cisco network management applications, such as Cisco Mobile Wireless Transport Manager (MWTM), to monitor and manage the Cisco MWR 2941-DC. This Network Management tool provides monitoring and management capabilities to the RAN-O solution. The Cisco MWTM addresses the element-management requirements of mobile operators and provides fault, configuration, and troubleshooting capability. For more information about MWTM, see http://www.cisco.com/en/US/products/ps6472/tsd_products_support_series_home.html.

MIB Support

The Cisco MWR 2941-DC router supports the following MIBs:

• CISCO-ACCESS-ENVMON-MIB • CISCO-CDP-MIB • CISCO-CONFIG-COPY-MIB • CISCO-CONFIG-MAN-MIB • CISCO-ENHANCED-MEMPOOL-MIB • CISCO-ENTITY-EXT-MIB • CISCO-ENTITY-FRU-CONTROL-MIB • CISCO-ENTITY-SENSOR-MIB • CISCO-ENTITY-VENDORTYPE-OID-MIB • CISCO-ENVMON-MIB • CISCO-FLASH-MIB • CISCO-IETF-PW-MIB • CISCO-IETF-PW-TC-MIB • CISCO-IF-EXTENSION-MIB • CISCO-IMAGE-MIB • CISCO-IP-RAN-BACKHAUL-MIB • CISCO-L2-TUNNEL-CONFIG-MIB • CISCO-MEMORY-POOL-MIB • CISCO-PROCESS-MIB • CISCO-PRODUCTS-MIB • CISCO-RTTMON-MIB • CISCO-SMI • CISCO-SYSLOG-MIB	• CISCO-TC • CISCO-VTP-MIB • ENTITY-MIB • HCNUM-TC • IANAifType-MIB • IF-MIB • IMA-MIB • INET-ADDRESS-MIB • MPLS-VPN-MIB • OLD-CISCO-CHASSIS-MIB • OLD-CISCO-INTERFACES-MIB • OLD-CISCO-SYS-MIB • OLD-CISCO-TS-MIB • PerfHist-TC-MIB • RMON2-MIB • RMON-MIB • SNMP-FRAMEWORK-MIB • SNMP-TARGET-MIB • SNMPv2-CONF • SNMPv2-MIB • SNMPv2-SMI • SNMPv2-TC
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Limitations and Restrictions

The following limitations and restrictions apply to the Cisco MWR 2941-DC router.

Hardware Limitations and Restrictions

The following hardware limitations and restrictions apply to the Cisco MWR 2941-DC router.

- The Cisco MWR 2941-DC router only supports the following HWICs:
 - HWIC-4T1/E1 (4 port clear-channel T1/E1 HWIC)

**Caution**

The Cisco MWR 2941-DC does not support online insertion and removal (OIR) of HWIC cards. Attempts to perform OIR on a card in a powered-on router might cause damage to the card.

Software Limitations and Restrictions

The following software limitations and restrictions apply to the Cisco MWR 2941-DC router.

- UMTS Iub Optimization not supported—Release 12.4(19)MR2 does not support UMTS Iub Optimization.
- L2TP not supported—The MWR 2941 currently does not support L2TP.
- PTP Boundary mode not supported—This release does not support PTP Boundary mode.
- PTP Transparent mode not supported—This release does not support PTP Transparent mode.
- Channel group limitations on GSM-Abis interfaces—Only one channel group per E1/T1 is supported on GSM-Abis interfaces.
- Contiguous time slots on GSM-Abis channel groups—GSM-Abis channel groups cannot use non-contiguous time slots. For example, you can configure **channel-group 0 timeslot 8-20**, but not **channel-group 0 timeslot 1-5, 10-20**.
- Out-of-band master mode not supported—This release does not support out-of-band master mode for Timing over Packet/adaptive clock recovery. If your network design requires out-of-band master clocking, you can use the CEoPs SPA on the 7600 router for this purpose.
- ACR out-of-band payload limitation—The MWR 2941 only supports the payload-size values 486 (625 packets per second) or 243 (1250 packets per second) for out-of-band clock recovery.
- Limited OSPF support—Bidirectional Forwarding Detection (BFD) is supported on VLAN interfaces only. OSPF is the supported BFD client. When BFD and OSPF are used together with layer 2 redundancy applications such as Flexlink and a layer 2 network failure occurs, the Cisco MWR 2941-DC attempts to reestablish layer 2 redundancy. If the Cisco MWR 2941-DC cannot reestablish layer 2 redundancy before the defined BFD detection timeout, it attempts to re-establish BFD and OSPF redundancy using an alternate layer 3 path. If BFD detects a layer 3 failure while the Cisco MWR 2941-DC is attempting to reestablish layer 2 redundancy, increase the BFD timeout value.
- T1 SAToP is not supported on the HWIC-4T1/E1.
- L3VPNs (also known as MPLS VPNs) are not supported.

New Features in Cisco IOS Release 12.4(19)MR2

The following features are supported in release 12.4(19)MR2 of the Cisco IOS software:

The following features are supported in release 12.4(19)MR2 of the Cisco IOS software:

- PWE3 Circuit Emulation over PSN (Packet Switched Network)—Allows you to create pseudowires (PWs) that emulate unstructured and structured T1s and E1s over an MPLS infrastructure, down to NxDS0 circuits. The Cisco MWR 2941-DC supports the following PWE3 standards:
 - Structure-agnostic TDM over Packet (SAToP)—Encapsulates TDM bit-streams (T1, E1, T3, E3) as PWs over PSNs; the feature is compliant with RFC 4553.

- Structure-aware TDM Circuit Emulation Service over Packet-Switched Network (CESoPSN)—Encapsulates structured (NxDS0) TDM signals as PWs over PSNs; the feature is compliant with RFC 5086.
 - Transportation of Service Using ATM over MPLS—Uses an Asynchronous Transfer Mode (ATM) PW to carry cells over an MPLS network; the feature is compliant with RFCs 4717 and 4816.
- GSM Abis Optimization over IP Implementation—Allows the Cisco MWR 2941-DC to optimize GSM voice and data traffic and maximize effective utilization of E1/T1 backhaul connections.
- Clocking features—Cisco IOS Release 12.4(19)MR2 introduces several new clocking features that are supported on the ASM-M2900-TOP daughter card, also known as the RTM Module. The RTM module supports the following new clocking features:
 - Precision Time Protocol (PTP)—Clocking and clock recovery based on the IEEE 1588-2008 standard; allows the Cisco MWR 2941-DC router to receive clocking from another PTP-enabled device or provide clocking to a PTP-enabled device.

This feature introduces a variety of new global commands: **ptp domain**, **ptp mode**, **ptp priority1**, and **ptp priority2**; the following interface commands: **ptp announce**, **ptp clock-destination**, **ptp clock-source**, **ptp delay-req**, **ptp enable**, **ptp master**, **ptp slave**, and **ptp sync**; and the following show commands: **show ptp clock**, **show ptp foreign-master-record**, **show ptp parent**, **show ptp port**, and **show ptp time-property**.

 - Adaptive Clock Recovery (ACR)—Also known as Timing over Packet (TOP), this feature allows the MWR 2941 to use in-band or out-of-band clocking on a virtual or regular TDM pseudowire interface. ACR allows the Cisco MWR 2941-DC to recover clocking from the headers of a packet stream and is compliant with the G.823 and G.824 standards. You can use the **recovered-clock slave** command to configure out-of-band clock recovery and the **recovered-clock recovered adaptive** command to configure adaptive clock recovery.
- Synchronous Ethernet—Allows the network to transport frequency and time information over Ethernet. You can use the **network-clock-select** command to configure synchronous Ethernet.



Note The RTM module is not required to use Synchronous Ethernet.

- ATM—This release includes ATM support with AAL0 and AAL5 encapsulation, F4 and F5 OAM (Operation, Administration, and Maintenance) monitoring, and Virtual Path (VP) shaping.
- IMA—This feature allows you to connect one or more interfaces to an ATM network using Inverse Multiplexing ATM (IMA). You can define IMA groups that can contain up to 8 bundles, with up to 24 links per bundle.
- IP Header Compression over PPP—This feature introduces support for IP header compression over PPP that is compliant with RFCs 2507, 2508, and 3544.
- Distributed Multilink PPP—Release 12.4(19)MR2 supports multilink PPP that is compliant with the RFC 1990 specification.
- Backup switch port interfaces using the **switchport backup interface** command.
- Flexlink
- IEEE 802.1d Ethernet Switching
- IEEE 802.1q VLANs
- VLAN Trunking Protocol (VTP)
- Per-VLAN Spanning Tree (PVST)+

- BITS Clocking
- Open Shortest Path First (OSPF)
- Bidirectional Forwarding Detection (BFD) for OSPF
- VPN Routing and Forwarding (VRF) Lite for OSPF
- ATM Cell Switching
- Label Distribution Protocol (LDP)