



3CX **PHONE SYSTEM**

**Network Preparation
and Troubleshooting
Guide**

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Introduction

Congratulations!

on selecting 3CX Phone System for your business, and thank you for choosing us to host and support it.

As the leading IP telephone system in the marketplace that continues to win industry awards, your business is about to experience a transformation in how it communicates, where it communicates from and how to get the comms information it needs to grow and adapt.

This document will be your preparation and troubleshooting guide to ensure your local network, firewall and internet connection are ready to support 3CX and the troubleshooting steps you need to follow, if you experience any issues.



Prepare Your Local Network

If your 3CX phone calls will share the same local network and internet connection as your other business internet traffic, it's essential to prepare your local network, to ensure your voice traffic is protected and prioritised. If you don't make these preparations before your 3CX system goes live, you risk impacting the quality of your business communications.

Ports Used by 3CX

The table below outlines the main TCP and UDP ports used by 3CX Phone System. You don't need to forward these ports when connecting to a hosted system, but if you restrict outbound traffic on your firewall you need to ensure these ports are allowed. If your company security policies require it, you can lock them down to your phone systems address (FQDN), e.g. `companyname.3cx.co.uk`.

PROTOCOL	PORT (DEFAULT)	DESCRIPTION
TCP	443	HTTPs port of 3CX Web Server
UDP & TCP	5060	3CX Phone System (SIP)
TCP	5061	3CX Phone System (SecureSIP) TLS
UDP & TCP	5090	3CX Tunnel Protocol Service Listener
UDP	9000-10999 (default)	3CX Media Server (RTP) – WAN audio/video/t38 streams
TCP	443	3CX WebMeeting Audio and Video. Not to be opened on the PBX. Must be opened on the network on which the webmeetings will take place
UDP	33434-33625	PingPlotter monitoring agent for troubleshooting



Internet Connection

The quality of your internet connection and the available bandwidth that connection has, will greatly impact the quality of your voice calls. Not all internet service providers (ISPs) have the network design that's needed to consistently deliver low-latency voice. For example, smaller ISPs that are growing, might not have the bandwidth to handle customer loads during peak usage hours, so it's important to choose an established business internet provider that can consistently guarantee low latencies across their network.

Take Action - talk to your ISP

Before your 3CX system goes live, ask your ISP for their IP Service Level Agreements (SLAs) in relation to: Delay, Jitter, and Packet loss and the processes they follow to maintain these service levels. If they are unable to provide you with this information there's a risk your business may experience intermittent call quality issues when making

calls across their network. Talk to us if this turns out to be the case and we can help you to navigate this. If we supply your internet connection you don't need to do anything, as we guarantee high quality voice calls at all times across our business internet services.



Firewalls, Switches, Access Points and VLANs

Your firewall, switches and wireless access points, need to be configured to prioritise your calls based on the 3CX ports outlined in the table above, or through a dedicated voice VLAN. We don't recommend reserving bandwidth as not all devices support this and it's much harder to check that it's actually working. This guide focuses on the VoIP element only, but it's important your business has an integrated policy to manage QoS and this [Cisco best practice white paper](#) for configuring Quality of Service (QoS) goes into more detail.

Take Action - configure your office network

Configure all of the devices on your network involved in handling your voice traffic, so that they prioritise the 3CX ports outlined in the table above, or via a dedicated voice vlan that your IP phones reside in, as Expedited Forwarding (EF). On most firewalls, switches and access points this will be configured as DSCP 46, with a Class of Service (COS) or IP Precedence of 5. If your devices support it, another option would be to use the source/destination address of your 3CX system, e.g., `companyname.3cx.co.uk`, instead of the individual ports.

Once these changes have been made, it's essential you check that they have been applied correctly and work across your entire network. To do this take a packet capture on each of your network devices involved in routing your voice traffic, while a test call is being made. With a test call running while you capture your network traffic you will then be able to check the 'Differentiated Services Field' in any voice packet within the capture and make sure Expedited Forwarding has been applied correctly.



Wi-Fi

If your devices are connecting to your local network and internet connection via WiFi, it's important to bear in mind that voice traffic (UDP packets) is more susceptible to network conditions than general internet browsing (TCP packets). For example if a web page doesn't load as quickly because some of the TCP packets are dropped across the WiFi connection, the impact is minimal. But with voice packet loss and latency across a WiFi connection can significantly degrade the quality of your calls.

Take Action

If the majority of your devices involved in making calls connect via WiFi, it's essential to carry out a survey of your network and its surrounding environment, using a tool like AirMagnet to ensure it's optimised to support your voice calls.



Devices

The flexibility of IP phone systems like 3CX can save businesses a huge amount money by leveraging existing devices to make calls from, using the 3CX clients and apps. This is great from a money saving perspective, but it does present some other challenges for IT managers, as call quality can be greatly affected by the health of the device the call is being made from. Yes, believe it not, hundreds of open Chrome tabs can affect the speed of your computer!

Take Action

If you plan to use the 3CX Web or Desktop clients on your company devices to make calls, it's important to have a monitoring agent on each device that provides you with information on CPU, RAM and disk usage. We recommend doing this before your 3CX system goes live, so that you can identify any devices that may be running out of system resources. This will also be useful in the future to identify if device performance is causing call quality to degrade for individual users.



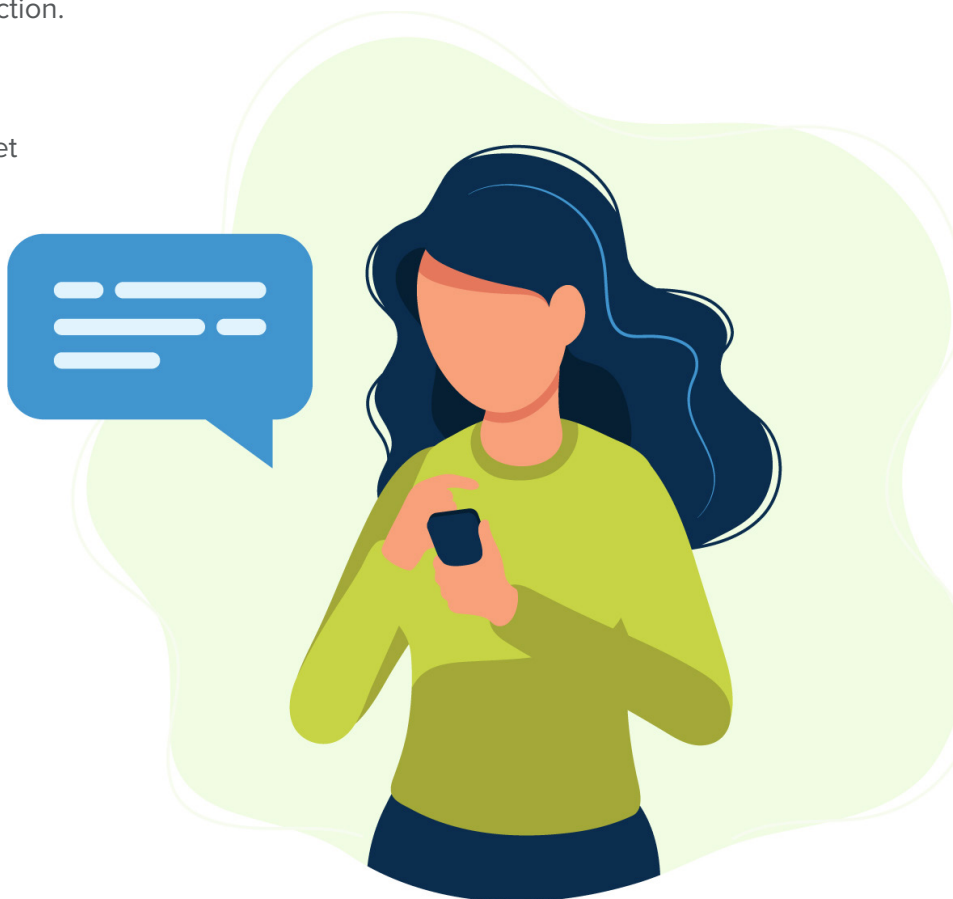
Call Quality Choices

Good quality calls with an accepted level of risk

If you have followed the previous steps and configured your network for Quality of Service (QoS), your WiFi is optimized, the following options should provide you with a good quality voice experience most of the time:

- 3CX Web Client or 3CX iOS and Android mobile apps.
- G.729 voice codec priority.
- Strong wireless network connection.
- Sennheiser Bluetooth headset.
- Standard FTTC business internet connection.

It's very difficult to control the quality of a 4G connection so we don't list it here. Sometimes the connection can be great, sometimes not, so it has to be driven by your attitude to risk. We recommend advising your end users that they can use a 4G connection, but it's at their own risk and you won't be able to troubleshoot call quality issues if they arise.



Better quality calls within a more controlled environment

If your business needs a more consistent call quality experience, whilst still remaining flexible and keeping hardware costs down, this option is the best middle ground:

- 3CX Desktop Client for Windows or 3CX Web Client.
- G.711 voice codec priority.
- Local network Quality of Service (QoS) is configured to prioritise 3CX voice traffic and has been tested end-to-end across your network.
- Resource optimised end user devices.



- Wired network connection or professionally installed and optimised WiFi network that's monitored and supported
- Sennheiser USB headsets.
- 1:1 fibre internet connection or leased line with a service level agreement (SLA) that guarantees low latency, jitter and packet loss.

Best call quality no matter what happens

If your business has to have the best call quality experience, no matter what happens, this is what's needed:

- Yealink High-Definition Voice IP handsets
- G.711 or G.722 voice codec priority

- Dedicated switches or a voice VLAN that prioritises all 3CX voice traffic across your local network and internet connection
- 1:1 fibre internet connection or leased line with a service level agreement (SLA) that guarantees low latency, jitter and packet loss. Or a dedicated private connection directly into your 3CX hosting providers data centre.
- A private interconnect from your 3CX hosting provider to your SIP trunk providers network, so your calls don't traverse the general internet.



Troubleshooting

If you have followed the above steps to prepare your local network and Internet connection for 3CX and you're still experiencing call quality issues, you can use our troubleshooting steps below to identify the cause and help you resolve it.

1 Choose a Windows or macOS device on your network that you can leave powered on for a couple of weeks. If you are using a web or desktop client with your 3CX service, it's best to install the PingPlotter agent on one of the end user devices that's reported an issue with call quality.

2 Download and install a 14 day free trial of PingPlotter here:
<https://pingplotter.com/download>

3 Once installed open PingPlotter and in the 'Enter target name or IP' box, put the IP address or domain name of your 3CX service. Leave all of the other settings as default and click the green play button to start tracing.

Now that a trace is running to your 3CX service, PingPlotter will start to measure the performance of every device along the path, from your test computer to your 3CX service. Each device is called a 'Hop' and is displayed in a row with its IP address, name along with its latency, jitter and packet loss results.

4 Ask your end users to record the date, time, telephone numbers involved and a description of any poor call quality calls they experience. Ask them to be as specific as possible in their description, e.g. popping, crackling, I couldn't hear them, they couldn't hear me etc, as this will help identify the problem.

5 When a poor quality call is reported scroll the timeline graph in PingPlotter to the date and time that the call occurred. You can change the timeframe of the graph to 24 hrs so it's easier to navigate. Then right click on the graph around the time of the call and select 10 minutes again. The graph is now showing you a live record of the 'network conditions' at exactly the time this call was made.

6 Interpreting the results. See our blog post: <https://zen.systems/voip-troubleshooting-guide> to learn how to interpret your PingPlotter results and how to resolve it.



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