



ReplixFax Fax over IP (FoIP)
Technical Overview and Benefits

Table of Contents

INTRODUCTION.....	3
HOW FAX OVER IP (FOIP) WORKS	3
FAX PROTOCOLS FOR FOIP	3
TRADITIONAL FAX SERVER VS. FOIP FAX SERVER.....	5
IMPLEMENTING FAX OVER IP	7
BENEFITS OF FAX OVER IP (FOIP)	7
COST SAVINGS	8
CONSOLIDATION	8
EASE OF DEPLOYMENT AND SUPPORT.....	8
REPLIXFAX FAX OVER IP (FOIP) SYSTEM.....	8
REPLIXFAX ENTERPRISE FAX SERVER	8
REPLIXFAX SUPPORT OF FAX OVER IP (FOIP)	9
REPLIXFAX FAX OVER IP (FOIP) INTEROPERABILITY	11
REPLIXFAX FAX SERVER CLUSTERING AND SERVER VIRTUALIZATION.....	14
BENEFITS OF REPLIXFAX FAX OVER IP SOLUTION.....	17

Introduction

As more organizations migrate to Voice over IP (VoIP) infrastructure, it becomes evident that electronic fax service leveraging their VoIP network infrastructure can reduce traditional telephony hardware and consolidate the management of voice, fax and data communications on a single network.

In this white paper we describe how Fax over IP (FoIP) works, the benefits of FoIP, and key features of the Softlinx' ReplixFax FoIP solution for a robust and scalable Fax over IP service deployment.

How Fax over IP (FoIP) works

Increasingly organizations are migrating from a circuit-switched voice network to a Voice over IP (VoIP) network infrastructure. By leveraging the VoIP network for IP fax service, organizations can save costs and achieve better utilization of network equipment resources to improve their overall return on investment (ROI) on the VoIP implementation.

Fax Protocols for FoIP

There are two ITU recommendations which address sending faxes over IP networks. T.37 specifies a method of encapsulating fax images in e-mails, and transporting them to the recipient in a store-and-forward manner. T.38 specifies a protocol for transmitting a fax across an IP network in real time.

Fax protocols, T.30 in particular, were designed for the Public Switched Telephone Network (PSTN). The PSTN is very different from a packet data network like the Internet. It offers very strict timing; latency is rock steady throughout a call; and latency is seldom very high. The lack of these features in packet data networks tends to spoil the quality of voice over IP, compared to voice over the PSTN. However, it can totally destroy modem data, like that used for fax. Jitter and packet loss can cause modem reception to fail, and excessive delays can cause timers designed for a low latency environment to

expire. T.38 tries to mitigate these factors, and can greatly improve the reliability of faxing across the internet. It can also send faxes using less bandwidth than using VoIP protocols. There are limits to what can be achieved on a congested network, though, and T.38 can never offer the reliability of a store and forward protocol, like T.37.

The T.38 protocol primarily operates between Internet-aware fax terminals, which connect directly to an IP network, and fax gateways, which allow traditional PSTN fax terminals to communicate via the Internet. T.38 is the only standardized protocol which exists for real-time FoIP. Reliably transporting a fax between PSTN fax terminals, through an IP network, requires use of the T.38 protocol at fax gateways. The T.38 protocol is designed to preserve the traditional fax experience and ensure that faxes are successfully sent and received in real-time as a point to point communication.

Figure 1 below shows an example of a Fax over IP network consisting of a T.38 FoIP fax server, T.38 fax gateway (also denoted as media gateway or integrated services router) and a PSTN fax machine. The T.38 fax gateway acts as a bidirectional bridge between the PSTN and IP networks. On the internal IP network, the T.38 fax gateway sends and receives T.30 data wrapped in T.38 packets, while externally it sends and receives T.30 fax signaling over the PSTN.

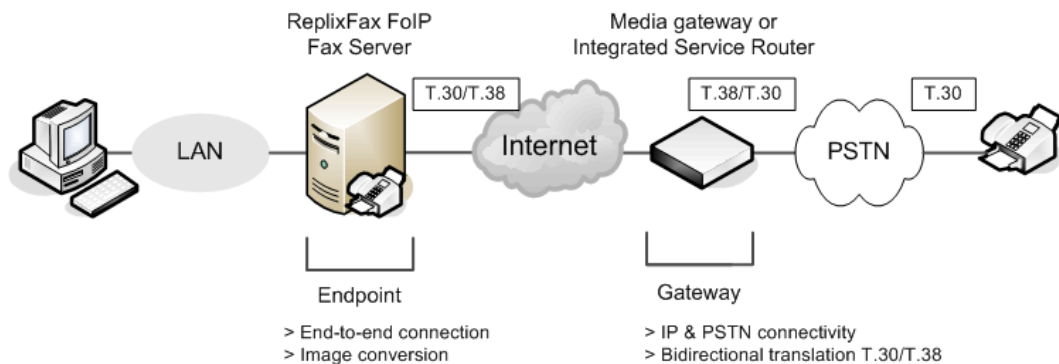


Figure 1. Fax over IP Connectivity

The T.38 FoIP fax server is connected to an IP network and transmits the T.30 protocol and fax image data using T.38 packets over the IP network to the receiving T.38 fax gateway. The receiving T.38 fax gateway, in turn,

translates the T.38 packets and repackages them into T.30 protocol signals and transfers them to the receiving fax machine. The receiving fax machine has a T.30 protocol engine that communicates with the T.30 protocol engine in the fax server through the T.38 fax gateway.

Gateway-to-gateway scenarios are also possible where two fax machines communicate via two gateways. In that case the T.30 protocol engines in the two fax machines are transported across the packet data network using T.38.

Traditional Fax Server vs. FoIP Fax Server

Figure 2 shows a traditional fax server connected to a PBX. The fax server includes fax modem boards that connect directly to the Public Switched Telephone Network (PSTN) through a local PBX. The fax server sends and receives faxes over the phone network to remote fax machines.

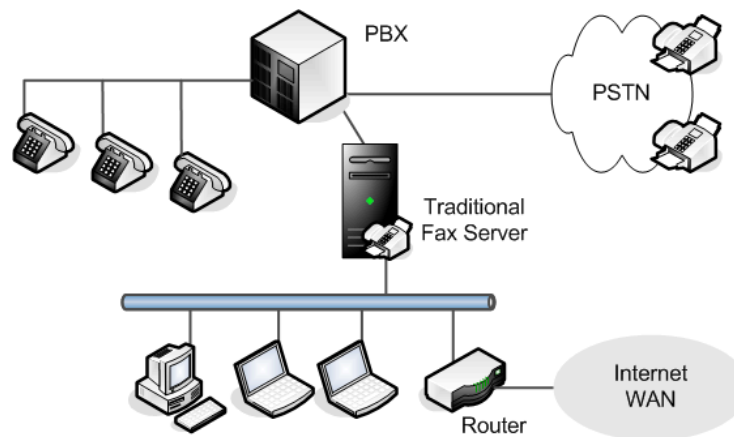


Figure 2. Traditional Fax Server Configuration with PBX

In multi-location enterprise fax deployments, remote offices often install a fax server component to bypass the long distance telephone charges. This is possible if the central office fax server can communicate with the remote fax server component over the Internet or a company WAN.

Prior to the adoption of real time Fax over IP (FoIP), Softlinx' ReplixFax system used this technique in a store-and-forward manner for over a decade to bypass long distance toll charges. The central fax server forwards a fax to a remote fax modem gateway, which dials out to a local number to deliver the

fax to a receiving fax device. Similarly, the incoming faxes are forwarded to the central fax server for central administration and configuration. However this method of least cost routing (LCR) has a drawback of having to install remote fax modem gateways at each of the remote office locations to enable the toll bypass.

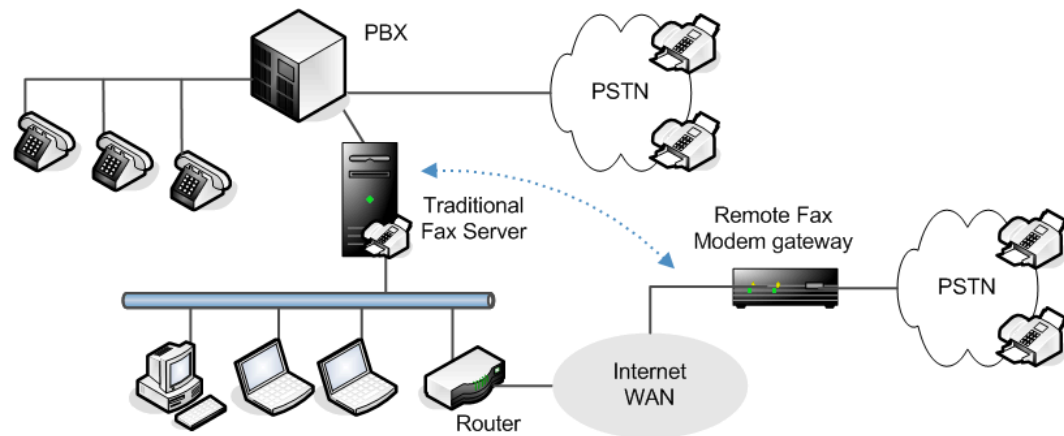


Figure 3. Traditional Fax Server with Remote Office Faxing

In a Voice over IP network, each IP end-point at remote offices is already equipped with a media gateway. An IP Fax Server such as ReplixFax FoIP fax server creates a fax using T.30 protocol and directly connects to a media gateway to transmit the fax using the T.38 packets over the IP network. The media gateway then repackages the T.38 packets into T.30 fax signals and delivers them to a terminating fax machine.

Figure 4 shows an IP fax server configuration with media gateways installed on the company's IP network.

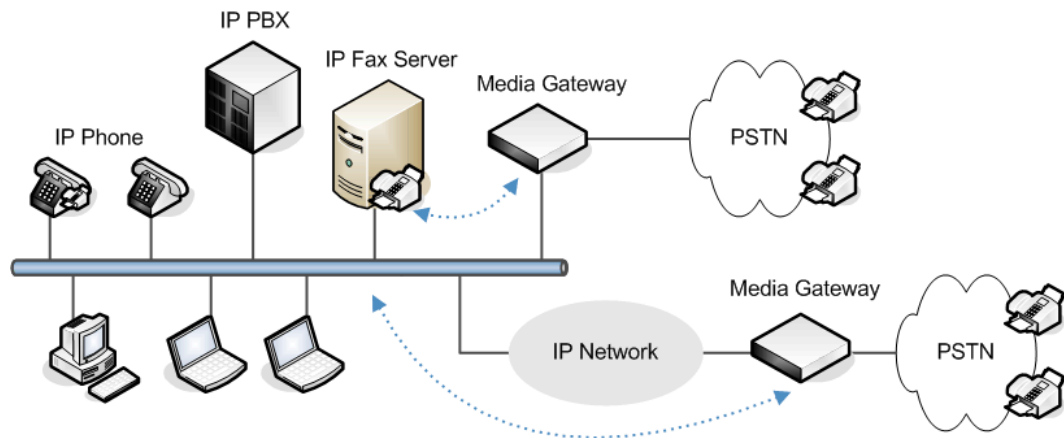


Figure 4. IP Fax Server Configuration over an IP network

Implementing Fax over IP

Implementation of Fax over IP requires a T.38 enabled fax server. T.38 support for an IP fax server is available from a class of intelligent fax boards such as Dialogic® Brooktrout® TR1034 or software-only solution such as Dialogic® Brooktrout® SR140 fax software. Softlinx' ReplixFax fax server supports both options. In either configuration, the ReplixFax fax server communicates with network equipment such as IP PBX, routers or media gateways that support T.38 Fax over IP protocols and SIP or H.323 call control.

Implementation of FoIP across the enterprise requires a VoIP network implementation, and proper configuration of media gateways, for T.38 support. Note that T.38 support may not be necessarily a default feature of the VoIP implementation.

Benefits of Fax over IP (FoIP)

Key benefits of implementing FoIP are summarized below.

Cost Savings

- Elimination of long-distance phone charges by driving long distance fax traffic over IP
- Reduced annual PBX maintenance and phone line costs by eliminating the need to maintain analog fax ports on PBX

Consolidation

- Reduced system management overhead with a single centralized fax system for the entire organization
- Better utilization of centralized fax server capacity and resources to support all remote locations
- Reduced network management overhead through consolidation of voice, fax and data on a single network

Ease of Deployment and Support

- Ability to provide fast, consistent IP fax services throughout the entire organization
- Ease of re-hosting FoIP software licenses on a new server, or disaster recovery configuration via server virtualization
- Elimination of fax hardware dependency or need to keep back-up fax boards (only applicable to software-only FoIP implementation)

ReplixFax Fax over IP (FoIP) System

ReplixFax Enterprise Fax Server

ReplixFax fax server is a comprehensive network fax solution for sending, receiving, and managing business fax communications over IP and PSTN networks. The Replix Enterprise Fax messaging architecture is a three-tier,

distributed system, where each of the three distinct layers – Client, Server and Gateway – is self-contained and interfaces with the adjacent layer over IP.

Shown below is a diagram of ReplixFax three-tier distributed architecture.

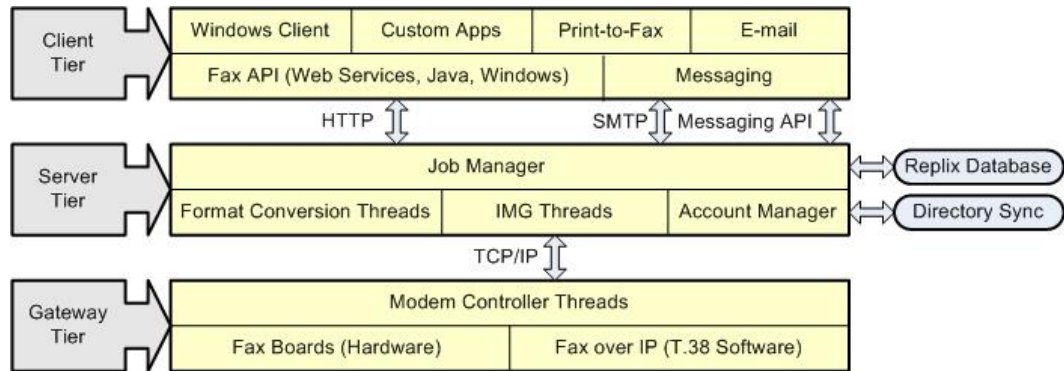


Figure 5. ReplixFax Three-tier Architecture

The ReplixFax fax system features an intuitive design and makes faxing as easy as printing to a network printer or sending an email to a fax destination, and offers a scalable platform with centralized user administration and system configuration capabilities via a standard web interface. In addition comprehensive Web Services APIs allow any business application to be enabled with electronic faxing capability for automated faxing from within applications.

Its scalable architecture, high availability, comprehensive integration toolkits and API's, directory and network management features satisfy both large-scale enterprise fax implementation requirements of multinational corporations and high volume production faxing needs of business application users.

ReplixFax Support of Fax over IP (FoIP)

The ReplixFax fax server supports FoIP via two configuration options—either a Dialogic Brooktrout TR1034 fax board or a software-only solution using Dialogic Brooktrout SR140 software license.

Dialogic Brooktrout SR140 software license

The Dialogic Brooktrout SR140 Fax Software provides Fax over IP (FoIP) capabilities for integrating fax servers and fax document management solutions with VoIP networks. Brooktrout SR140 can achieve the same high level of performance, reliability, and scalability as Brooktrout fax boards.

The Brooktrout SR140 can be deployed in SIP, H.323, and MGCP environments and provides native SIP and H.323 support. It has been successfully tested for interoperability with IP PBX and VoIP gateways from a number of leading vendors, is suitable for a variety of network-based fax applications, and can be integrated with document management and business process automation systems to support compliance with regulations such as Sarbanes-Oxley, HIPAA, and Basel II.

The Brooktrout SR140 is available in densities ranging from 2 to 60 channels and can support up to 120 ports in a single server.

Note that currently Brooktrout SR140 is available for Microsoft Windows and Linux OS server platforms only.

Dialogic Brooktrout TR1034 fax board

The Dialogic Brooktrout TR1034 fax board is a high-performance, intelligent board that offers both TDM-based and IP-based fax capabilities. The Brooktrout TR1034 is suitable for a variety of network-based fax applications and can be integrated with document management and business process automation systems to support compliance with regulations such as Sarbanes-Oxley, HIPAA, and Basel II.

As companies move to VoIP network, the versatile Brooktrout TR1034 can provide an easy migration path from traditional TDM-based fax systems to hybrid and all-IP fax systems. In addition, Dialogic works with leading IP PBX and gateway vendors to ensure fax interoperability.

The Brooktrout TR1034 delivers call completion at fast connection rates with field-proven reliability across a wide variety of fax machines and line conditions.

Note that Brooktrout TR1034 can run on several OS platforms including Microsoft Windows, Sun Solaris and Red Hat Linux.

ReplixFax Fax over IP (FoIP) Interoperability

ReplixFax T.38 FoIP solution interoperates with a number of IP PBXs, media gateways and integrated service routers. The Dialogic Brooktrout TR1034 and SR140 products are compliant with the T.38, SIP, and H.323 industry standards. They will interoperate with equipment which properly adheres to these standards.

Below is a list of vendors and their respective equipment which have been successfully tested and certified for Dialogic Brooktrout TR1034 and SR140. Any of these vendors' equipment will work with the ReplixFax FoIP solution.

Vendor	Equipment
Cisco	<ul style="list-style-type: none"> • Cisco Unified Communication Manager (Cisco Unified CallManager) <ul style="list-style-type: none"> - SIP, H.323, & (MGCP via CallManager) - release 4.2.x or later • Cisco Integrated Services Router (IOS based gateways capable of supporting T.38) <ul style="list-style-type: none"> - SIP, H.323, & (MGCP via CallManager) - IOS version 12.3 or later - T.38 V.34 supported on IOS 15.1.1T or later • Cisco AS Universal Gateway Series (those capable of supporting T.38)^a <ul style="list-style-type: none"> - SIP, H.323, & (MGCP via CallManager) - IOS version 12.3 or later • Cisco High Performance Gatekeeper Series (H.323 IOS Gatekeepers) <ul style="list-style-type: none"> - H.323 - IOS version 12.3 or later • Cisco Unified Communications 500 Series for Small Business <ul style="list-style-type: none"> - SIP and H.323 - IOS version 12.4 or later • Cisco SPA2102-NA ATA <ul style="list-style-type: none"> - SIP - Software version 3.3.6 or later
	<p>Note: at the time of testing the maximum T.38 protocol supported by the Cisco SPA2102 ATA was V.17 (14,400 bits/sec); Error Correction Mode (ECM) was not supported</p>
	<ul style="list-style-type: none"> • Cisco Unified Border Element (CUBE) with Cisco 2911 <ul style="list-style-type: none"> - SIP - CUBE version 9.x or later - IOS version 15.2-3.T1 or later
Avaya	<ul style="list-style-type: none"> • Avaya IP Office <ul style="list-style-type: none"> - SIP

	<ul style="list-style-type: none"> - IP Office 500 hardware with VCM 32 (T.38 support) with the third-party SIP endpoint license - Release 6.0 or later - DevConnect Certified, Release 7.0 • Avaya Aura Communication Manager <ul style="list-style-type: none"> - H.323, SIP (CM release 5.0 or greater) - Release 3.01 (with update 628.6-11410) or later within the 3.x codeline. - Release 4.03 or later within the 4.x codeline. - Release 5.0 or later within the 5.x codeline - DevConnect Certified, Release 6.0.1 <p>Note: At time of testing, Communication Manager did not support Error Correction Mode (ECM)</p> <ul style="list-style-type: none"> • Avaya Media Gateway Series (those capable of supporting T.38) <ul style="list-style-type: none"> - H.323, SIP - Firmware version 26.31.0 or later
3Com	<ul style="list-style-type: none"> • 3Com VCX V7000 platform <ul style="list-style-type: none"> - SIP - Software version 9.0.7 or later • 3Com Media Gateway <ul style="list-style-type: none"> - SIP - Software version 4.40.211.387 or later
Aastra Technologies	<ul style="list-style-type: none"> • Ericsson MX-ONE Telephony System <ul style="list-style-type: none"> - SIP - Release V3.2 SP1 or later • The MX-ONE Telephony System includes: <ul style="list-style-type: none"> - Ericsson MX-ONE Manager Telephony System version 8.48.1 - Ericsson MX-ONE Telephony Server version 12.45.6 - Ericsson MX-ONE Media Gateway Classic version 1.4_5
Alcatel	<ul style="list-style-type: none"> • Alcatel OmniPCX Enterprise <ul style="list-style-type: none"> - SIP, H.323 - Release 7.1 or later - Certified with Release 9.1 • Alcatel OmniPCX Office (OXO) <ul style="list-style-type: none"> - SIP - Release 7.0 or later
AudioCodes	<ul style="list-style-type: none"> • Mediant <ul style="list-style-type: none"> - SIP (using UDP) - Software version 5.00A or later • MP-114 <ul style="list-style-type: none"> - SIP (using UDP) - Software version 5.60A or later
BroadSoft	<ul style="list-style-type: none"> • Achieved BroadSoft validation on BroadWorks Release 18.SP1 with Dialogic® Brooktrout® Fax Software SDK 6.5.2
Grandstream	<ul style="list-style-type: none"> • Grandstream HT-502 ATA <ul style="list-style-type: none"> - SIP - V1.1C or later • Grandstream GXW4024IP Analog Gateway <ul style="list-style-type: none"> - SIP

	<ul style="list-style-type: none"> - V0.4A or later
Linksys	<ul style="list-style-type: none"> • Linksys SPA 8000 Gateway <ul style="list-style-type: none"> - SIP - Software version 5.1.10 or later - Hardware version 1.0.0 or later
Mitel	<ul style="list-style-type: none"> • Mitel 3300 MXe <ul style="list-style-type: none"> - SIP - Mitel 3300 MXe controller software version 9.0.3.15 or later (SDK 6.3.4 or higher is required when using MXe controller software version 10) - Prerequisites: The DSP II module, T.38 licenses, and SIP trunk licenses must be installed and enabled
Multi-Tech	<ul style="list-style-type: none"> • MultiVoIP MVP210 <ul style="list-style-type: none"> - SIP - Multi-Tech MVP210 firmware version 6.11.27-07-Aug-09 or later
Nortel	<ul style="list-style-type: none"> • Nortel Communication Server 1000 Release 5.5 <ul style="list-style-type: none"> - SIP - Release 5.5 or later
Patton	<ul style="list-style-type: none"> • Patton 4960 PRI Gateway <ul style="list-style-type: none"> - SIP - R5.4 2009-07-20 or later • Patton 4554 BRI Gateway <ul style="list-style-type: none"> - SIP - R5.3 2009-05-20 or later
Quintum	<ul style="list-style-type: none"> • Quintum Tenor Series <ul style="list-style-type: none"> - SIP, H.323 - Release P104-12-10 or later
ShoreTel	<ul style="list-style-type: none"> • ShoreGear 220T1A Switch <ul style="list-style-type: none"> - SIP - Software Release 10, build 15.6.4207.0 (Controlled Release) - Software Release 11.1, build 16.23.5609.0 - Software Release 12.1, build 17.22.5240.0
	<p>Note: At time of testing, maximum T.38 speed supported was V.29; requires Dialogic SDK 6.2.3 or later</p>
Siemens	<ul style="list-style-type: none"> • HiPath 4000 <ul style="list-style-type: none"> - SIP - Release V6 R1.12.18 or later • HiPath 8000 <ul style="list-style-type: none"> - SIP - Release V3.0 R2 PS19.E05 or later • RG8702 Media gateway <ul style="list-style-type: none"> - SIP

Dialogic Products	Equipment
Dialogic Products	<ul style="list-style-type: none"> • Dialogic® DMG 1000 & 2000 Series <ul style="list-style-type: none"> - SIP - Release 5.1.118_5n or later - DMG 2000 models with V.34 support: requires SR140 SDK 6.4.10 or later, 6.5.7 or later, or 6.6 or later • Dialogic® DMG 4000 Series <ul style="list-style-type: none"> - SIP - SUI-1_8.51 or later • Dialogic® IMG 1010 Integrated Media Gateway <ul style="list-style-type: none"> - SIP, H.323 - Release 10.3.2 or later • Dialogic® BorderNet 500 Session Border Controller <ul style="list-style-type: none"> - BN500IP - SIP - inGate SIParator Release 4.8.5 or later • Dialogic® BorderNet 2020 Session Border Controller <ul style="list-style-type: none"> - BN2020 SBC - SIP - Release 2.1.0 or later • Dialogic® BorderNet 3000 Session Border Controller <ul style="list-style-type: none"> - BN3000 SBC - SIP - Release C2.9.4.12 or later • Dialogic® BorderNet 4000 Session Border Controller <ul style="list-style-type: none"> - BN4000 SBC - SIP - Release 2.1.0 or later

ReplixFax Fax Server Clustering and Server Virtualization

For the best utilization of centralized fax server resources, and highly available and scalable fax service provisioning, the ReplixFax FoIP solution supports the following capabilities:

- Fax server clustering
- Server virtualization

Fax Server Clustering

The ReplixFax fax server “out-of-the-box” clustering consists of multiple fax server units running on Microsoft Windows servers (see Figure 6). Each fax server acts as an equivalent fax cluster member, or a fax processing unit.

By implementing the ReplixFax server clustering, users can benefit from uninterrupted fax service in case of any fax server component system failure and scalable capacity where additional fax server units can be added with ease to meet increasing fax capacity needs. (Note: The ReplixFax fax server clustering feature is currently available only on Microsoft Windows OS platforms. For more details, read a companion ReplixFax white paper, "ReplixFax Fax Server Cluster Configuration.")

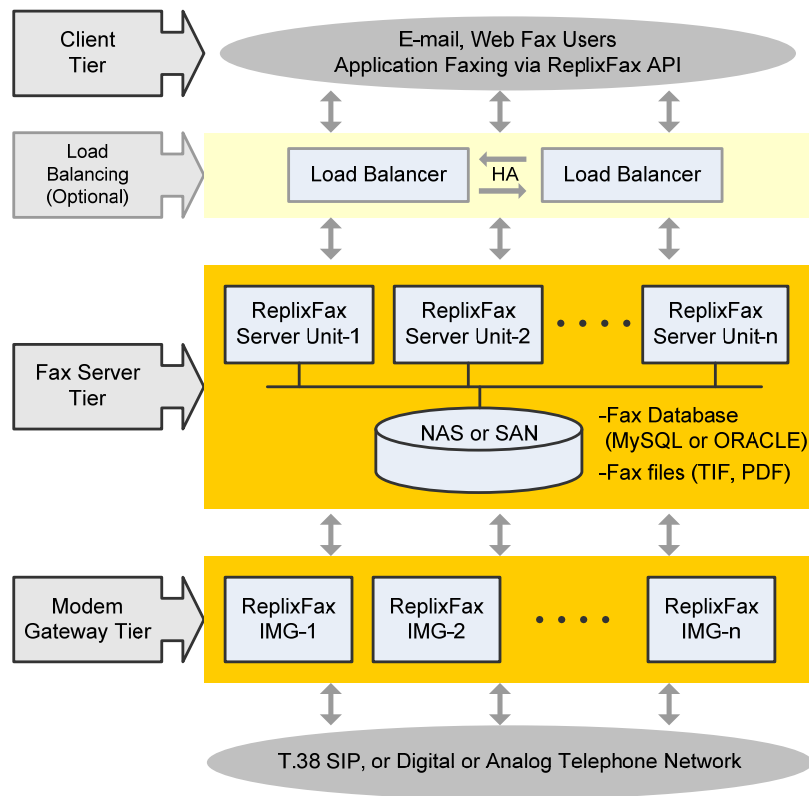


Figure 6. ReplixFax Fax Server Clustering Architecture

Server Virtualization

ReplixFax fax server and its components can run in a virtual OS environment. The ReplixFax solution is certified to run on VMware ESX Server version 3.0.1 or later on Microsoft Windows OS platform.

Figure 7 below shows an example of a centralized ReplixFax fax server configuration that takes advantage of out-of-the-box fax server clustering and server virtualization. In this example, a 96-port fax server system is configured with two Windows OS server platforms with a total of four (4) ReplixFax fax server processing units that share a single fax database.

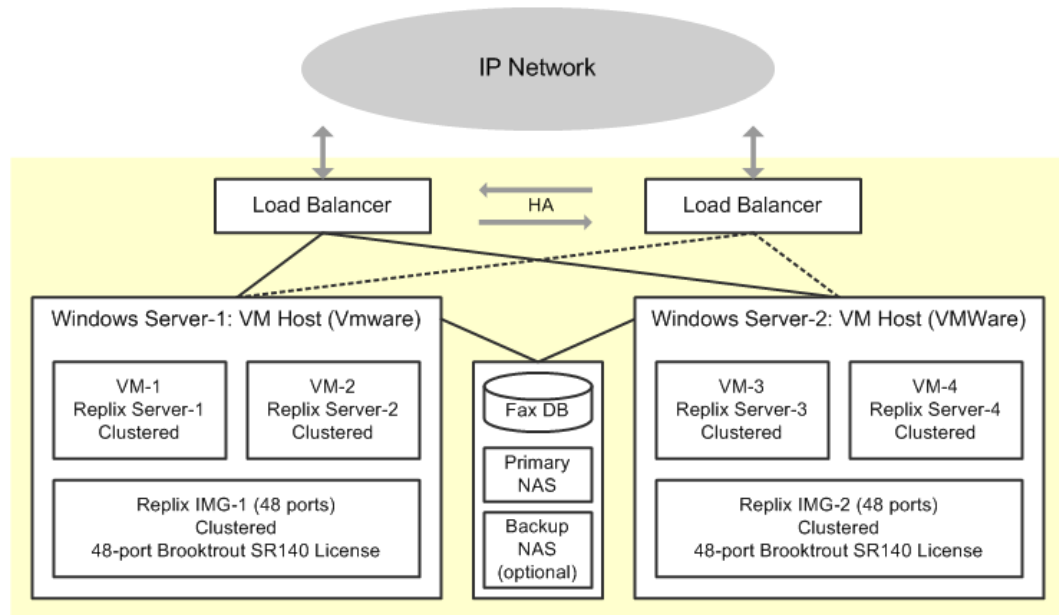


Figure 7. Example of ReplixFax Configuration

Below is a list of virtualization software vendors which is certified to run the ReplixFax fax server system.

Virtualization

- | | |
|---------------|--|
| VMware | <ul style="list-style-type: none"> • SR140 only • VMware ESX Server version 3.0.1 or later running any support Windows guest operating system • VMware ESXi Server version 4.0.0 or later running any supported Windows or Red Hat Linux guest operating system |
|---------------|--|
-

Benefits of ReplixFax Fax over IP Solution

The ReplixFax FoIP system is an industry-proven, scalable and highly reliable enterprise fax messaging system. Deployment of the ReplixFax FoIP solution over your VoIP network infrastructure offers considerable cost-savings and other benefits compared to fax servers running on traditional telephone network.

Key benefits of implementing the ReplixFax FoIP solution include:

- Centralization and consolidation of all fax services across the enterprise to reduce costs
- Convergence of voice, fax and data communications onto a single IP network to streamline network infrastructure
- Centralized administration and configuration capabilities of the ReplixFax web-based system management
- Out-of-the-box fax server clustering to support scalable and highly available fax server configuration
- Server virtualization to support better utilization of resources and optimized system performance
- Secure delivery of business documents protects information and provides compliance to regulatory and governance requirements
- Provide an audit trail of business fax communications
- Business continuity via redundancy or disaster recovery site

Softlinx' ReplixFax Enterprise Fax Messaging System has been serving the needs of many Fortune 1000 corporations worldwide over a decade with customers in financial, healthcare, pharmaceutical, insurance, manufacturing industries and government organizations.



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