



***DETERMINING NETWORK READINESS for UC***

A Unified Communications Networking Guide

## What's Covered

- Benefits of Unified Communications
- Is My Network Ready?
- Sizing up Your Solution
- Company Growth
- The Right Networking Equipment
- Network Port Requirements
- Network Connectivity
- Remote Users
- What Switchvox Appliance is Ready for You?

## Introduction

The Telecom world has been through many whirlwind changes in recent years, and it's time for you to prepare your network for the telecom upgrade you've been waiting for!

Switchvox takes the difficulty out of setting up futuristic Unified Communication functionality, but it still relies on the basic network capability of your company. Without the proper foundation, any Unified Communications solution can operate at a diminished capacity.

This document will help you prepare your network for the installation of a Switchvox platform. We will cover details about network traffic, network routing, VPN access, firewall functionality, multiple network communications, home users, and much more.

## Benefits of Unified Communications?

You might have a phone system sitting in your back office. Or you're using a key system that isn't providing you the functionality you need. You may want the benefits of APIs (Application Programming Interfaces), leveraging UC to integrate your business web, video applications with your phone system – providing a single interface to multiple applications.

Network infrastructures are changing. Your telephony, video, and data applications are converging over IP. You are using more cloud-based services and utilizing a mobile work-force. Unified Communications is the tool to enable the integration of all of these applications into a single, seamless interface to make your business more accessible and efficient. Digium's Switchvox UC solution never stops providing you an intelligent communications platform that is cost effective, easy to use, and robust enough to get the job done.

*Switchvox is exactly what you're looking for to take your business communications to the next level. The question is now, is my existing network equipped and ready for UC?*

## Is My Network Ready?

We're glad you asked. But first, there are a few questions that you will need to answer about your company. These will help you make the tough decisions about what needs to be done with your network, and what type of equipment you'll need to install to make sure your Switchvox will work seamlessly for your business.

How many users do you have?	<b>1-10 users</b>	<b>11-50 users</b>	<b>51-400 users</b>
What kind of networking equipment are you using?	<b>Consumer Class</b>	<b>Limited Managed</b>	<b>Fully Managed</b>
How many ports do you need per user?	<b>Only 1</b>	<b>Usually 2</b>	<b>Many Available</b>
What kind of Internet connection do you have?	<b>Cable/DSL</b>	<b>T1 or smaller</b>	<b>Metro-E/MPLS</b>
Do you have remote users?	<b>No Remote Users</b>	<b>A Few Remote Users</b>	<b>Many Remote Users</b>

## Sizing up your solution - How many users do you have?

The number of users you have is not only important to determine which Switchvox appliance you will need, but is also important for the type of network service you need to address your business requirements. (You will learn more about your current networking equipment in the next section.) Keep in mind, with more users on your network, you may need more bandwidth or network services.

### How Many Employees are in Your Company?

1-10 Users	11-50 Users	51-400 users
<p>With 1-10 users, your networking equipment should not impede your ability to successfully make great sounding phone calls. The amount of bandwidth that voice traffic requires can be very minimal - even over-the-counter or retail home networking equipment has enough processing and throughput capacity to transmit calls and data at the same time.</p>	<p>As the number of users grows in your company, so will your networking needs. This can be as simple as installing a more advanced router and firewall and sometimes a switch with a higher port density. In a 11-50 user network, consumer class networking hardware can degrade audio quality due to the amount of network throughput required for 11+ VoIP calls; you will want to start looking at your network to ensure you have the right equipment to handle the voice properly.</p>	<p>If your company has more than 50 users, you will need more intelligent networking equipment with greater processing capabilities, stronger security, and a system equipped to handle the greater amount of simultaneous voice and data traffic.</p>

### What if My Company Grows too Quickly?

During any network upgrade or with any new installation, it is best to plan for the future. If you know you won't have more than 50 users, in your network, for the next few years, there is no good reason to upgrade to handle 200+ users. However, if your company is growing quickly, it may be worth the extra investment in intelligent networking equipment to ensure that the quality of your services does not suffer.

Now that we've outlined the number of users, let's look at the right networking equipment for each category. Meaning, before installing Switchvox, an optimized network for your number of users should be deployed. The next few pages walk through how to optimize this network.

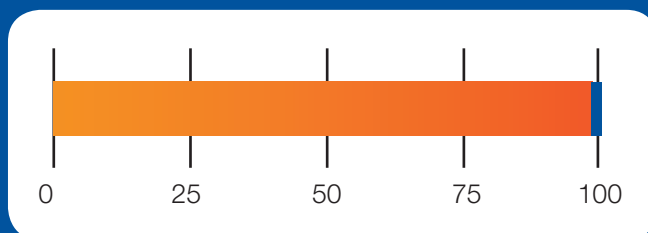
## Background Concepts

### What is Quality of Service?

Networks are capable of using a protocol named Quality of Service (QoS) to prioritize important traffic types. With an unmanaged switch (typically, a consumer-class switch) all network traffic is sent as it is received. No differentiation or fragmentation is assigned to types of traffic or traffic order. This means that as one person is sending a large video file over your network or server, then they will be using up a large portion of the available bandwidth for that application and could starve out other applications, such as voice. If someone later picks up the phone to make a call, this call will also be transmitted on the same network pipe as the video file.

### Just adding one more call to your network can cause your audio quality to suffer!

Let's imagine that this chart represents the total bandwidth required to transfer both the video file and have a successful voice conversation. Ignoring overhead, if you need any additional bandwidth, your network isn't capable of providing it on a 100 Mbps interface without any other settings in place to prioritize or fragment that bandwidth. What happens if you make another call, or you want to transfer more data at that time?



### How to Prioritize Voice Traffic

This is when QoS comes in and helps. In an unmanaged network, the video traffic and voice traffic will interfere with each other, competing for bandwidth. This is why voice calls will sometimes sound great, and why at other times they sometimes sound horrible. When voice quality fluctuates like this, installing QoS capable switches and routers are the most important first steps to fixing the problem.

With managed switches, the Switchvox platform can tell the network that it is trying to transmit highly important voice data, which will be tagged with special QoS markings. If the network supports it, the voice traffic will then take priority over the data traffic. Sure, this may slow the data transfer down, but at least you won't miss any of your voice call – it will sound crystal clear AND you will still be able to transfer all of your data.

### Does QoS work over the Internet?

Unfortunately, due to the nature of the Internet, there is no way to guarantee QoS on an Internet connection. This is simply because the QoS information (or tag in the frame or packet) may be stripped off the network traffic before it even hits the Internet switches and routers.

### Tagging Voice Packets

Switchvox will tag your voice packets with QoS information, and calls inside your company network will sound fine. If you make a call through a SIP provider, or to another site over the Internet, then there is a risk that the voice quality will suffer. We will cover methods of increasing audio quality over the Internet later.



## The Kind of Networking Equipment You Choose Can Affect Your Voice Quality

The kind of networking equipment you are using is critical to having a good quality phone conversation. Companies with fewer employees will have an easier job of choosing networking equipment and can shop based on price rather than robust processing and management capabilities because they have fewer networking requirements.

There are several reasons to explain this. In a smaller company you typically have fewer employees and fewer simultaneous voice, video and data traffic. For example, if your company is a small retail store with a few phones, and has a couple of Point of Sale (POS) terminals with no desktop computers, then you won't be transmitting a significant amount of data. Most data networks of any class are equipped with enough bandwidth and resources to handle simultaneous voice and data traffic.

However, if you have many active computer users, all of which are sending and receiving large video files and actively using email, watching training videos and more, then you'll want networking appliances equipped to prioritize and process all of this simultaneous traffic.

### Networking Equipment Categories

Consumer Class	Limited Managed	Fully Managed
<p>If you walk into a typical electronics retailer and pick up a networking switch, it is very likely that you have just bought a consumer class switch. These usually have 8 or less ports and have no configuration options; you simply plug them in and turn them on. These switches will not support QoS or any form of network management. Examples of Consumer Class switches are D-Link DGS-2205 and Linksys EG008W.</p> <p><i>Note: Some Consumer Class routers also act as switches, and have a web interface for configuration. Don't confuse this with a managed switch, as they most likely will not allow you to use QoS on your network!</i></p>	<p>A Limited Managed network is one that includes managed switches, but no central management between sites. You can configure a managed switch's QoS settings, and make sure that voice traffic doesn't get trampled on by other applications. With only one or two managed switches, this is simple to do, and you don't have to worry about advanced configuration. Keep in mind, with a Limited Managed Network, QoS settings will typically only cross switches and routers in which you have configured QoS. If you are using any sort of unmanaged switch or router on your network, then you will lose QoS settings.</p>	<p>Fully Managed Network, you can ensure that QoS traffic is properly transmitted across all switches and routers in your company. In many cases, this will allow you to optimize your bandwidth so voice will take precedence over data. You may ask 'why should voice take priority?' When transferring a data file, you will eventually receive the full file over a busy network. With voice, on the other hand, you can't get back the part of the conversation that was dropped because of the saturated network. You want great voice quality even when you have multiple phones in multiple areas of your company talking to one another.</p>

## Background Concepts

### What is Half Duplex?

First, let's talk about the concept of "Duplexing". Duplexing is when a signal travels in both directions at the same time on a single path. For example, duplexing allows data to be transmitted and received at the same time, on the same circuit. This is called *Full Duplex Mode*.

Half Duplex is when you can EITHER transmit OR receive a packet at a given time. Why is this important? If your network is only transmitting at half duplex, then your phone will not be able to effectively hold a conversation with the Switchvox system. This is normally not an issue for regular data, but since voice traffic is real-time dependent, it can cause other issues like delay, jitter, and packet loss. (Half-Duplex technology is not typically deployed in new networks today.)

### What is Delay?

Delay occurs when there is a higher than normal latency on your network. (Latency is the amount of time it takes between one person saying something and the other person hearing what was said.) Latency doesn't typically cause audio quality issues, but when the latency is over about 150ms, the delay is noticeable to your users.

### Troubleshooting Tip:

*Delay won't be reported as an audio quality issue. It will be a lapse in time in the conversation. To fix this issue, we recommend pinging the phones to see what their "round trip delay" is. Sometimes, a simple network tuning can fix this issue by fragmenting data packets, so delay is less than 10ms.*

### What is Jitter?

Jitter occurs when voice packets arrive with varying delays. This is typically caused with changes in network traffic, and can typically be fixed by using QoS, or reducing the amount of traffic your network equipment is handling.

Your users will often report jitter as poor audio quality. Asterisk, the telephony engine that Switchvox is built on, supports an intelligent Jitter Buffer, which allows the system to keep your users from hearing the jitter. However, if the jitter is too high, you'll have to fix the network underneath Switchvox to improve this audio quality.

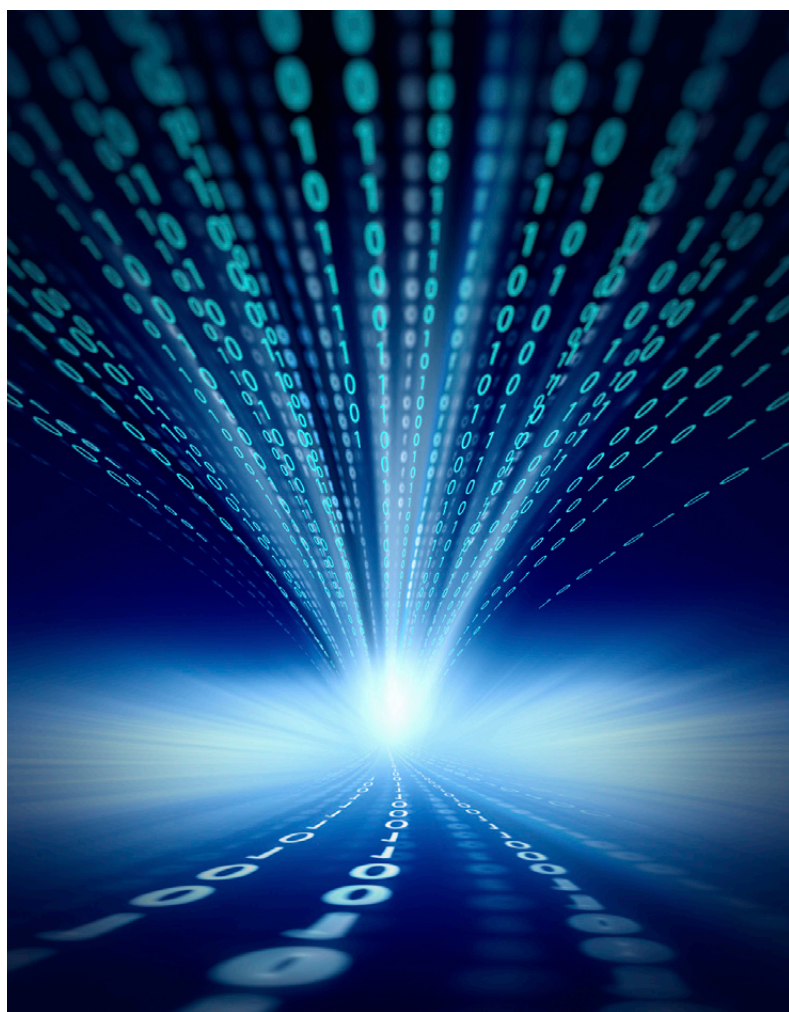
### What is Packet Loss?

Packet Loss happens when parts of the conversation are simply lost in the network. Normally, this is not a big issue, but if your network starts to lose a lot of packets, the voice conversation will exhibit odd sounds in the middle of the conversation. This can also be fixed by tuning your network with QoS settings and ensuring voice traffic is the primary traffic on the network.

### What is DHCP?

DHCP stands for "Dynamic Host Configuration Protocol", and is the service that your computers and phones use to find out the details of their local network, and how to access other computers, phones, and the Internet.

The information provided by DHCP includes the device's IP address and available DNS (Domain Name System) servers. DHCP can also provide basic provisioning direction to phones that are looking for their server. You can use DHCP in your network to simply provide an IP address and manually configure your phones. You can also use DHCP in conjunction with your own provisioning system. However, using the Phone Feature Packs in Switchvox, makes this all very easy to configure.

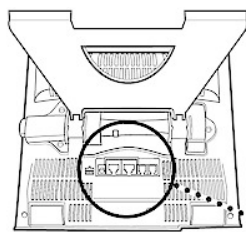


## How Many Ports do You Need Per User?

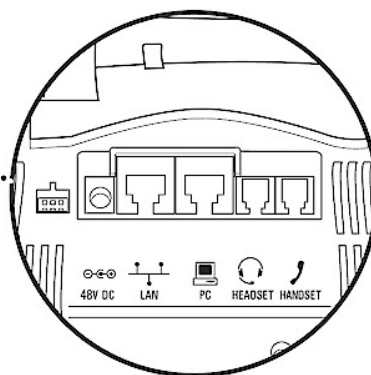
The number of switch ports your company has per user is an important metric, considering it dictates which phones you can purchase.

Since Switchvox is a standards-based, SIP-based server, you can choose any SIP-compliant VoIP phone available and register it with Switchvox. This allows for greater flexibility when choosing a phone. Phones may be selected for the user experience, pricing, and even administration. Switchvox makes phone provisioning easy by providing Phone Feature Packs, which support **Polycom** and **snom** phones.

Only 1	Usually 2	Many Available
<p>If your company only has one switchport or network LAN port per user, you will need to purchase phones that have an integrated switch (as shown). There are many models on the market that support a range of features. Some have gigabit or 100 Mbps switches, and you'll want to be sure to get the right phone to fit your network.</p>	<p>If you can offer your users a separate switchport for their phone, it will make administration easier. Connecting a computer into a phone can sometimes be counter-intuitive. 2-ports per user will offer your phone a bit more reliability. Also, you can go with relatively inexpensive 100 Mbps phones, or single port phones, rather than making a costly move to gigabit phones for a gigabit network.</p>	



*Example of an IP phone with a built-in switch.*



### What is a Phone Feature Pack?

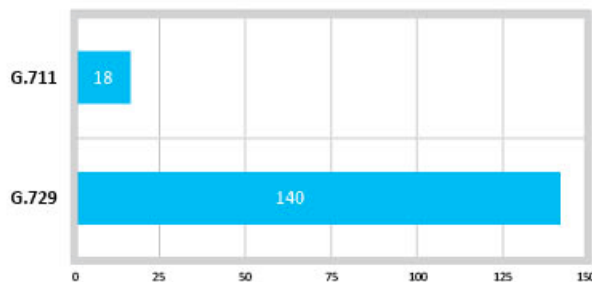
In Switchvox, we've integrated a specifically designed DHCP server that responds to auto-provisioning requests from Polycom and snom phones. The DHCP server in Switchvox will not interfere with any other existing DHCP servers. It is designed to tell Polycom and snom phones where to find Switchvox. The Phone Feature Pack allows the administrator to configure their entire phone network without being required to type in a phone's MAC Address. In addition, the Phone Feature Packs provide you with some feature integration with Switchvox's online applications.

## What Kind of Internet Connection Do You Have?

Your Internet connection will play a significant role in the type of Service Provider you partner with for your phone service. If you plan to use VoIP, you'll want to have a high upload speed or broadband service, which is not common on the basic, low-end Internet service. If you plan to use analog or PRI (Primary Rate ISDN) circuits, then this will not be an issue for you.

*(Note: If you have Cable/DSL in a remote site, you will only be able to support a few users at that location.)*

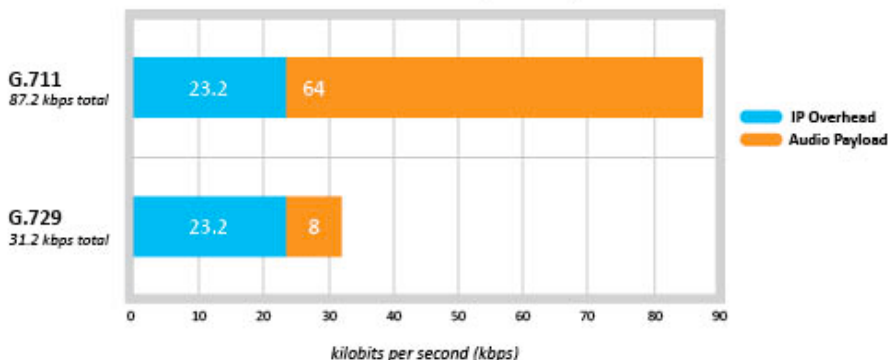
Call Density on 1.5 Mbps Connection



Approximate number of simultaneous calls (using IAX2 trunks)

Consumer Class	Limited Managed	Fully Managed
<p>If you only have a few users, Cable/DSL might be perfect. The issue with Cable/DSL lines is that their upstream datarate or upload speed can be slow. Commonly, DSL circuits offer 512Kbps for the upload bandwidth, supporting only 1-2 calls simultaneously. These services are typically asynchronous, offering slower upload connections than download connections. Cable can be more forgiving, but since you are sharing your Internet connection with other neighboring users or businesses, bandwidth can degrade at peak usage times. We recommend testing your Internet connection before committing to using it for all of your calls. If you can only get one or two calls through with good audio quality, you'll want to upgrade to a higher speed, or order a direct or dedicated PSTN connection.</p>	<p>With a T1 or similar connection, you will have a synchronous upload and download rate. What this means is, you can upload with the same throughput as you can on the download. For example, a T1 is 1.5Mbps, regardless of the upload or download direction. Depending on the codec you use, a T1 may be sufficient for both your data and voice traffic. Be careful though: if your data traffic requires more bandwidth or is queued up before your voice traffic, then you may run into audio quality issues.</p>	<p>When your company selects a Metro-E/MPLS type of Internet connection, you typically will not experience voice quality issues. Metro Ethernet circuits can exceed 2 Mbps and may even support 10Mbps or Gigabit services. You will want to ensure that your Metro-E/MPLS network is capable of some level of QoS, so that significant data transfers do not monopolize any inter-site voice traffic.</p>

Network Bandwidth Required per Call



## Do You Have Any Remote Users?

Having remote users can sometimes cause unforeseen issues with your internal network. For example, if you have a slower Internet connection, your remote users might cause audio quality issues on calls through the Internet. Increasing your available bandwidth, or decreasing the bandwidth required for each call can fix this.

It is typically much easier to reduce the bandwidth of a call than to increase your available bandwidth. You will do this by replacing the default codec of your remote users and your SIP provider with a low-bandwidth codec like G.729.

### What is G.729?

G.729 is a Low-Bandwidth Codec. This means that a G.729 call will take up a fraction of the bandwidth required to make a standard call.

No Remote Users	A Few Remote Users	Many Remote Users
<p>Since you won't have any remote users, the only Internet-based calls you will need to worry about are if you are using a SIP provider of any kind. If you are, you may want to look into use G.729.</p>	<p>With a few remote users and a good Internet connection, you won't have much trouble with calls that occur over your internet connection. You might consider using a VPN for access, but that is not strictly necessary as long as your Switchvox has a publicly accessible IP Address or hostname. If your audio quality sounds good with the default codec, you won't need to use G.729 yet.</p>	<p>As the number of remote users increases, you will want to bring a VPN service online, and activate more G.729 on your network. This will be strictly a function of how big your Internet connection is, and how many calls you want to successfully make.</p>

## What's the Next Step to Getting My Network Ready?

Now, you have determined that your network is ready for Unified Communications. You've addressed the networking hardware, voice quality settings, and invested in phones and other technologies that will make the most of your available bandwidth. You need a UC solution that will work with any phone, all types of networking services as well as saves you money and provides all of the features for your business communications today and in the future.

If you've successfully addressed all of the networking considerations on the previous pages, your network is ready for Switchvox! It's now time to take the next step and implement Switchvox.

## Why Switchvox is the Right Solution:

### Saves You Money

Switchvox allows your business to place calls using traditional PSTN telephone lines or with VoIP, saving you up to 70 percent on your monthly phone bill. Out of the box, Switchvox is more affordable than proprietary systems that have fewer features! And, because we don't lock you in to specific service providers or equipment vendors for your phones, you can choose a solution that fits your needs and your budget. Switchvox puts you in control of the most important asset in your business - your voice.

### Grows With You

If you're like most businesses, you want a system that will easily accommodate future growth, without unexpected expenses. Scalability and advanced features are just what Switchvox provides. This family of appliances enables you to easily add new users and office locations as your business grows, without disrupting your current communication system. Plus, with the benefit of subscriptions, when new features are released, your system is always kept current. Updates are made server-side and all clients are updated at the same time.

### Many Products in One

Switchvox is more than just a business phone system, it is a complete Unified Communications solution that combines the power of many products into one. Complete with a conference bridge, chat/instant messaging server and fax server, you can easily consolidate some of your office activities and save more money in the process.

### Easy to Manage

An intuitive point-and-click interface allows you to manage every aspect of Switchvox from anywhere you have internet access. Empower your employees to manage their own find me, follow me and voicemail boxes. You can easily know the "who, what, when, and where" of your business calls using Switchvox's extensive features, including the integration of caller ID, distinctive ringtones and call history.

## Which Switchvox Appliance is Right for You?

Switchvox is available in three editions; HOME, SOHO, and SMB. Switchvox SMB comes with all the features, SOHO is pared down to have a limited feature set suitable for some very small offices and HOME is suitable for some home offices.



	Switchvox 65 with 10 Silver Subscriptions	Switchvox 305 with 10 Silver Subscriptions	Switchvox 355 with 10 Silver Subscriptions
<b>Ideal For:</b>	Offices that don't have a computer rack and need the space-savings of a small platform	Medium-sized businesses with a computer rack or shelf space that want the power of a server-class UC system	Medium to large businesses that want a high-performance, highly redundant, full-featured rackmount UC system
<b>Users / Calls:</b>	Supports 1 to 30 users Up to 12 concurrent calls	Supports 1 to 150 users Up to 45 concurrent calls	Supports 1 to 400 users Up to 75 concurrent calls
<b>Expansion Slots:</b>	Two	Three	Three
<b>Recording / Conferencing:</b>	Up to 5 concurrent recorded calls Up to 5 simultaneous conference users	Up to 10 concurrent recorded calls Up to 15 simultaneous conference users	Up to 20 concurrent recorded calls Up to 30 simultaneous conference users
<b>Redundancy / Failover:</b>	Cold Spare Available	Cold Spare Available	RAID Controller with mirrored drives Redundant Power Supplies Cold Spare Available
<b>Subscription Options:</b>	Silver Subscription Plan Gold Subscription Plan Platinum Subscription Plan	Silver Subscription Plan Gold Subscription Plan Platinum Subscription Plan	Silver Subscription Plan Gold Subscription Plan Platinum Subscription Plan
<b>Warranty Options:</b>	Standard 1 Year Warranty 3 Year Extended Warranty 5 Year Extended Warranty	Standard 1 Year Warranty 3 Year Extended Warranty 5 Year Extended Warranty	Standard 1 Year Warranty 3 Year Extended Warranty 5 Year Extended Warranty

The screenshot displays the Digium Switchboard interface with several active windows:

- Current Calls:** Shows a call from Digium (+2564281234) on hold and another from Dave Miller (+1021) active. It also lists an inactive line.
- Parking Lot:** A table showing parked calls with columns for Caller, Parked By, and Park Duration.
- Directory:** A search interface for SIP extensions, listing names like Stephan Christopher and Stephanie Adams.
- Phonebook:** A list of contacts including Dave Miller, John Smith, Jane Doeann, and others, with options to add or edit entries.
- Salesforce:** A window showing a contact record for John Smith, including office and home phone numbers and a last note.
- Customer Support 'MRT':** A table showing call queue information, including member names, call duration, and status.
- Chat:** A chat window for Dave Miller with a message from Jane Doeann: "Hello Dave. Can you join me on a call? I'm talking to a customer who needs our Premier package." and a response from Dave Miller: "Sure Jane. Bring me on." followed by Jane Doeann: "Calling you now."
- Google Lookup:** A search window showing results for "Digium" and "The Asterisk Company".

Digium continues to win awards for this Unified Communications system. CRN listed it as one of its 25 Products to Watch and named it a Tech Innovator award winner in the VoIP category.



There are many powerful options to choose from in the Switchboard interface. Do you want to record calls? Do you want to integrate with Salesforce or create web mashups with Google Maps? All of that is possible, with just a few clicks of your mouse.

We can simplify phone system challenges for businesses just like yours. Thousands of small businesses have already recognized the benefits of this powerful, yet affordable solution.



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