

# Faxing Over IP Networks

Customer Tip

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# Preface

This guide is intended for network administrators, or service providers, with the responsibility for configuring settings within an IP network expected to provide telephony service to a Xerox fax device.

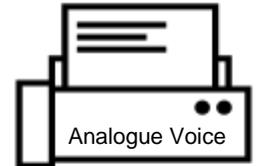
# Contents

<b>Preface .....</b>	<b>i</b>
<b>Communication Protocols .....</b>	<b>1</b>
What is Voice over IP (VoIP)? .....	1
What is Fax over VOIP (FoVoIP)? .....	1
What is Fax over IP (FoIP)? .....	1
What Fax Protocol does Xerox Use? .....	1
<b>Quality of Service Requirements.....</b>	<b>2</b>
What is Quality of Service? .....	2
What are Network Impairments? .....	2
What Service Level is Required for Fax?.....	2
Recommended Network Configuration Settings .....	3
<b>Network Setups .....</b>	<b>4</b>
IP Exchanges, Access Devices and Terminal Adapters .....	4
Providers & Protocols.....	4

# Communication Protocols

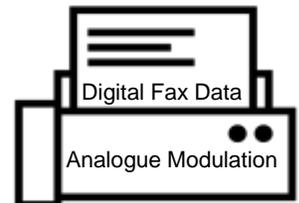
## What is Voice over IP (VoIP)?

Internet Protocol (IP) networks carry data in a digital packet format. Voice signals must be encoded into this digital format before being transmitted over IP. This encoding also compresses the data to reduce the load (bandwidth) on the network. This function is provided by an access device that supplies the conversion interface.



## What is Fax over VOIP (FoVoIP)?

FoVoIP is often called Fax Pass-through. The fax is connected to the VoIP interface on the network and is treated like a standard voice call. The analogue fax signals are encoded into a digital format, just as for a voice call. The voice encoding compression severely limits the fax speed, and network quality issues that are acceptable to voice calls usually cause the fax to fail.



## What is Fax over IP (FoIP)?

FoIP is sometimes called Fax Relay. In FoIP, the fax data is sent in its raw digital form across the IP network. As with all IP data, it is divided into a packet structure. Because the fax data is in its raw state it uses less bandwidth and can employ redundancy (data duplication) or Forward Error Correction to improve reliability. Sometimes the fax data rate is reduced to further limit bandwidth usage. It is thus normal for the fax performance to be degraded and SuperG3 not supported. There are proprietary versions (e.g. Cisco) but the cross-vendor standard from the International Telecommunications Union is called T.38. For additional information refer to: <https://en.wikipedia.org/wiki/T.38>.

It is possible to configure the Xerox devices for FoIP operation using an IP terminal interface. This interface recognizes the signals from the fax machine and decodes them back to the raw fax data, in real time. A similar interface may be required at the other end of the communication. The interface must also convert fax data received from the network back into analogue signals that the machine will understand. To ensure successful faxing, it is important that all network elements are configured correctly.

## What Fax Protocol does Xerox Use?

The fax module is capable of standard G3 (v.17) fax operation (maximum data rate 14400 bps) or Super G3 (v.34) fax (maximum data rate 33600 bps). It is designed to connect to analogue telephone lines that carry audible frequencies (i.e. speech). Fax data is converted into audible signals for transmission through the Public switched telephone network using a modem.

Please refer to the Customer Expectation Document, for the desired product to determine if the Xerox product you are using supports this functionality. Please note that for certain Xerox products a separate Fax Kit needs to be purchased to support this functionality.

# Quality of Service Requirements

## What is Quality of Service?

Quality of Service (QoS) is a prioritized or guaranteed level of service for a particular network user or application (e.g. VoIP or FoIP). QoS places demands on characteristics such as available bandwidth and the level of network impairments. Network impairments can sometimes be controlled by Service Level Agreements with private network providers but are generally impossible to control over public internet-wide communications. For this reason, fax communications across the internet are not recommended. Bandwidth and communications protocols, such as FoIP, can be more easily managed by the end to end capabilities (and configuration) of the network interfaces.

## What are Network Impairments?

Data in an IP network is divided up into packets. As each packet of data moves through the network it can be subject to various impairments that can affect some, all, or none of the packets at any given time.

**Packet Loss:** This is the most serious impairment and means that the data stream cannot be fully recombined at the other end. FoVoIP is very sensitive to this and a small level can often lead to failure. If FoIP is configured with redundancy, relatively large levels of loss can be accepted.

**Packet Delay:** Some delay in the packet stream is unavoidable; the level will depend on the length of the network path and the level of congestion within the network. Again, FoVoIP is sensitive to this, since the underlying fax protocol has strict timing requirements. FoIP uses methods to work around this, avoiding failure of the fax communication.

**Packet Jitter:** Jitter is a variation of delay between packets. Above a certain level the affected packet(s) will be considered lost and FoVoIP audio will be broken, resulting in fax failure. FoIP reliability will be better due to lower bandwidth demands against the buffer memory available.

## What Service Level is Required for Fax?

This table gives an approximate guide to the maximum levels of impairments that can be present and still support a successful fax call between supported products, for each configuration of VoIP/FoIP service used:

Telephony/Fax Service	Bandwidth	Loss	Delay	Jitter
G.729 Pass-through → G.711*	84 Kbps‡	0.01%	500 ms	50 ms
G.711 Pass-through	84 Kbps‡	0.10%	300 ms	30 ms
Cisco Fax Relay (7200 or 14400)†	55 Kbps‡	0.50%	500 ms	25 ms
T.38 (no redundancy; ls & hs=0)†	25 Kbps‡	0.30%	100 ms	10 ms
T.38 (redundancy; ls=5, hs=2)†	52 Kbps‡	10%	800 ms	50 ms

† Voice codec configuration: G729

‡ Bandwidth measured during image data at a fax rate of 14400 bps.

\* With "Upspeed" (G.729→G.711) Note: If a pure G.729 channel is used, the fax call is likely to fail.

## Recommended Network Configuration Settings

It is **recommended that for reliable faxing the network should be configured for T.38 with redundancy.**

However, some network setups may not support it; those that do may fix the redundancy at a set level. For instance, with a Cisco IOS configuration, this is set in the dial-peers with the command below. It is not recommended to disable fax Error Correct Mode (ECM), since any quoted improvements are questionable and not guaranteed.

```
fax protocol t38 ls-redundancy 5 hs-redundancy 2
```

# Network Setups

## IP Exchanges, Access Devices and Terminal Adapters

For some installations, it may not be appropriate to provide VoIP access by using a full-scale IP exchange (IP PBX). In these cases, multi-port access devices can provide a more localized service. For small or unusual network setups an Analogue Terminal Adapter (ATA) provides ultimate flexibility on a per machine basis. Many include two phone ports allowing connection of two fax machines, or one machine and one phone. Each ATA connects to an existing network point and so is convenient where phone points are not available.

IP PBXs usually provide a centralized configuration utility. But each access device or ATA must be set up individually and are generally configured to work with a VoIP registry/gatekeeper or service provider.

Accurate and consistent configuration across the network is very important – the wrong configuration is often the cause of fax failure.

## Providers & Protocols

Service providers and registry/gatekeeper servers supply directory services (called number to IP address translation), call initiation, handling and sometimes other telephony features, such as voicemail. ATAs and other access devices communicate with these servers using standardized protocols, the most common of which are SIP and H.323. Each access device and registrar/gatekeeper must understand (and be configured for) the same protocol, as must any two end-point devices trying to initiate a fax call. For example, all parties must support SIP (or H.323) and T.38 to achieve the recommended FoIP service.