Cisco RAN Optimization Solution for GSM and UMTS Backhaul Optimization: Applications

Whether a mobile wireless operator needs to cost-efficiently expand its Global System for Mobile Communications (GSM) network capacity to keep pace with traffic growth, reduce operating expenses (OpEx) in a Universal Mobile Telecommunications Service (UMTS) rollout, or provide data offload for 3G services over alternative backhaul, Cisco® RAN Optimization is the solution. This “quick look” paper presents an overview of the various deployment scenarios where this Cisco solution provides significant benefits.

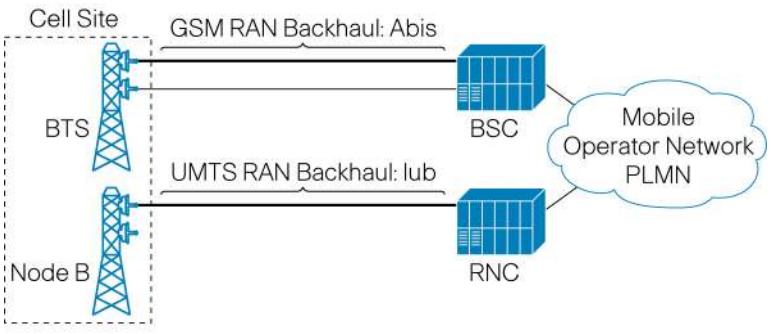
Introduction

A typical radio access network (RAN) backhaul network connects cell-site nodes with central-site nodes, for both 2G and 3G networks:

- For GSM, the backhaul network is commonly known as the “Abis interface” and connects the cell-site base transceiver station (BTS) with the central-site (or aggregation-site) base station controller (BSC). Voice calls, General Packet Radio Service/Enhanced Data Rates for Global Evolution (GPRS/EDGE), and GSM signaling are transported over one or multiple T1/E1 links using various coding schemes.
- In the case of UMTS, the backhaul is commonly known as the “Iub interface” and connects the cell-site Node B with the central-site radio network controller (RNC). It transports UMTS voice and data traffic, and UMTS signaling over one or multiple T1/E1 links using ATM cell switching.

Figure 1 shows a typical RAN backhaul layout for both 2G and 3G networks.

Figure 1. Overview of a Typical 2G or 3G RAN Backhaul Network



Mobile Operators need cost-effective solutions to address the following challenges of this common scenario:

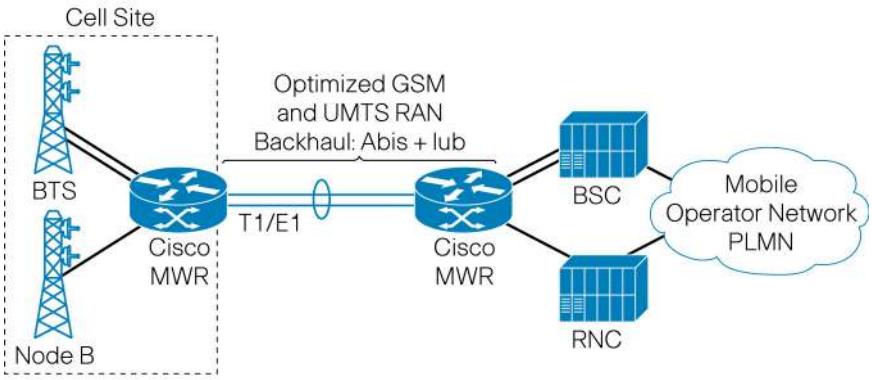
- GSM links are usually deployed for peak utilization, and so on average, during nonpeak periods, the GSM E1 bandwidth is underutilized and is not reallocated for other traffic (for example, UMTS or IP).

- UMTS links need to be deployed in 2-Mbps E1 increments, even if the actual total peak bandwidth is much lower. For many operators, the subscriber base is small and the peak bandwidth usage is a just a fraction of the available E1 bandwidth.
- 3G broadband data services such as High-Speed Downlink Packet Access (HSDPA) require a minimum of two E1 links (bandwidth of 3.8 Mbps) to provision the service.

In addition, as the number of customers grows and the backhaul network grows, new T1/E1 lines are required, compounding these inefficiencies.

Cisco RAN Optimization enables mobile operators to solve these problems, delivering a next-generation, highly efficient, multiservice optimized RAN backhaul. The Cisco solution consists of a Cisco MWR 1941-DC-A Mobile Wireless Edge Router, an environmentally strengthened device deployed at cell sites that performs aggregation and optimization of both GSM and UMTS traffic. The MWR is also an aggregation node deployed at central sites to perform decompression and distribution of optimized RAN backhaul traffic. Figure 2 shows a typical Cisco RAN Optimization layout.

Figure 2. Overview of a Typical Cisco RAN Optimization Deployment



The Cisco RAN Optimization achieves a nominal compression efficiency of 50 percent for GSM traffic. Therefore, an optimized backhaul network only needs half the number of T1/E1 links to transport the same level of GSM traffic. In addition, for UMTS backhaul, idle cells and unused padding are eliminated in Iub traffic, resulting in higher Iub efficiency. Compressed GSM and UMTS traffic is then dynamically aggregated using IP over a reduced number of E1 trunks, sharing bandwidth and thereby using RAN resources more efficiently.

The solution is completely RAN vendor-independent and is therefore compatible even with proprietary Abis interface specifications. It is a transparent end-to-end solution that does not degrade voice quality and does not require any change in the control and software of either the BTS/BSC or the NodeB/RNC.

The following sections of this paper introduce various deployment scenarios for GSM and UMTS optimization and present applications of Cisco RAN Optimization for alternative backhaul, next-generation data offload, and satellite backhaul optimization.

Note: For any of the scenarios described in this paper, the actual optimization efficiency depends on the T1/E1 link utilization and GSM/UMTS provisioning. Please contact a Cisco representative to evaluate what type of optimization best suits your network characteristics and to

determine what level of efficiency gain a Cisco RAN Optimization can deliver in your own environment.

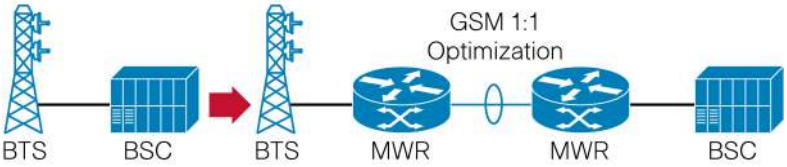
GSM RAN Backhaul Optimization Scenarios

This section presents four scenarios for GSM optimization and the benefits delivered by the Cisco solution.

1. GSM 1:1 Optimization

Although it does not reduce the number of backhaul T1/E1 links, this deployment scenario, shown in Figure 3, provides room to expand the GSM network without additional T1/E1 links and to introduce IP services for innovative revenue-generating opportunities at the cell site.

Figure 3. GSM 1:1 Optimization



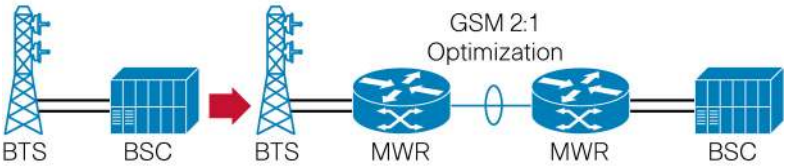
Solution Benefits

- Allows for expansion of GSM channels up to an additional T1/E1 with an efficiency factor of 2:1
- Cell-site IP services: carries IP traffic on backhaul link using recaptured bandwidth
- Remote management and cell-site control
- Ideal for satellite or microwave links
- Ready for UMTS deployment

2. GSM 2:1 Optimization

This scenario, shown in Figure 4, saves one T1/E1 link on the backhaul, reduces OpEx, and introduces IP services at the cell site.

Figure 4. GSM 2:1 Optimization



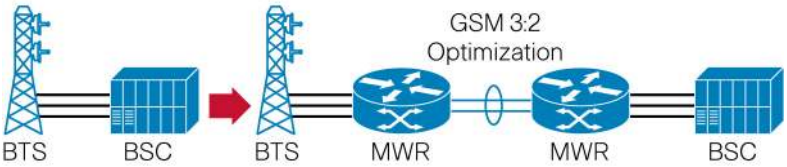
Solution Benefits

- Cost saving on T1/E1 links: OpEx reduction with efficiency factor of 2:1
- Cell-site IP services: carries IP traffic on backhaul link using recaptured bandwidth
- Remote management and cell-site control

3. GSM 3:2 Optimization

This scenario, shown in Figure 5, saves one T1/E1 link on the backhaul and reduces OpEx accordingly. It also allows using the recaptured backhaul bandwidth to expand the GSM network with additional channels or data bandwidth and to introduce IP services at the cell site.

Figure 5. GSM 3:2 Optimization



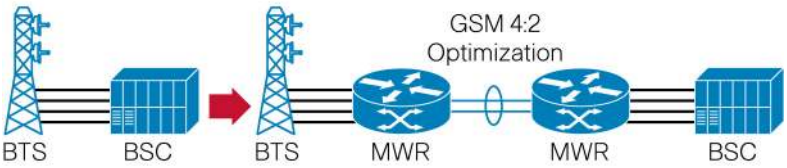
Solution Benefits

- Cost saving on T1/E1 links: OpEx reduction with efficiency factor of 3:2
- Allows for expansion of GSM channels up to an additional T1/E1 with an efficiency factor of 4:2
- Cell-site IP services: carries IP traffic on backhaul links using recaptured bandwidth
- Remote management and cell-site control
- Ready for UMTS deployment

4. GSM 4:2 Optimization

This scenario, shown in Figure 6, saves two T1/E1 links, with a significant OpEx reduction. It also introduces IP services at the cell site.

Figure 6. GSM 4:2 Optimization



Solution Benefits

- Cost saving on T1/E1 links: OpEx reduction with efficiency factor of 4:2
- Cell-site IP services: carries IP traffic on backhaul links using recaptured bandwidth
- Remote management and cell-site control

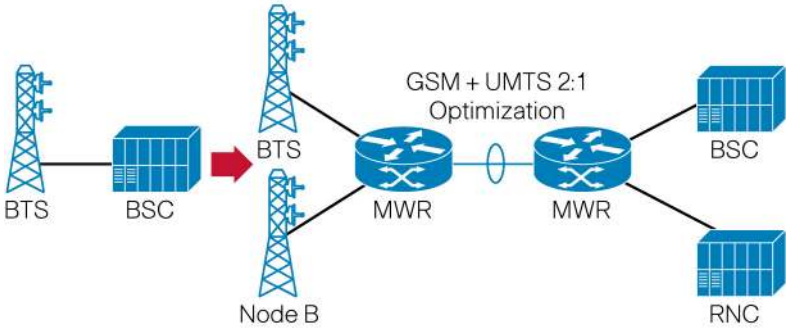
UMTS and GSM RAN Backhaul Optimization Scenarios

This section presents three scenarios for UMTS rollout over an existing GSM network infrastructure and describes the benefits gained by introducing the Cisco solution.

1. GSM and UMTS 2:1 Optimization

In this scenario, shown in Figure 7, UMTS is deployed using the existing GSM T1/E1 link, saving OpEx and reducing time to market for 3G services. It also allows for innovative IP services to be deployed at the cell site.

Figure 7. GSM and UMTS 2:1 Optimization



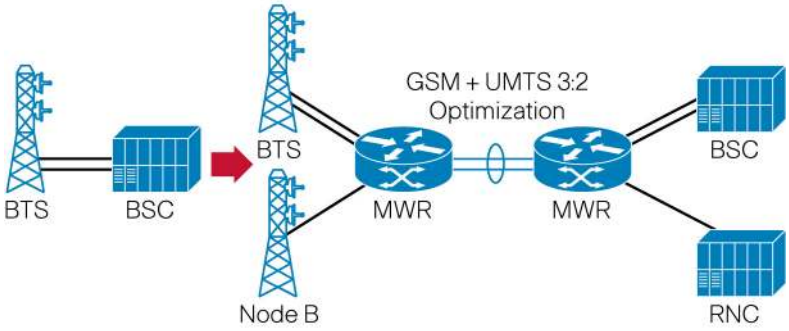
Solution Benefits

- Deployment of UMTS using same number of T1/E1 links already used for GSM
- OpEx avoidance: avoids leasing an additional T1/E1 line for UMTS, with efficiency factor of 2:1
- Ideal for initial UMTS rollout period, eliminates potential delays from additional link provisioning
- Cell-site IP services: carries IP traffic on backhaul link using recaptured bandwidth

2. GSM and UMTS 3:2 Optimization

In this scenario, shown in Figure 8, UMTS cell site is deployed using the existing GSM backhaul links. It avoids contracting a new T1/E1 link for UMTS rollout, saving on OpEx and reducing time to market. It also introduces IP services at the cell site.

Figure 8. GSM and UMTS 3:2 Optimization



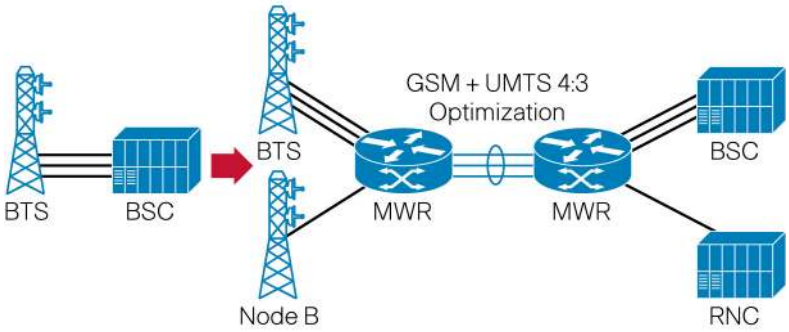
Such a deployment has these characteristics:

- Deployment of UMTS using same number of T1/E1 links already contracted for GSM
- OpEx avoidance: avoids leasing an additional T1/E1 line for UMTS, with efficiency factor of 3:2
- Cell-site IP services: carries IP traffic on backhaul link using excess bandwidth

3. GSM and UMTS 4:3 Optimization

In this scenario, shown in Figure 9, UMTS cell site is deployed using the existing GSM backhaul links. It avoids contracting a new T1/E1 link for UMTS rollout, saving on OpEx and reducing time to market. It also introduces IP services at the cell site.

Figure 9. GSM and UMTS 4:3 Optimization



Solution Benefits

- Deployment of UMTS using same number of T1/E1 links already contracted for GSM
- OpEx avoidance: avoids leasing an additional T1/E1 line for UMTS, with efficiency factor of 4:3
- Cell-site IP services: carries IP traffic on backhaul links using recaptured bandwidth

Alternative Backhaul

In addition to optimization and aggregation, the Cisco solution, which uses IP-based transport to carry backhaul traffic, is compliant with Third-Generation Partnership Project (3GPP) R5 and R6 specifications. Another compelling benefit of a Cisco IP-based solution is the ability to use a variety of connectivity options for alternative backhaul that offer higher capacities and lower costs than leased lines. The possibilities include Metro Ethernet, WiMax, xDSL, and cable technologies, with adequate service-level agreements (SLAs) to satisfy the latency and jitter tolerances of RAN nodes.

The alternative backhaul option allows using a less-expensive and more flexible transport network to satisfy the RAN backhaul needs, providing the following benefits:

- OpEx savings
- Bandwidth flexibility for both voice and data services
- Easy upgrade and deployment of additional bandwidth as RAN services expand
- Ability to provide innovative IP services at the cell site using the excess bandwidth available on the alternative IP backhaul

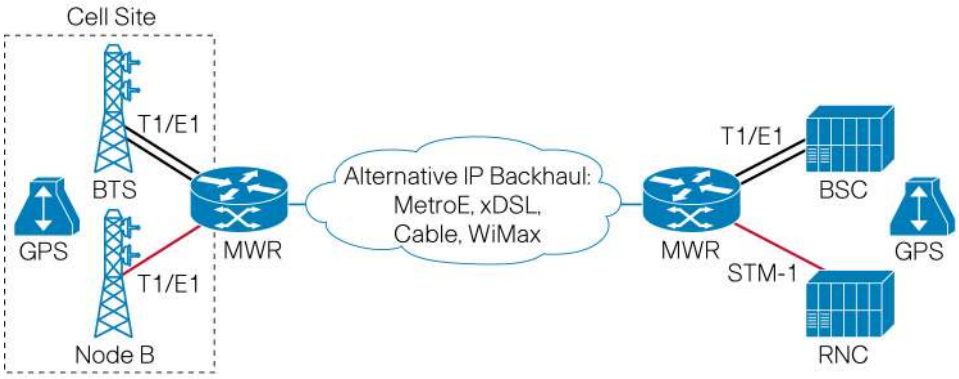
In general, alternative IP backhaul technologies do not provide a reliable means to propagate the synchronization clock signal through the backhaul to the cell site. Therefore, an external clock source is needed for the cell site to properly synchronize.

To deliver a reliable clock source, there are two options available:

The first option uses an external Global Positioning System (GPS) receiver placed at the cell site. Many RAN vendors already provide their cell-site nodes with an integrated GPS receiver that is able to deliver a reliable clock source from the satellite GPS signal. When such a receiver is not embedded, an external GPS receiver can be deployed at each cell site, enabling the cell-site nodes to use the GPS signal as a reliable clock source.

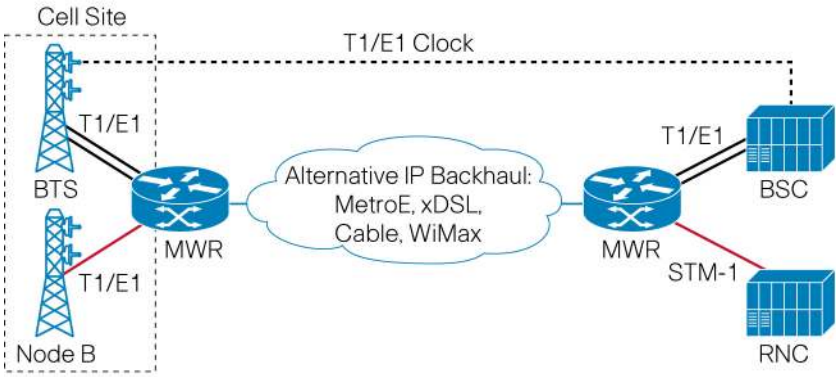
In Figure 10, the GPS signal is fed into the base station at the cell-site node to synchronize correctly and provide reliable handover between cells.

Figure 10.



An alternative solution to propagate a reliable clock source is presented in Figure 11. This solution offloads all voice and data traffic to the alternative IP backhaul, but still employs a single T1/E1 line to propagate the clock from the central site to the cell site. The clock source is taken from the operator's SDH network.

Figure 11.



Both of these solutions deliver great advantages to mobile operators in terms of OpEx savings and backhaul bandwidth scalability. They allow operators to deploy innovative services, provide additional coverage, and service a growing customer base with increased flexibility, ease of management, and short time to market.

HSDPA Data Offload

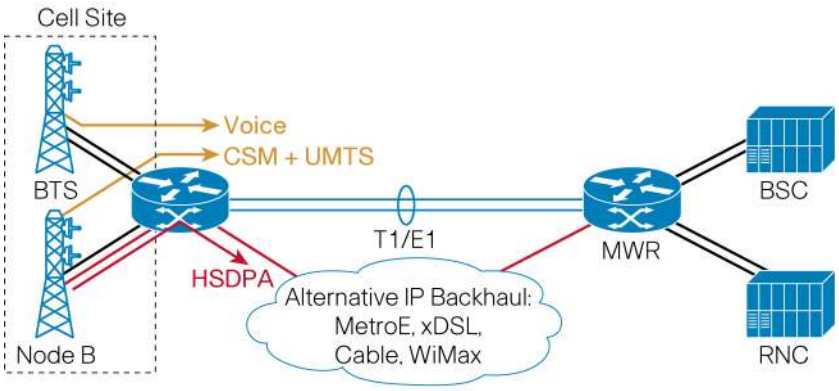
For UMTS cell sites where HSDPA is expected to be deployed, the Cisco solution for RAN optimization allows Iub traffic to be optimized and transported over T1/E1 links together with GSM traffic, and HSDPA traffic to be transported over a separate IP network used as an alternative backhaul. This data offload solution allows for OpEx savings, bandwidth flexibility, and easier expansion.

GSM/GPRS and UMTS (voice) traffic is optimized by the Cisco mobile wireless router and transported to the central site using the T1/E1 optimized backhaul. This solution is the GSM and UMTS deployment scenario presented earlier in this document.

HSDPA is optimized by the cell-site router and then routed to an alternative IP backhaul that uses Metro Ethernet, xDSL, WiMax, or cable technologies. The alternative backhaul provides bandwidth

flexibility for easier expansion and less-expensive leasing costs of network resources for OpEx savings. Figure 12 shows a typical HSDPA deployment scenario.

Figure 12.



HSDPA offload offers the following benefits:

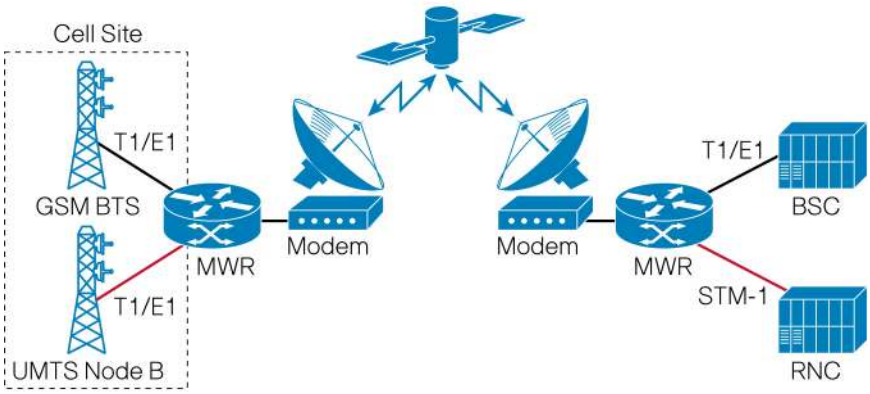
- Broad selection of alternative backhaul technologies
- OpEx savings because of less-expensive backhaul costs
- Easier and faster network expansion and provisioning of additional RAN resources
- End-node transparency; does not affect BTS/BSC or NodeB/RNC operations

Satellite Backhaul Optimization

When leased line infrastructure is unavailable or prohibitively expensive, mobile operators lease satellite for backhaul from remote areas. Cisco RAN Optimization reduces the required bandwidth on the satellite link and provides substantial savings on backhaul expense.

Figure 13 shows an overview of a satellite backhaul deployment. At the cell site, GSM traffic is compressed and aggregated with UMTS traffic by the MWR. The result is lower bandwidth aggregated traffic that is routed to the satellite modem and transmitted to the other side. Depending on actual T1/E1 link utilization for both GSM and UMTS, Cisco RAN Optimization can reduce the bandwidth required on the satellite link up to 50 percent, providing significant savings in OpEx.

Figure 13.



Benefits – Summary

Cisco RAN Optimization provides the following benefits:

- OpEx reduction for RAN backhaul from compression and optimization of both GSM and UMTS traffic.
- Faster and less-expensive expansion of GSM networks.
- UMTS rollout with reduced OpEx, optimizing the existing GSM RAN backhaul network and transporting UMTS traffic over the recaptured bandwidth.
- New revenue-generating IP-based services at the cell site. Cisco RAN Optimization delivers end-to-end IP connectivity from cell sites to central nodes, allowing for advanced IP services to be provided at the cell site.
- 3G data offload over alternative IP backhaul provides more bandwidth and reduces OpEx. A Cisco mobile wireless router can route optimized voice and data RAN traffic over any IP-enabled backhaul network with an adequate SLA, such as leased E1/T1 lines, Metro Ethernet, WiMax, cable, and xDSL.
- RAN vendor-independent solution is compatible with proprietary Abis and Iub interfaces and does not affect the vendor-specific bit streams.
- Cisco quality-of-service (QoS) mechanisms provide reliable end-to-end delivery of all RAN traffic and protection against oversubscription of GSM or UMTS channels.
- No effect on voice quality, because bit stream is not affected.
- Transparent BTS/BSC and NodeB/RNC operations and software updates.
- Support for all codecs, subrates, and signaling types.

Supporting Solutions, Products, and Service Offerings

The Cisco RAN Backhaul Optimization solution is part of a broader Cisco offering for RAN infrastructure optimization for both GSM and UMTS networks, as well as Code Division Multiple Access (CDMA) infrastructures. Supporting solutions, products, and service offerings are:

- Cisco MWR 1941-DC-A Mobile Wireless Edge Router
- Cisco Mobile Wireless Transport Manager (MWTM) management platform
- Cisco Advanced Services for RAN Optimization

Why Cisco

Cisco provides a complete IP-based RAN infrastructure optimization solution that increases efficiency, reduces costs, and enables additional services based on IP, where Cisco is the recognized market leader.

Worldwide leader in IP networking solutions:

- IP-based transport of RAN traffic, compliant with 3GPP R5/R6
- IP end-to-end services at cell site

World-class reliable and expandable solution:

- RAN vendor-independent solution integrates with all major existing RANs
- Transparent RAN solution; does not affect voice quality and data throughput
- Wide range of interface choices for alternative backhaul

World-class network management products:

- Integrated management solution based on Simple Network Management Protocol (SNMP) allows for centralized management of remote sites
- Expertise and knowledge in deploying network management solutions to manage thousands of nodes
- Worldwide support organizations (Cisco Advanced Services, TAC)

World-class technical support

For More Information

For more information about Cisco RAN optimization solutions and products, visit: http://www.cisco.com/go/mobile.

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

Asia Pacific Headquarters
Cisco Systems, Inc.
168 Robinson Road
#28-01 Capital Tower
Singapore 068912
www.cisco.com
Tel: +65 6317 7777
Fax: +65 6317 7799

Europe Headquarters
Cisco Systems International BV
Haarlerbergpark
Haarlerbergweg 13-19
1101 CH Amsterdam
The Netherlands
www-europe.cisco.com
Tel: +31 0 800 020 0791
Fax: +31 0 20 357 1100

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at **www.cisco.com/go/offices.**

Printed in USA C11-416914-00 06/07

