

## Bandwidth Optimization Solutions: Strengthening Competitiveness by Saving Bandwidth in Mobile and Wireline Networks

### Executive Summary

Faced with a highly competitive data and VoIP industry environment, as well as declining revenues for voice services per user, telecom operators and service providers are looking for solutions that can reduce CAPEX and OPEX while at the same time put their companies in a stronger, success-enabling position.

This application note describes how Dialogic® I-Gate® 4000 Session Bandwidth Optimizer Core X (I-Gate 4000 SBO-CX) solutions can work with many applications to optimize traffic while enabling not only CAPEX and OPEX savings, but also the desired level of quality and reliability of transported calls.

For the common application examples presented in this application note, the I-Gate 4000 SBO-CX is a standalone equipment solution for those seeking to minimize the bandwidth requirements and packet rate (packets per second) of the VoIP packet streams carried in single and multiple destinations, for mobile operators deploying or using 3G networks, as well as for mobile and wireline operators using VoIP media gateways that interconnect 2G mobile switches (for example, MSC) and/or PSTN switches (for example, tandem national or international switches), and also for operators and service providers that carry wholesale VoIP interconnection traffic.

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## Introduction

Mobile and wireline networks are carrying growing volumes of revenue-generating VoIP traffic and surging volumes of data traffic. In addition, telecom operators and service providers worldwide are concerned about a trend towards reduced revenues for voice services per user.

To address these concerns within a highly competitive industry environment, telecom operators and service providers are looking at CAPEX and OPEX reduction solutions, among other solutions, that could put their companies in a stronger, success-enabling position.

Dialogic® I-Gate® 4000 Session Bandwidth Optimizer Core X (I-Gate 4000 SBO-CX) systems are well suited for the telecom operator and the service provider that carry VoIP (Voice over IP) traffic and are seeking significant CAPEX and OPEX savings, as the systems can achieve an efficient (optimal) utilization of the core and edge transport infrastructure.

The I-Gate 4000 SBO-CX solutions also can benefit:

- Mobile operators deploying or using 3G networks by
  - Optimizing Nb traffic carried between 3G mobile gateways and/or
  - Optimizing luCS traffic carried between a 3G mobile gateway and a Radio Network Controller (RNC)
- Mobile and wireline operators using VoIP media gateways that interconnect 2G mobile switches (for example, Mobile Switching Center [MSC]) and/or PSTN switches (for example, tandem national or international switches) by
  - Optimizing the VoIP carried between the VoIP media gateways
- Operators and service providers that carry wholesale VoIP interconnection traffic by
  - Optimizing the VoIP traffic transported between different VoIP interconnecting networks

This application note provides examples of I-Gate 4000 SBO-CX solutions, including ones that illustrate the achievable benefits.

## Mobile and Wireline VoIP Optimization Solutions — Overview

The I-Gate 4000 SBO-CX is a standalone CAPEX and OPEX savings system designed for delivering a large reduction in the bandwidth requirements and the traffic load (packets per second) for VoIP traffic carried in the following applications:

- Between 3G mobile media gateways (Nb traffic optimization)
- Between a 3G mobile media gateway and a Radio Network Controller (luCS traffic optimization)
- Between VoIP media gateways

For the I-Gate 4000 SBO-CX, standalone refers to it being fully autonomous and not requiring call control (for example, MSC server or softswitch) or external equipment for its operation.

Also, I-Gate 4000 SBO-CX VoIP session optimization is performed while maintaining the quality of the transported calls.

The I-Gate 4000 SBO-CX can be used with a wide range of transmission infrastructure elements such as satellite, radio, WiMax, and terrestrial (coax, fiber).

Figure 1, Figure 2, and Figure 3 depict basic examples of I-Gate 4000 SBO-CX solutions for the three applications listed above.

It should be noted that the I-Gate 4000 SBO-CX can seamlessly interconnect to an IP network “as-is”, without the need to introduce modifications in the architecture or topology of the operating network.

# Bandwidth Optimization Solutions: Strengthening Competitiveness by Saving Bandwidth in Mobile and Wireline Networks

## Application Note

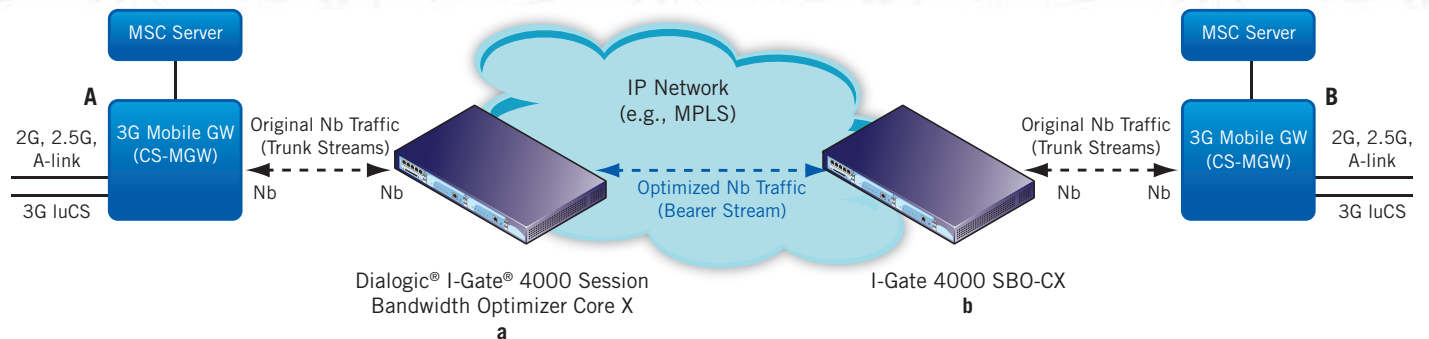


Figure 1. Bandwidth Optimization between 3G Mobile Media Gateways

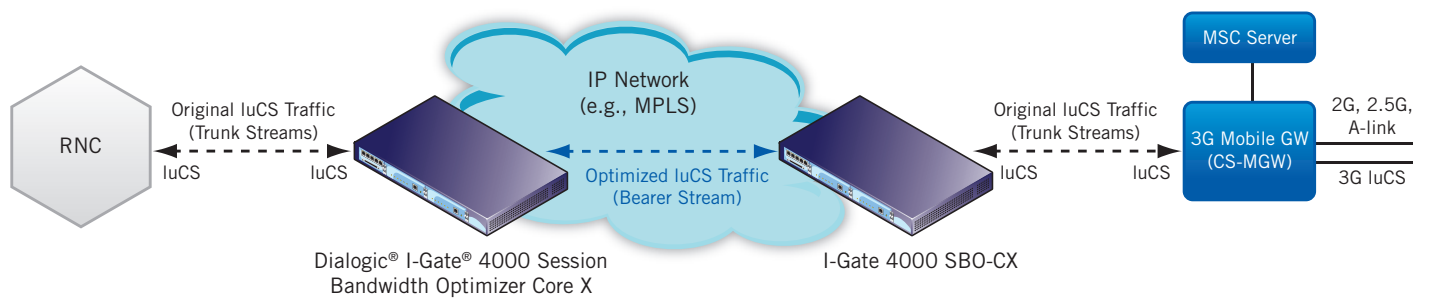


Figure 2. Bandwidth Optimization between a Radio Network Controller (RNC) and a 3G Mobile Media Gateways

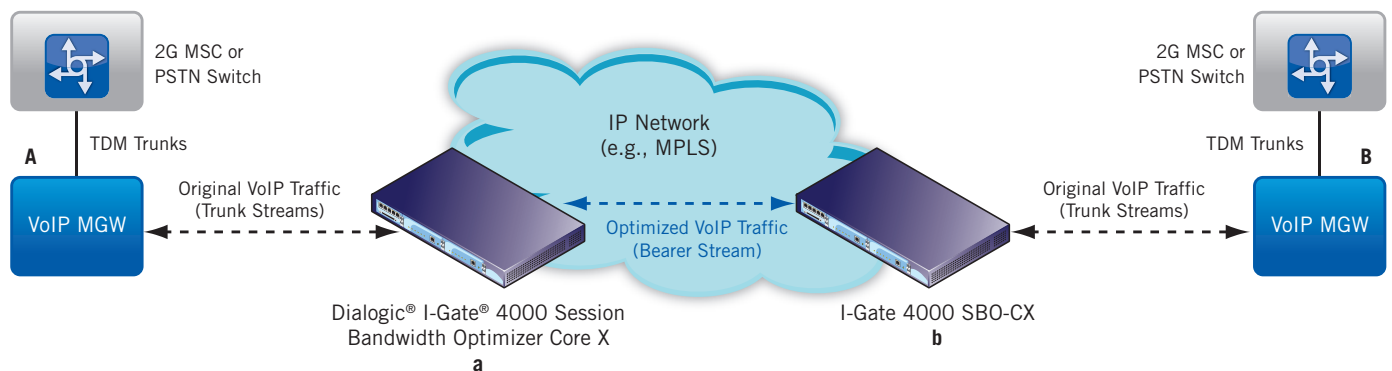


Figure 3. Bandwidth Optimization between VoIP Media Gateways

The Figure 3 example operates as follows: at one end, an I-Gate 4000 SBO-CX terminal (a) receives VoIP packet streams from one or more (near-end) VoIP media gateways (A), executes IP traffic optimization (compression) processes, and sends the optimized IP packet streams to a far-end peer I-Gate 4000 SBO-CX terminal (b). At the peer terminal (b), the received optimized IP packet streams are decompressed, and the decompressed IP packet streams are sent to one or more (far-end) VoIP media gateways (B).

As a result of the I-Gate 4000 SBO-CX traffic optimization processes, the bandwidth requirements for the transport of the optimized VoIP traffic between the I-Gate 4000 SBO-CX systems can be significantly lower than the bandwidth requirements for the transport of the original traffic between the VoIP media gateways before the I-Gate 4000 SBO-CX solution has been deployed.

This reduction in the bandwidth requirements is expressed by the parameter referred to as Bandwidth Savings.

Similarly, as a result of the I-Gate 4000 SBO-CX traffic optimization processes, the packet rate (packets per second) for the transport of the optimized VoIP traffic between the I-Gate 4000 SBO-CX systems can be significantly lower than the packet rate for the transport of the original traffic between the VoIP media gateways before the I-Gate 4000 SBO-CX solution has been deployed.

Two parameters provide a quantitative expression of the achievable benefits of an I-Gate 4000 SBO-CX solution to the operator:

- BW Savings (%) =  $[(\text{Original VoIP Traffic BW Requirements} - \text{Optimized VoIP Traffic BW Requirements})] \times 100 / (\text{Original VoIP Traffic BW Requirements})$ .
- Packet Rate Reduction (%) =  $[(\text{Original VoIP Traffic Packet Rate} - \text{Optimized VoIP Traffic Packet Rate})] \times 100 / (\text{Original VoIP Traffic Packet Rate})$ .

The scenario depicted in Figure 3 is also applicable to the scenarios illustrated in Figure 1 and Figure 2. In the scenario of Figure 1, the I-Gate 4000 SBO-CX executes Nb traffic optimization processes on the Nb streams carried between 3G Mobile Gateways. In the scenario of Figure 2, the I-Gate 4000 SBO-CX executes luCS traffic optimization processes on the luCS streams carried between an RNC and a 3G Mobile Gateway.

Although Figure 1, Figure 2, and Figure 3 show basic single-destination applications, which include a pair of I-Gate 4000 SBO-CX systems that optimize the traffic streams carried through them (VoIP/Nb/luCS), an I-Gate 4000 SBO-CX system can simultaneously support multiple-destination applications where the system simultaneously optimizes the traffic streams between it and several remote systems.

Figure 4 and Figure 5 show examples of multiple-destination applications.

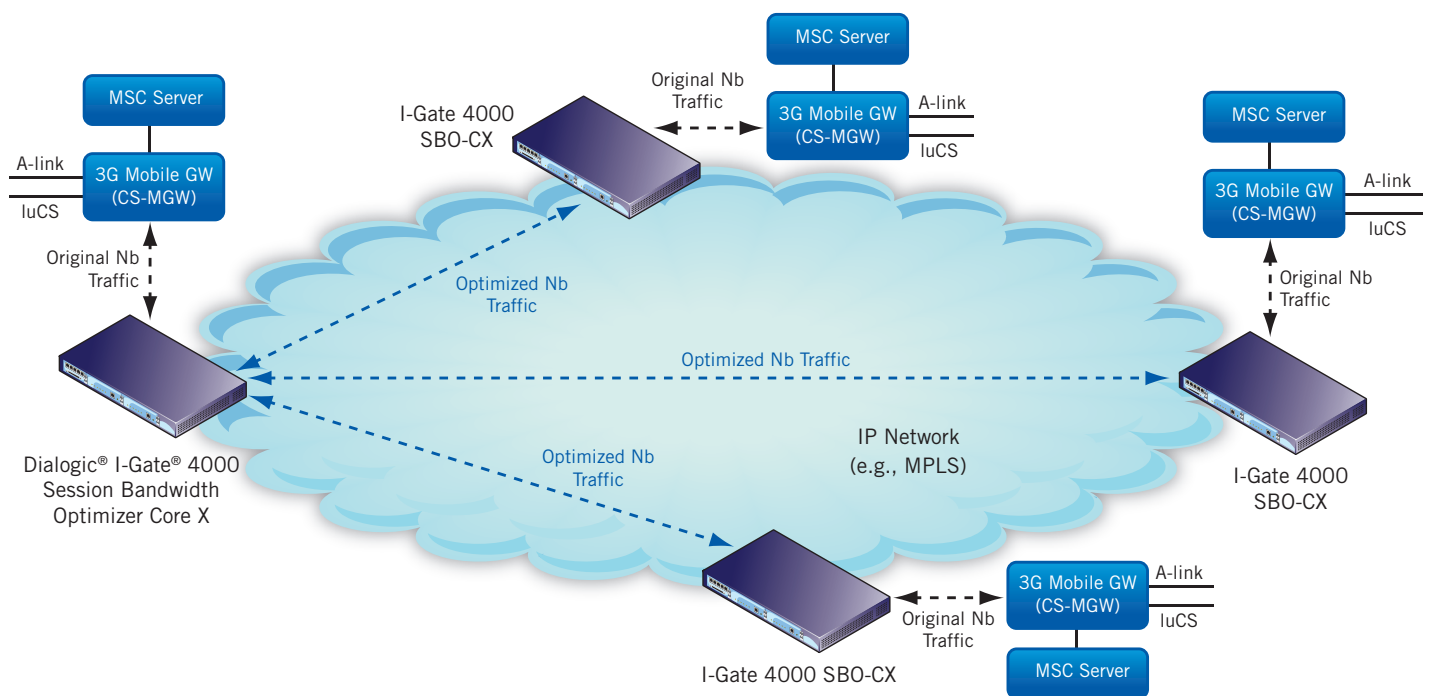


Figure 4. Bandwidth Optimization between Multiple 3G Mobile Media Gateways

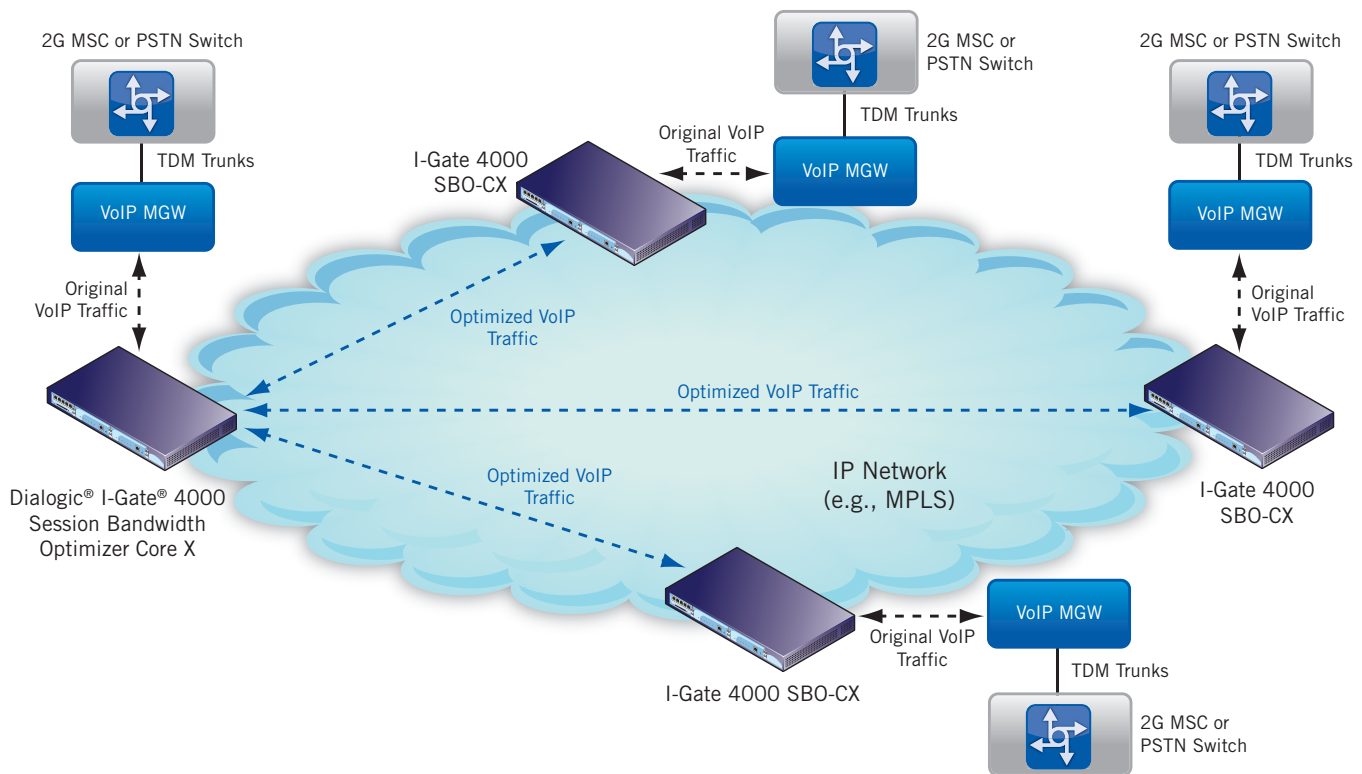


Figure 5. Bandwidth Optimization between Multiple VoIP Media Gateways

Note the following pertaining to the I-Gate 4000 SBO-CX solutions depicted above:

- Figure 1, Figure 2, and Figure 3 provide a basic view of I-Gate 4000 SBO-CX solutions. For simplicity, the figures do not show all the network elements that generally exist in real IP networks, such as routers and LAN switches.
- An I-Gate 4000 SBO-CX system can be deployed at the same site as the connected VoIP media gateway(s) or 3G mobile media gateway(s), or at a different site, such that an IP interconnection is available between them.
- In an I-Gate 4000 SBO-CX solution, the original (before optimization) IP packet streams are called trunk streams and the link that carries them is called the trunk link. The optimized IP packet streams carried between peer I-Gate 4000 SBO-CX systems are called bearer streams and the link that carries them is called the bearer link.

Detailed descriptions of I-Gate 4000 SBO-CX applications are provided in the following sections of this application note.

## Dialogic® I-Gate® 4000 Session Bandwidth Optimizer Core X Solution for 3G Mobile Networks — Nb and IuCS Traffic Optimization

The deployment of 3G-based mobile network infrastructure, as part of a migration from 2G to 3G or as a new mobile network, can challenge an operator with high CAPEX and OPEX associated with the transmission network. This section discusses the I-Gate 4000 SBO-CX solution for optimizing traffic for Nb and IuCS interfaces.

### 3G Mobile Media Gateway Applications — Nb Interface Side

In a 3G mobile core network, the transport of traffic between the 3G mobile media gateways is implemented through an IP network to which they interconnect using an Nb interface.

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The I-Gate 4000 SBO-CX represents a cost-effective solution that optimizes the Nb traffic transported between the 3G mobile media gateways while maintaining the quality and reliability of the transported calls. Nb traffic optimization refers to savings in the bandwidth requirements and reduction in the packet rate (packets per second) of the Nb traffic.

Figure 6 and Figure 7 show examples of a 3G mobile network that includes 3G mobile media gateways before and after the deployment of the I-Gate 4000 SBO-CX solution.

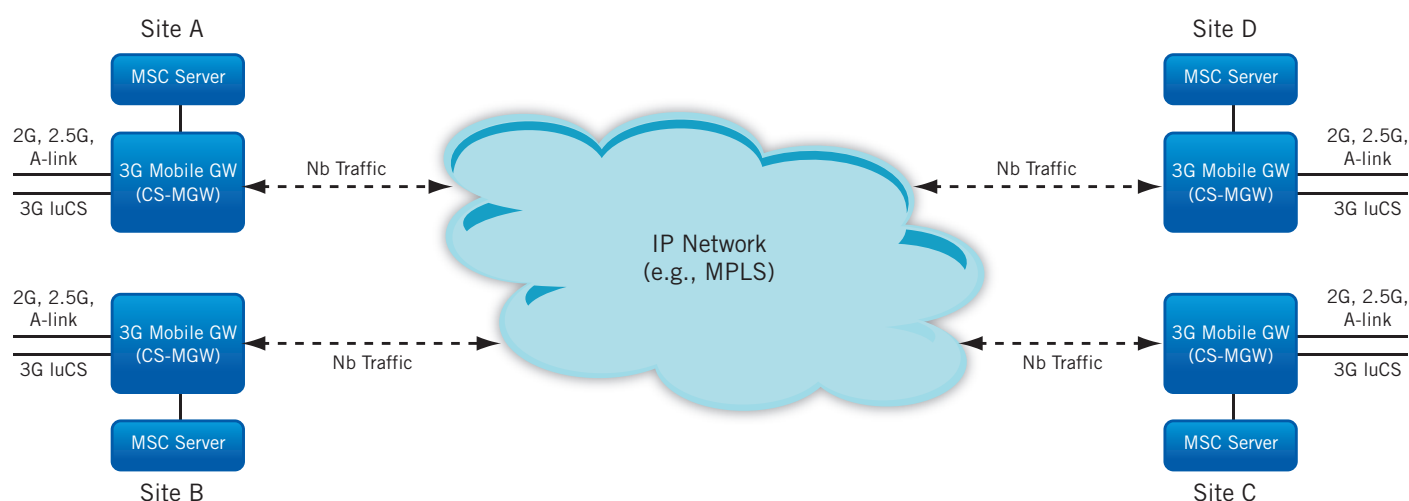


Figure 6. 3G Mobile Network with 3G Mobile Gateways before Deploying a Dialogic® I-Gate® 4000 Session Bandwidth Optimizer Core X Solution

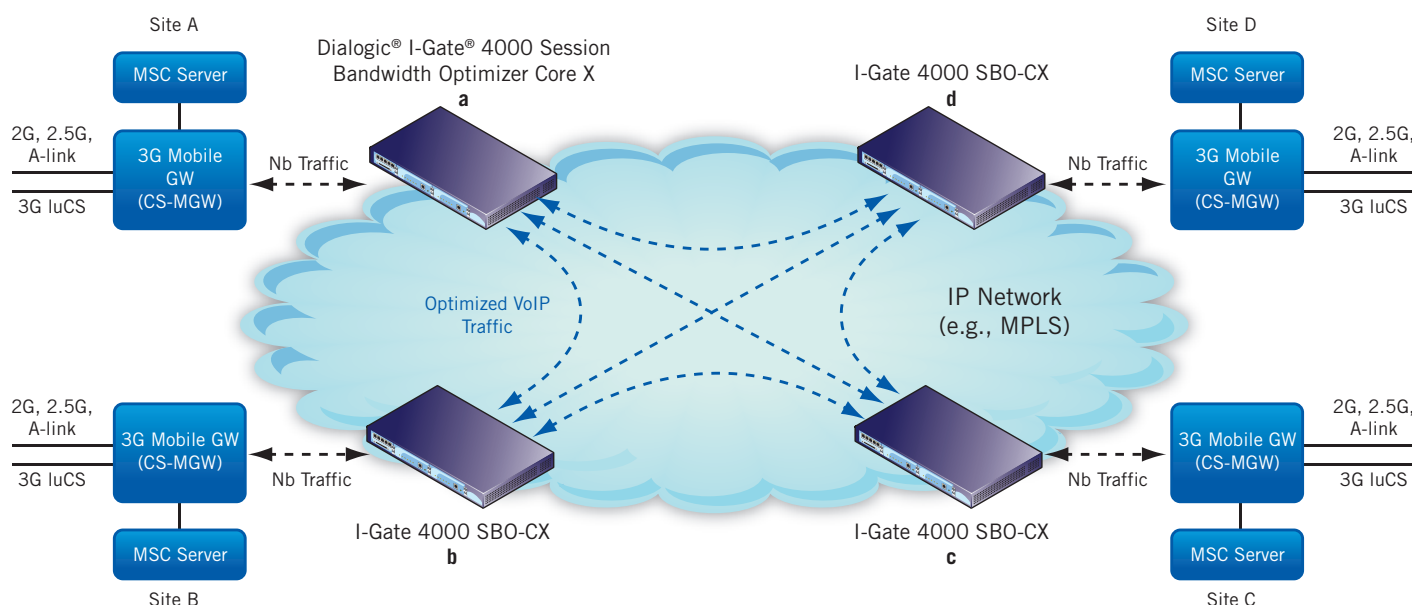


Figure 7. A 3G Mobile Network after Deploying Dialogic® I-Gate® 4000 Session Bandwidth Optimizer Core X Solution — Nb Traffic Optimization Case

The following section provides a description of available benefits of the I-Gate 4000 SBO-CX solution for Nb traffic optimization.

### Nb Optimization Benefits — Example

The following example illustrates possible benefits of an I-Gate 4000 SBO-CX solution to a telecom operator or service provider. The example analyzes the bandwidth requirements for the traffic carried between a pair of 3G mobile media gateways; for example, between those in sites A and C in Figure 7.

In this example, the Nb traffic has the following characteristics:

- Interface: Nb
- Total number of simultaneous calls at the busiest hour: 2,500
- Voice codec of the original traffic: 12.2 kbps
- Packetization Interval of the original traffic: 20 msec
- Voice activity of the original traffic: 50%

Figure 8 illustrates an example of the two 3G mobile media gateways and the characteristics of the Nb traffic carried between them.

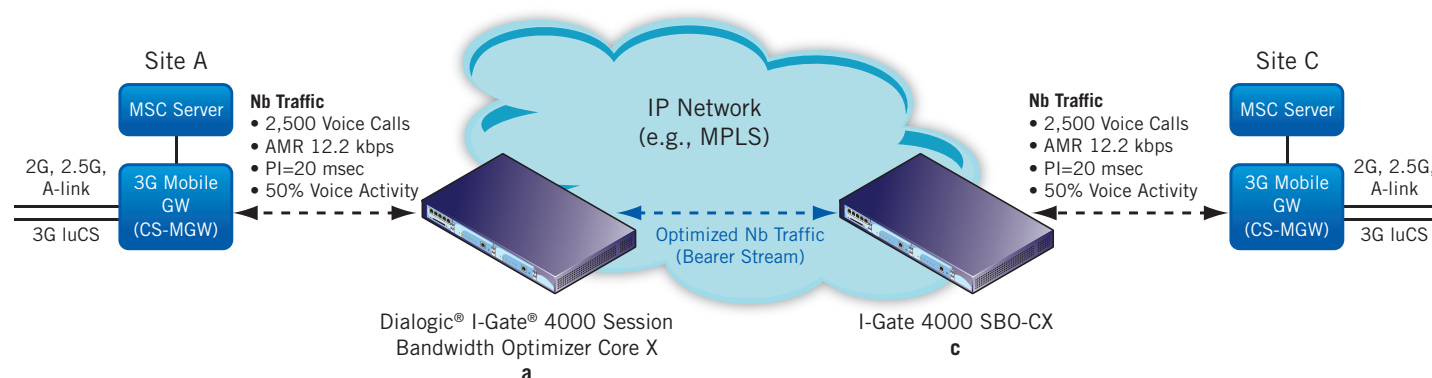


Figure 8. Nb Traffic Optimization between 3G Mobile Media Gateways — Example

Figure 9 and Figure 10 compare the bandwidth requirements and the packet rate before and after an I-Gate 4000 SBO-CX solution is deployed.

The columns in Figure 9 represent the following:

- Column A depicts the bandwidth requirements before deploying an I-Gate 4000 SBO-CX solution. It shows the bandwidth requirements for the Nb traffic carried between 3G mobile media gateways for 2,500 voice calls, assuming GSM-AMR 12.2 kbps encoding, 20 msec Packetization Interval, and 50% speech activity.
- Column B depicts the bandwidth requirements after deploying an I-Gate 4000 SBO-CX solution. It shows the bandwidth requirements for the optimized Nb traffic carried between a pair of I-Gate 4000 SBO-CX systems (installed between the 3G mobile media gateways), for the same traffic load and traffic characteristics as column A.

# Bandwidth Optimization Solutions: Strengthening Competitiveness by Saving Bandwidth in Mobile and Wireline Networks

## Application Note

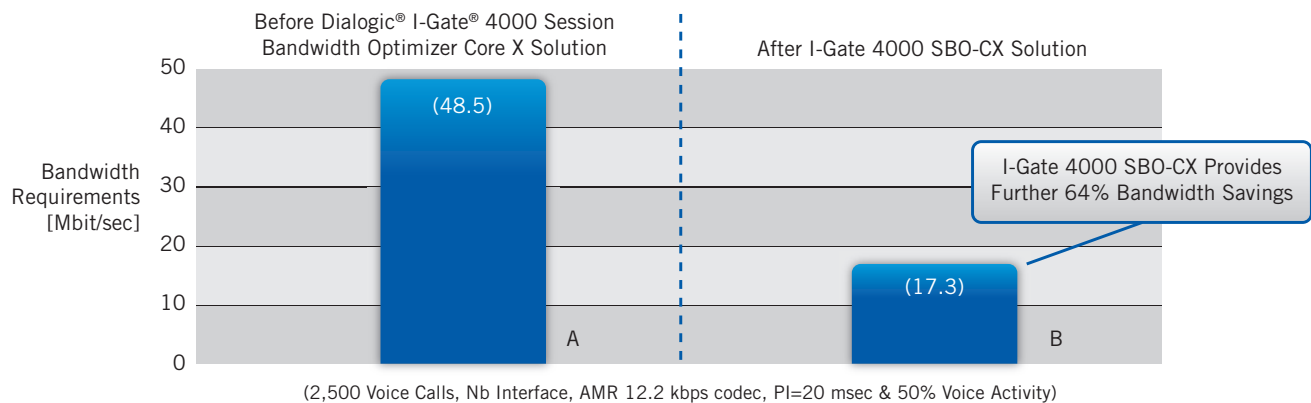


Figure 9. Nb Traffic Bandwidth Consumption Examples

The columns in Figure 10 represent the following:

- Column C depicts packets-per-second rate for the Nb traffic before deploying an I-Gate 4000 SBO-CX solution. It shows the packets-per-second rate for the Nb traffic carried between 3G mobile media gateways shown in Figure 9, column A.
- Column D depicts packets-per-second rate for the Nb traffic after deploying an I-Gate 4000 SBO-CX solution. It shows the packets-per-second rate for the optimized Nb traffic carried between a pair of I-Gate 4000 SBO-CX systems (installed between the 3G mobile media gateways) shown in Figure 9, column B.

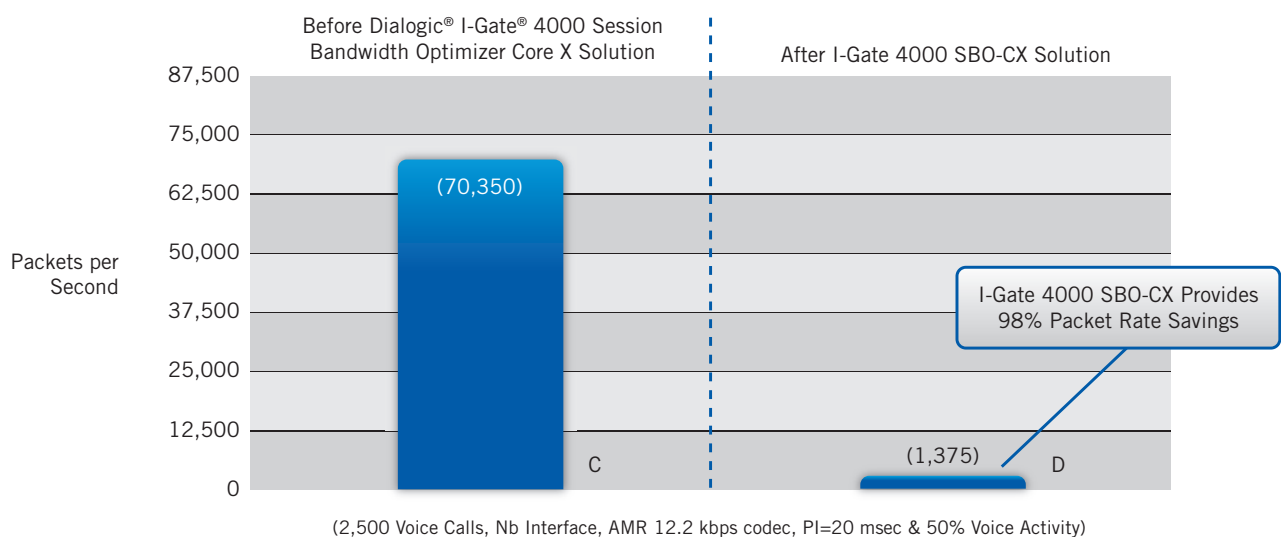


Figure 10. Nb Traffic Packets-Per-Second Rate Examples

As important as the bandwidth savings and packet rate reduction benefits are, it is notable that they were achieved while maintaining quality and reliability levels, thus further promoting customer satisfaction.

## 3G Mobile Media Gateway Applications — IuCS Interface Side

In a 3G mobile network, 3G mobile media gateways interconnect to the RNC (Radio Network Controllers) through the IuCS interface.

The I-Gate 4000 SBO-CX systems can also be used to optimize the luCS traffic transported between 3G mobile media gateways and RNCs.

Figure 6 and Figure 7 are examples of this type of solution. At the RNC site, luCS traffic is sent from an RNC to the near-end I-Gate 4000 SBO-CX system where, after optimization processes, the optimized luCS traffic is sent to the far-end peer I-Gate 4000 SBO-CX system. At the peer system, the received optimized luCS traffic is decompressed, and the decompressed luCS traffic is sent to the 3G mobile media gateway.

Typical bandwidth savings and reduction in the packet rate of the luCS VoIP streams provided by the I-Gate 4000 SBO-CX solution are similar to those achievable between 3G mobile media gateways, described in the example presented previously for Nb traffic.

## Dialogic® I-Gate® 4000 Session Bandwidth Optimizer Core X Solution for NGN Networks — VoIP Traffic Optimization

Today, many operators are deploying Next Generation Networks (NGN) for switching that include VoIP media gateways and softswitches.

The VoIP media gateways are deployed at various sites and are connected to PSTN Class 4 or Class 5 switches and/or mobile network MSC switches, through TDM links and to distant VoIP media gateways through IP packet-switching networks.

Since it is able to operate transparently between a vendor's media gateways, the I-Gate 4000 SBO-CX can provide a cost-effective solution that optimizes the VoIP sessions transported between the VoIP media gateways while maintaining the quality and reliability of the transported calls. Having VoIP sessions optimization can translate to savings on the bandwidth requirements and reduction in the packet rate (packets per second) of the VoIP traffic.

Figure 11 and Figure 12 show examples of a network that includes VoIP media gateways before and after the deployment of the I-Gate 4000 SBO-CX solution.

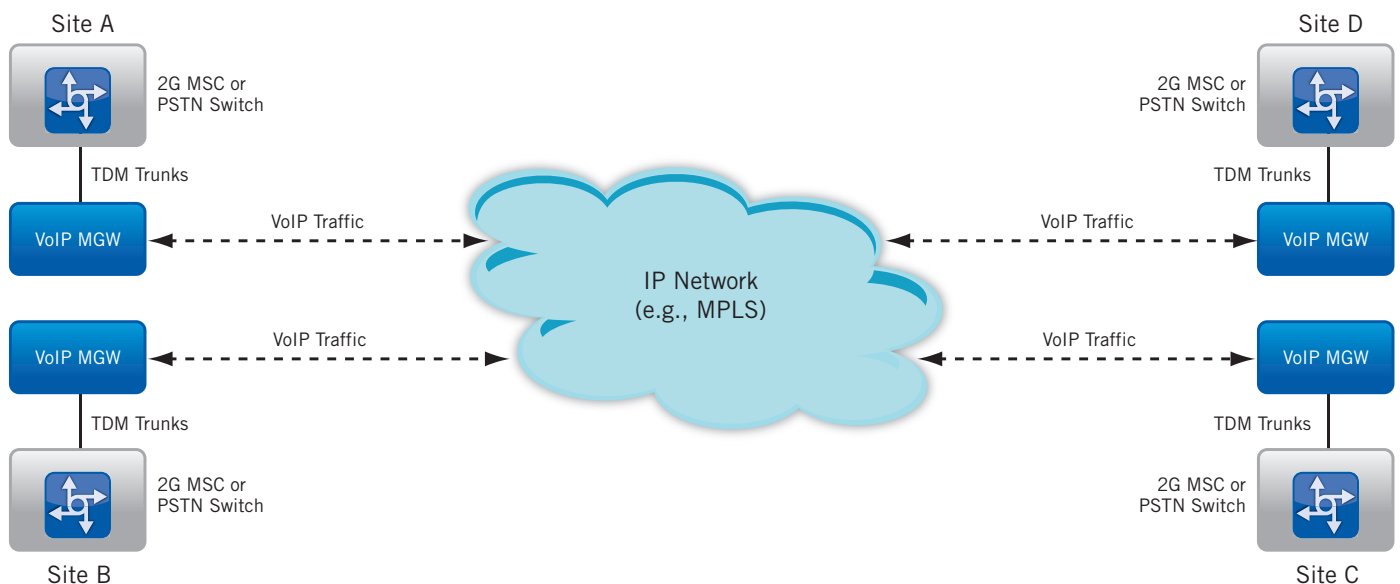


Figure 11. A VoIP Media Gateway Network before Deploying Dialogic® I-Gate® 4000 Session Bandwidth Optimizer Core X Solution

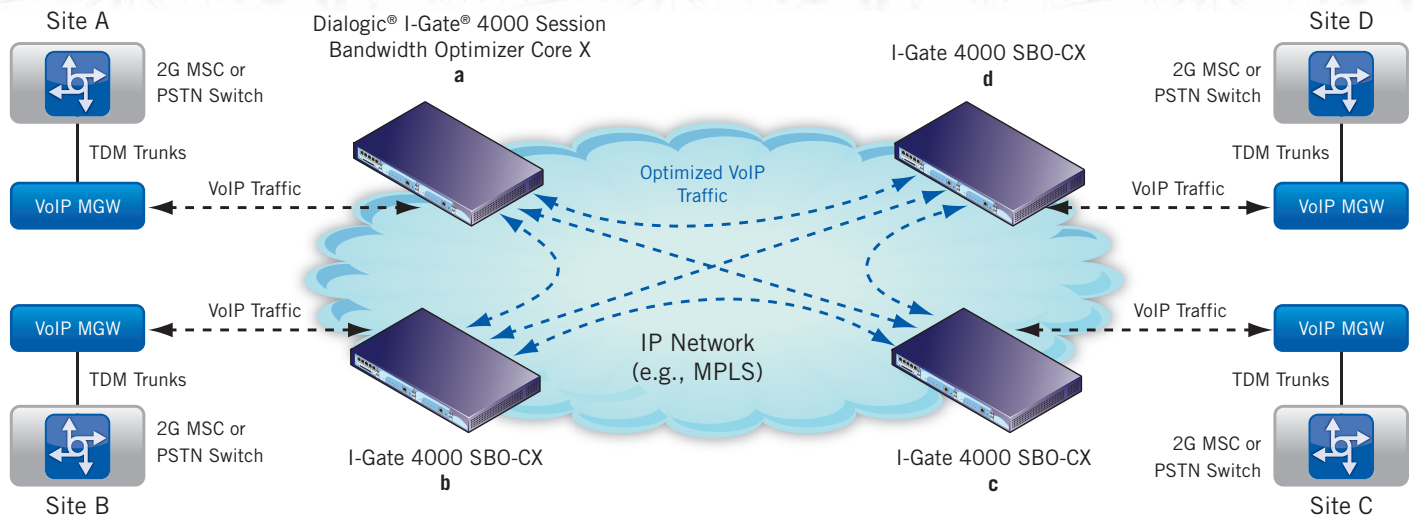


Figure 12. A VoIP Media Gateway Network after Deploying Dialogic® I-Gate® 4000 Session Bandwidth Optimizer Core X Solution

The following section provides a description of available benefits of an I-Gate 4000 SBO-CX solution for VoIP traffic optimization.

## VoIP Optimization Benefits — Example

The following example illustrates possible benefits of an I-Gate 4000 SBO-CX solution to a telecom operator or service provider. The example analyzes the bandwidth requirements for the traffic carried between a pair of VoIP media gateways, for instance, between those in site (B) and site (D) in Figure 12.

In this example, it is considered that the VoIP traffic has the following characteristics:

- Total number of simultaneous calls at the busiest hour: 2,500
- Voice codec of the original traffic: G.729
- Packetization Interval of the original traffic: 20 msec

Voice activity of the original traffic: 50%

Figure 13 shows the two VoIP media gateways and the characteristics of the VoIP traffic.

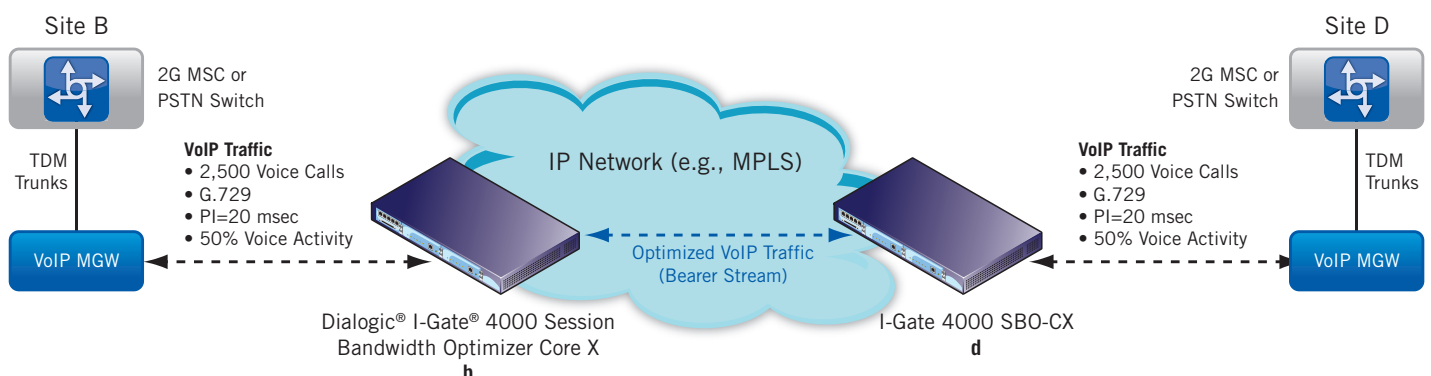


Figure 13. VoIP Traffic Optimization between VoIP Media Gateways — Example

Figure 14 and Figure 15 compare the bandwidth requirements and the packet rate before and after an I-Gate 4000 SBO-CX solution is deployed.

The columns in Figure 14 represent the following:

- Column A depicts the bandwidth requirements before deploying the I-Gate 4000 SBO-CX solution. It shows the bandwidth requirements for the VoIP traffic carried between the VoIP media gateways for 2,500 voice calls, assuming G.729 encoding, 20 msec Packetization Interval, and 50% speech activity.
- Column B: depicts the bandwidth requirements after deploying an I-Gate 4000 SBO-CX solution. It shows the bandwidth requirements for the optimized VoIP traffic carried between a pair of I-Gate 4000 SBO-CX systems (installed between the VoIP media gateways), for the same traffic load and traffic characteristics of column A.

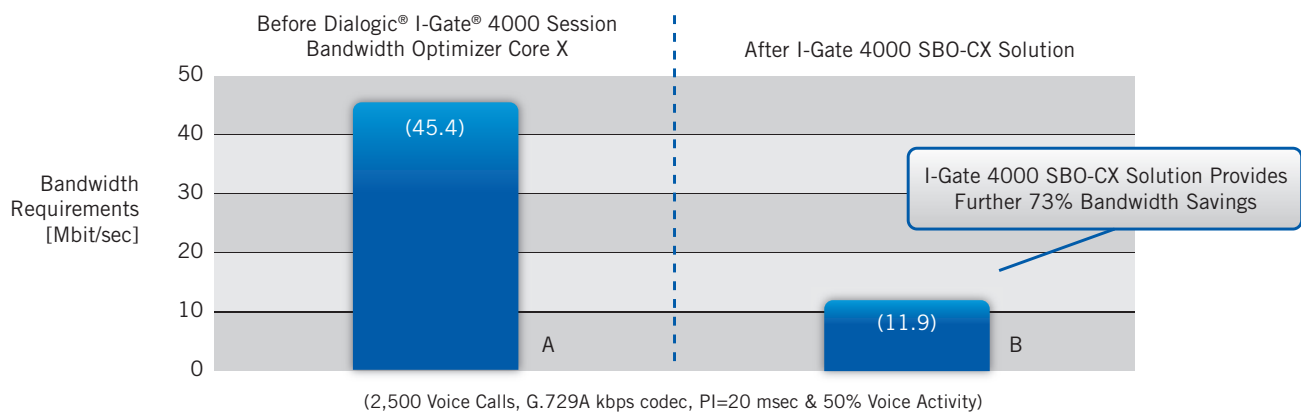


Figure 14. VoIP Traffic Bandwidth Consumption Examples

The columns in Figure 15 represent the following:

- Column C depicts the packets-per-second rate before deploying an I-Gate 4000 SBO-CX solution. It shows the packets-per-second rate for the VoIP traffic carried between the VoIP media gateways shown in Figure 14, column A.
- Column D depicts the packets-per-second rate for VoIP traffic after deploying an I-Gate 4000 SBO-CX solution. It shows the packets-per-second rate for the optimized VoIP traffic carried between a pair of I-Gate 4000 SBO-CX systems (installed between the VoIP media gateways) shown in Figure 14, column B.

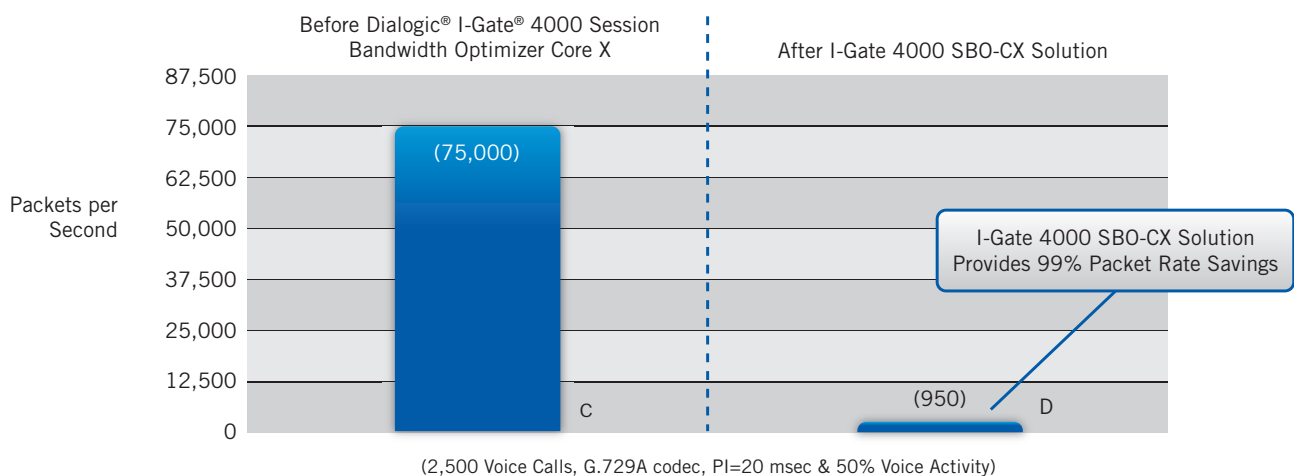


Figure 15. VoIP Traffic Packets-Per-Second Rate Examples

Once again, as important as the benefits are, it is notable that they were achieved while maintaining the quality and reliability levels, thus further promoting customer satisfaction.

## Dialogic® I-Gate® 4000 Session Bandwidth Optimizer Core X in Satellite Link Applications — Mobile and Wireline Networks

Despite general trends toward decreasing costs of bandwidth resources, the transport of Nb, luCS, or VoIP traffic over satellite links still can challenge telecom operators and service providers due to high CAPEX and OPEX, and bandwidth-bounded capacity expansion capability.

For telecom operators and service providers carrying Nb, luCS, or VoIP traffic over costly or bandwidth-bounded satellite links, bandwidth optimization systems that use I-Gate 4000 SBO-CX provide an unparalleled solution that are capable of delivering savings on bandwidth resources, network equipment, and operations, while also providing high-quality services and an efficient and profitable use of the existing transmission infrastructure and satellite modem routers.

In this application, I-Gate 4000 SBO-CX systems are deployed at the ends of a satellite link.

Figure 16 and Figure 17 are examples of point-to-point satellite applications, and Figure 18 and Figure 19 are examples of point-to-multipoint satellite applications.

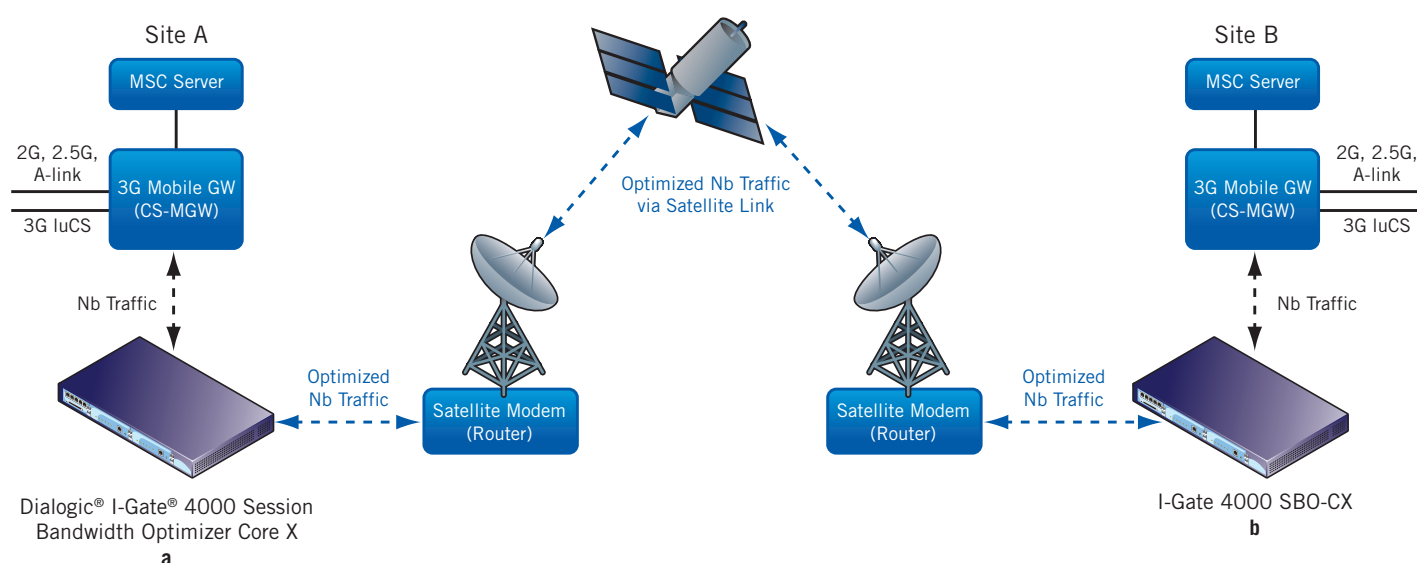


Figure 16. Dialogic® I-Gate® 4000 Session Bandwidth Optimizer Core X in Point-To-Point Satellite Application — Nb Traffic

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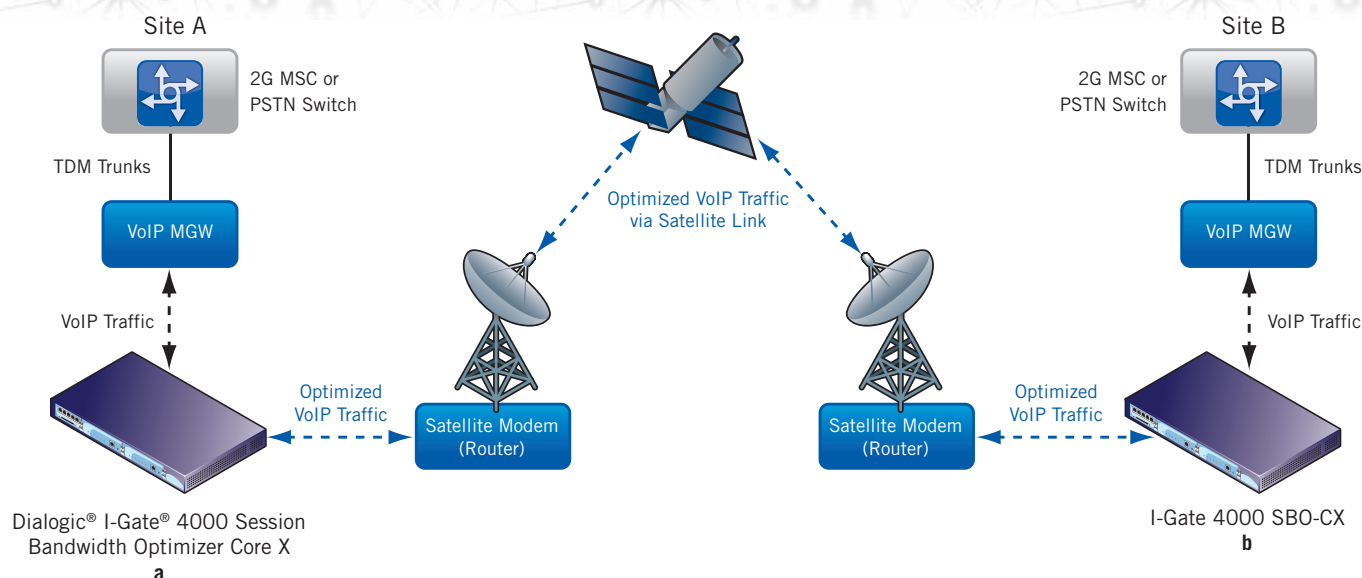


Figure 17. Dialogic® I-Gate® 4000 Session Bandwidth Optimizer Core X in Point-To-Point Satellite Application — VoIP Traffic

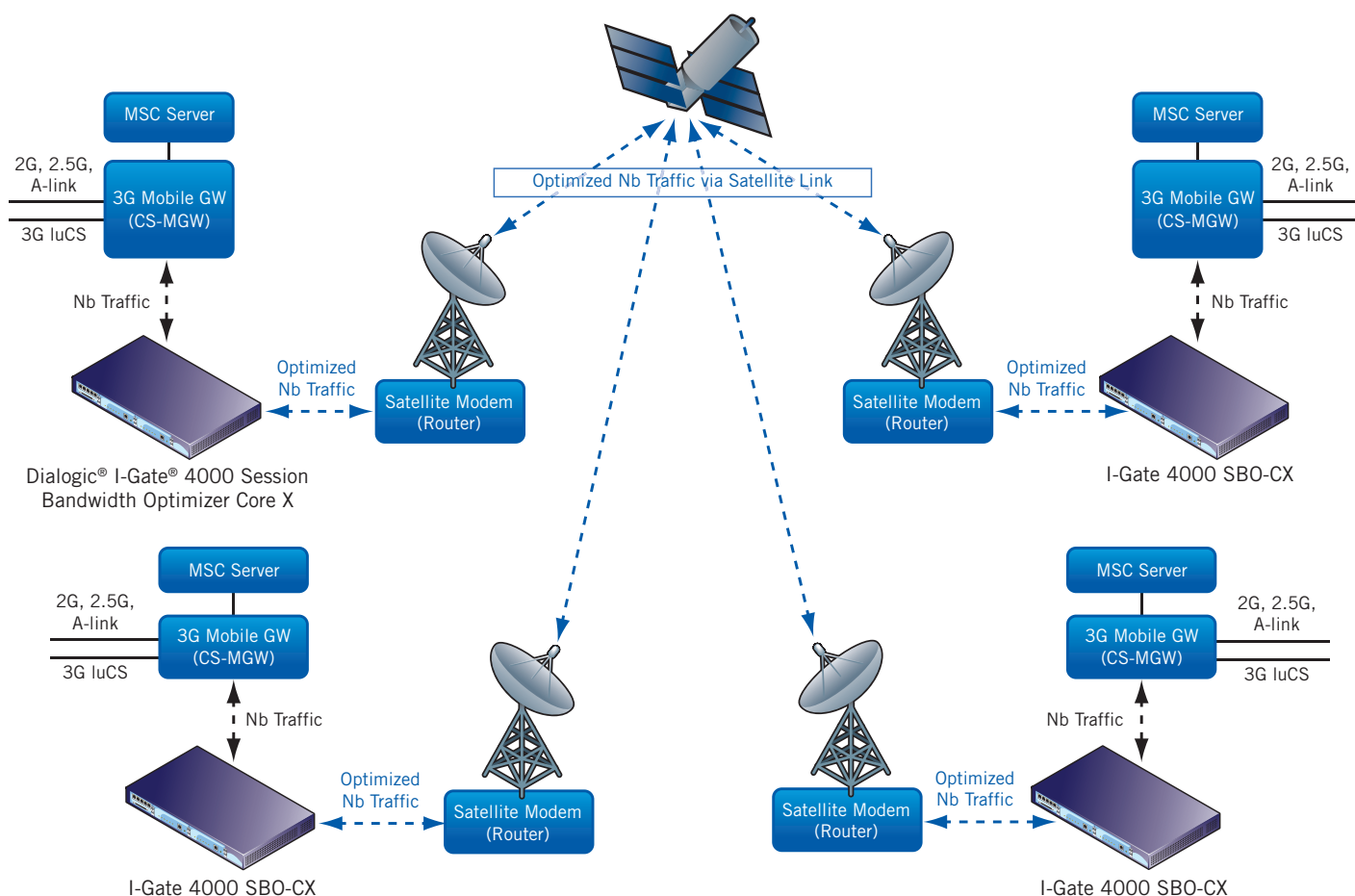


Figure 18. Dialogic® I-Gate® 4000 Session Bandwidth Optimizer Core X in Point-To-Multipoint Satellite Application — Nb Traffic

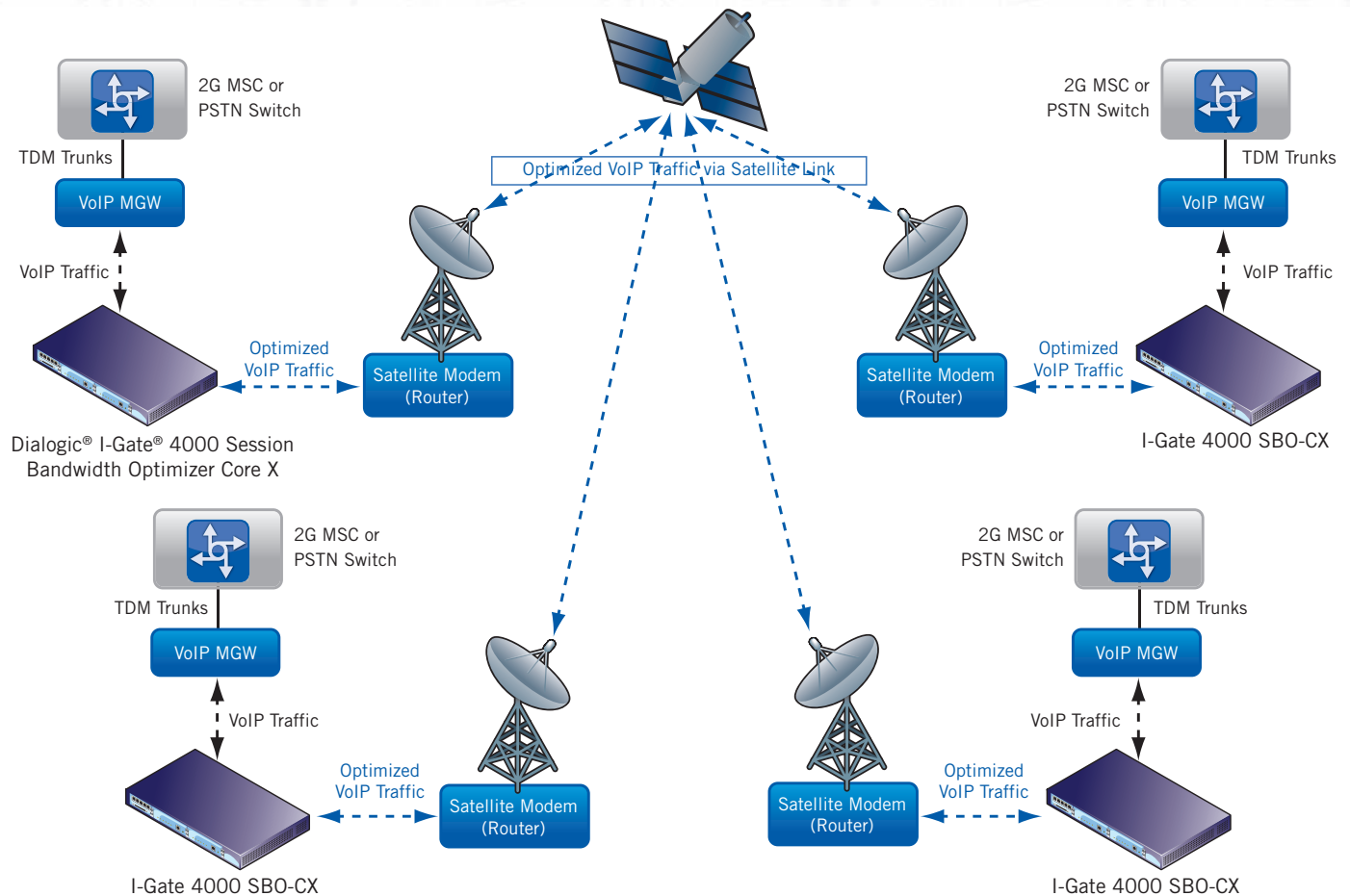


Figure 19. Dialogic® I-Gate® 4000 Session Bandwidth Optimizer Core X in Point-To-Multipoint Satellite Application -- VoIP Traffic

The I-Gate 4000 SBO-CX solutions described in this section are capable of providing a high bandwidth savings and a significant reduction in the packet rate (packets per second) of the Nb or VoIP traffic, while maintaining the quality of the voice traffic. In addition, the I-Gate 4000 SBO-CX system design can provide reliable transmission through bearer links with impairment such as high delay.

For the satellite applications described in this section — general bandwidth savings provided by the I-Gate 4000 SBO-CX are 60% - 70%, with the specific value depending on the traffic profile characteristics, thus allowing significant reduction in CAPEX and OPEX.

In addition, the I-Gate 4000 SBO-CX provides 88% - 98% reduction in the packet rate, which benefits the operator in the form of a significant reduction in the processing requirements (CPU load capability) of the satellite modem/routers, thus enabling a further reduction in CAPEX and OPEX, as well as enhancement of the quality of the voice traffic transported through the satellite link.

## Dialogic® I-Gate® 4000 Session Bandwidth Optimizer Core X Solution for Backup Transmission Networks

Telecom carriers and service providers worldwide have been called upon to build critical failure protection network solutions such that their services (and dependent revenue) can continue in the event that one or more critical segments of their telecom infrastructure go out of service due to a technical failure or an external event (for example, accident, earthquake, terror attack, etc.).

In an effort to minimize the impact should one of these adverse events actually occur, different levels of redundancy solutions are typically implemented, ranging from internal redundancy on a per-equipment basis to fully redundant networks.

Operators can build a backup (redundant) transmission network using their own transmission infrastructure, or they can lease one from other operators.

Specifically, for the transmission networks that carry traffic between 3G mobile gateways or between VoIP media gateways, despite the technical and operational benefits offered by highly resilient network architectures (for example, SDH/SONET dual-ring), the desired level of overall reliability generally calls for separating the two different transmission networks. However, building an effective backup network solution typically can duplicate the investment demanded for a single transmission network alone, which can be quite high considering the multiple cost components of a network deployment project (for example, equipment, real estate, excavation, others).

The I-Gate 4000 SBO-CX system provides an outstanding opportunity for operators looking to build a cost-effective fully featured backup transmission network solution and to position themselves to achieve the high overall reliability target for their Nb or VoIP traffic at greatly reduced CAPEX, while at the same time providing rapid infrastructure rollout, minimizing OPEX, and maintaining high-quality services.

Figure 20 shows an example of backup network architecture including VoIP media gateways interconnected through an IP/MPLS network and to a backup network. Typically, the traffic between the VoIP media gateways is carried through both of these networks, in load-sharing mode. In case of a failure in one of the networks, the traffic between the relevant VoIP media gateways will be carried through the other network.

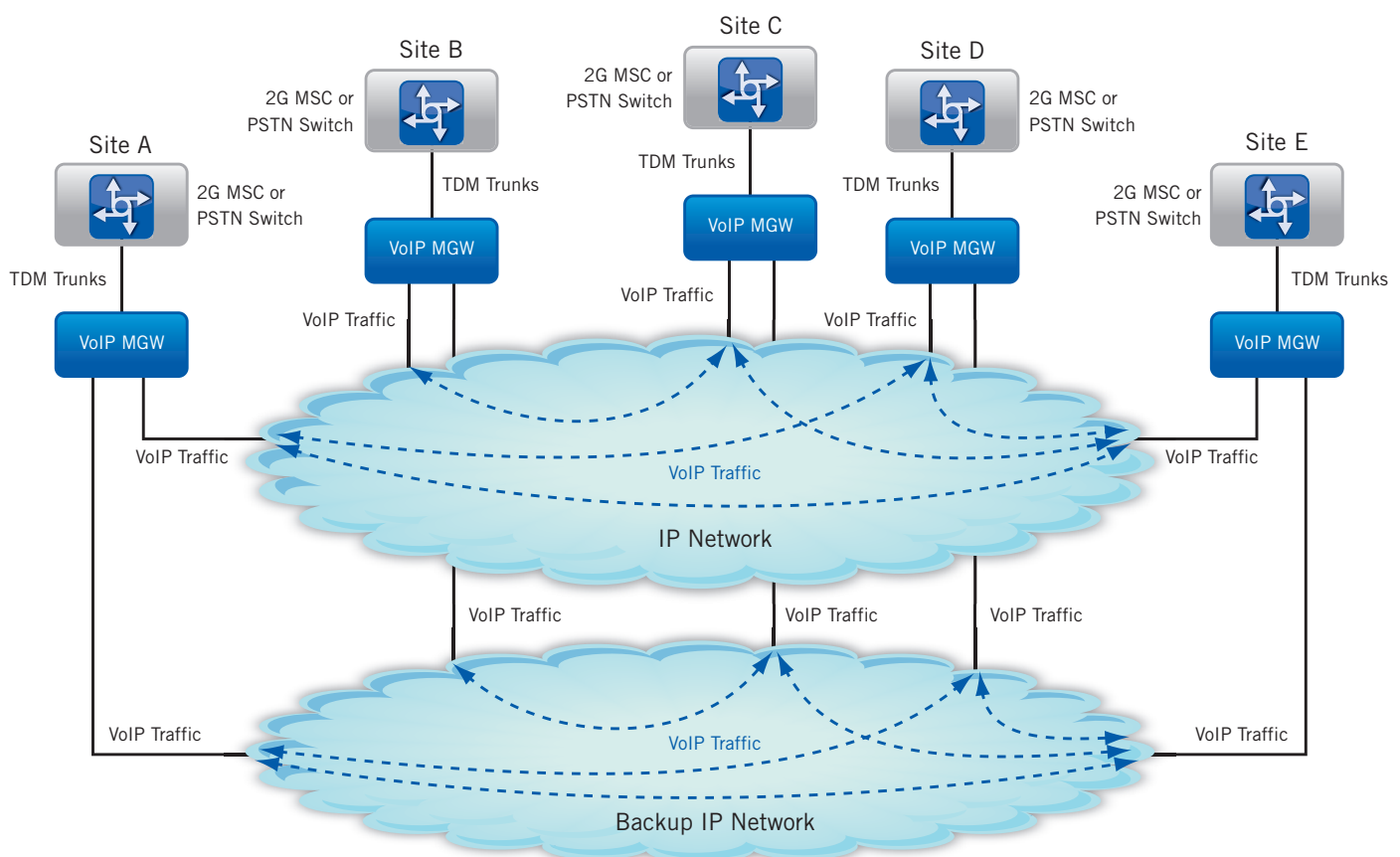


Figure 20. A Backup Protection Network Architecture

Figure 21 shows an example of the same backup networks shown in Figure 20 after deploying an I-Gate 4000 SBO-CX solution, where the traffic through the backup network is optimized by I-Gate 4000 SBO-CX systems. In this case, the bandwidth requirements for the backup network can be significantly lower (typically 50% to 70% bandwidth savings) than the example in Figure 20.

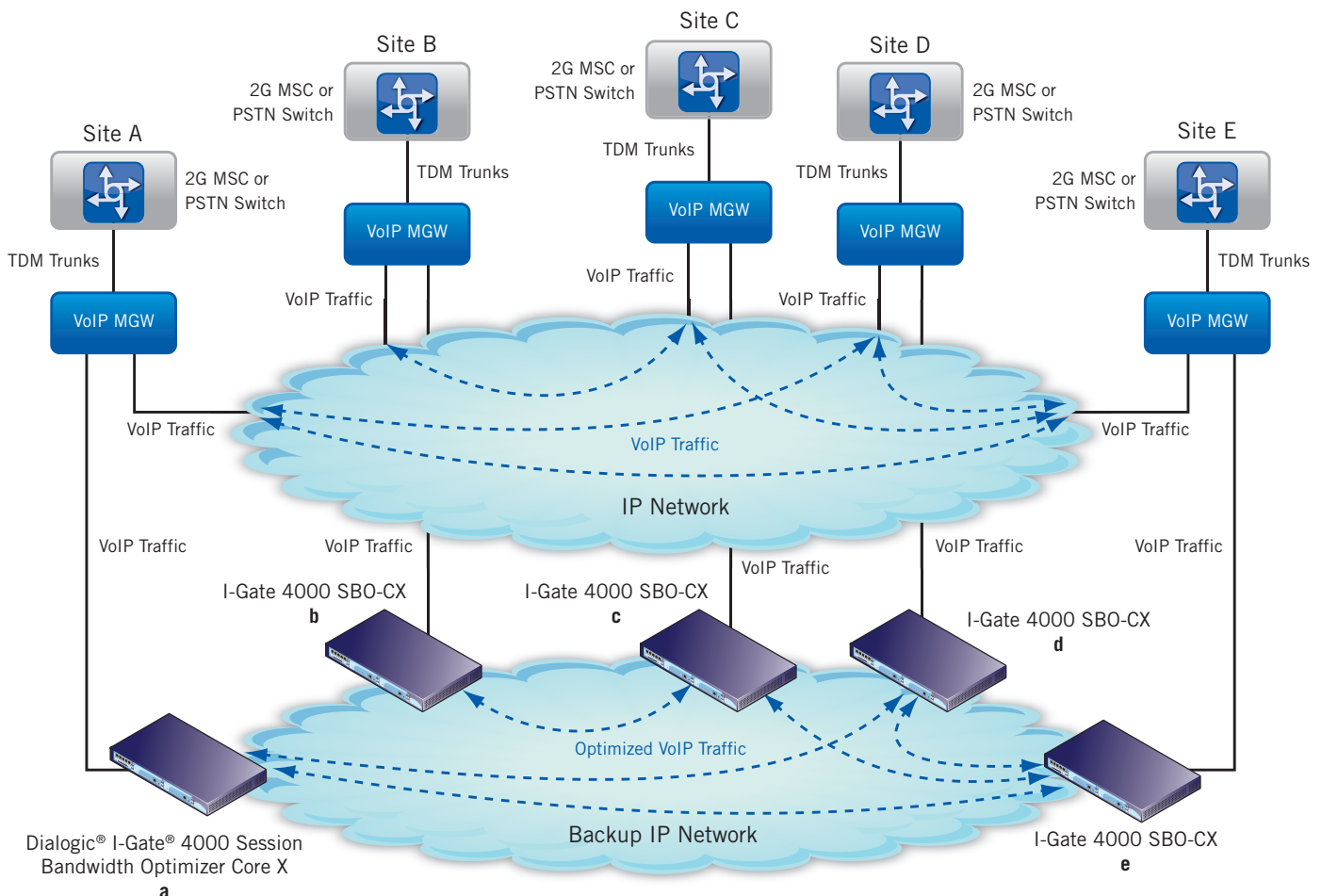


Figure 21. Dialogic® I-Gate® 4000 Session Bandwidth Optimizer Core X Solution for a Backup Protection Network Architecture

## Dialogic® I-Gate® 4000 Session Bandwidth Optimizer Core X Enterprise VoIP Applications

The rapid rise in broadband access for enterprise customers, and their growing demand for IP-based voice and data services, present challenges to operators aiming to maximize the use of the already deployed access network infrastructure.

The I-Gate 4000 SBO-CX systems represent an unparalleled solution that optimizes the VoIP sessions among multiple VoIP Media Gateways (MGW) and/or IP PBXs located in different branch offices, while preserving the original voice quality. An I-Gate 4000 SBO-CX may be located at the enterprise headquarters site and at any remote site.

Figure 22 is an example of an I-Gate 4000 SBO-CX solution in an enterprise VoIP application.

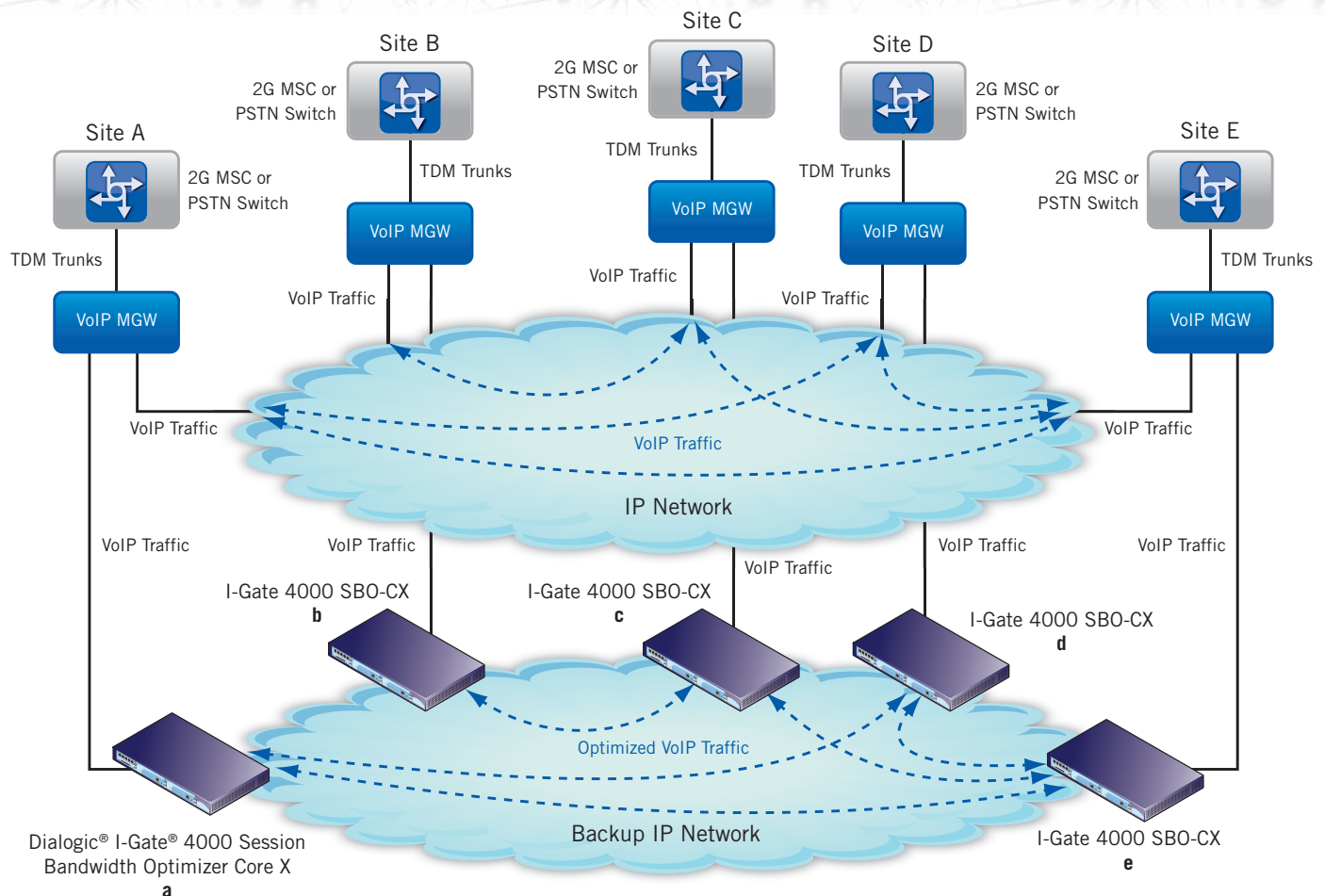


Figure 22. Enterprise VoIP Sessions Optimization Solution

The VoIP traffic generated by a VoIP media gateway or IP PBX (for example, HQ site) are sent to a near-end I-Gate 4000 SBO-CX system where, after optimization processes, the optimized IP packet streams are sent to an I-Gate 4000 SBO-CX system at a distant site (for example, Branch Office 1 or 2). At the distant site, the received optimized IP packet streams are decompressed, and the decompressed IP packet streams are sent to a VoIP media gateway or IP PBX.

The I-Gate 4000 SBO-CX solution can provide bandwidth savings and a reduction in the VoIP packet rate (packets per second), while maintaining the quality of the voice traffic.

For the enterprise VoIP applications, the further bandwidth savings provided by the I-Gate 4000 SBO-CX are typically 60% to 70% (with the specific savings value depending on factors such as the traffic profile characteristics), thus allowing for reduced in CAPEX and OPEX.

In addition, the I-Gate 4000 SBO-CX provides up to 98% reduction in the packet rate, which stands to benefit the operator with a significant reduction in the processing requirements (CPU load capability) of the IP network routers, thus in turn allowing for a further reduction of CAPEX and OPEX as well as enhancement of the quality of the voice traffic transported through the IP network.

The optimized VoIP sessions can be carried over a transmission media (for example, satellite, terrestrial, microwave, WiMax, and others), and can be transferred over an IP network.



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The Network Fuel logo, featuring the words "NETWORK FUEL" in a bold, sans-serif font. The word "NETWORK" is in a smaller font size than "FUEL". The logo is set against a background of a complex network diagram with many nodes and connecting lines.

**NETWORK FUEL™**