



ReplixFax Fax over IP (FoIP)  
Technical Overview and Benefits

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## Introduction

As more organization's networks evolve to support Voice over IP (VoIP), it becomes evident that integrating IP fax service with their VoIP network can easily increase the benefits of their IP network infrastructure by reducing traditional telephony hardware and consolidating the management of voice, fax and data communications on a single network.

Davidson Consulting estimates that Fax over IP (FoIP) sales will grow by a 50 percent Compound Annual Growth Rate (CAGR) to \$245 million in 2010. Several business trends are driving this growth, including decreasing costs for IP networks, an increasingly mobile workforce and a focus on a reliable, interoperable and streamlined communication.

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

## 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

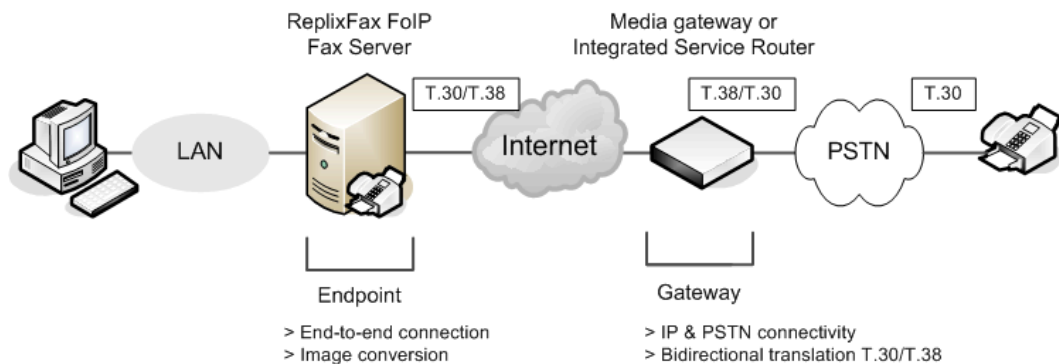
There are two ITU recommendations which address sending faxes over IP networks. T.37 specifies a method of encapsulating fax images in e-mails, and transporting them to the recipient in a store-and-forward manner. T.38 specifies a protocol for transmitting a fax across an IP network in real time.

Fax protocols, T.30 in particular, were designed for the Public Switched Telephone Network (PSTN). The PSTN is very different from a packet 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 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**

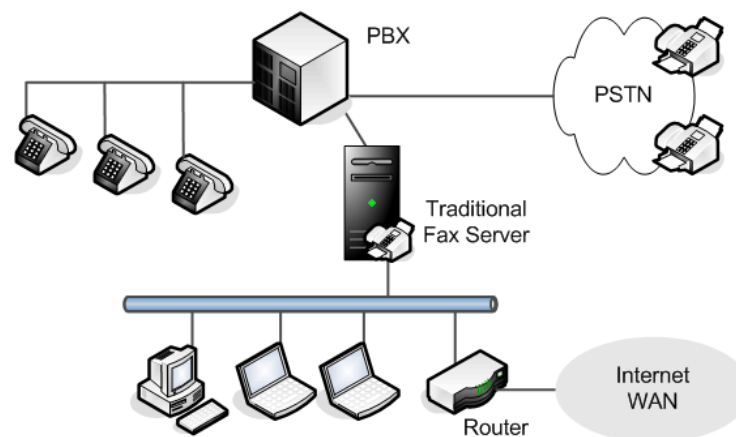
The T.38 FoIP fax server is connected to an IP network and transmits the T.30 protocol and fax image data using T.38 packets over the IP network to the receiving T.38 fax gateway. The receiving T.38 fax gateway, in turn, translates the T.38 packets and repackages them into T.30 protocol signals

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 network using T.38.

## Traditional Fax Server vs. FoIP Fax Server

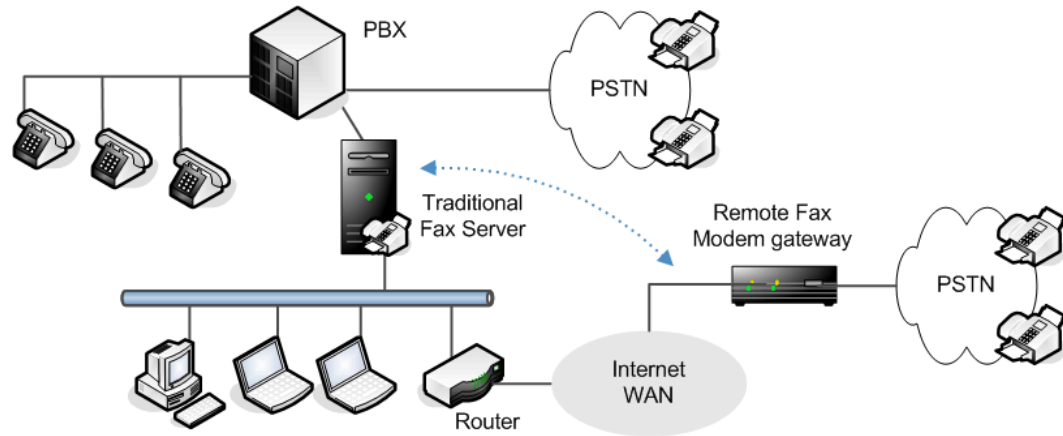
Figure 2 shows a traditional fax server connected to a PBX. The fax server includes fax modem boards that connect directly to the Public Switched Telephone Network (PSTN) through a local PBX. The fax server sends and receives faxes over the phone network to remote fax machines.



**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

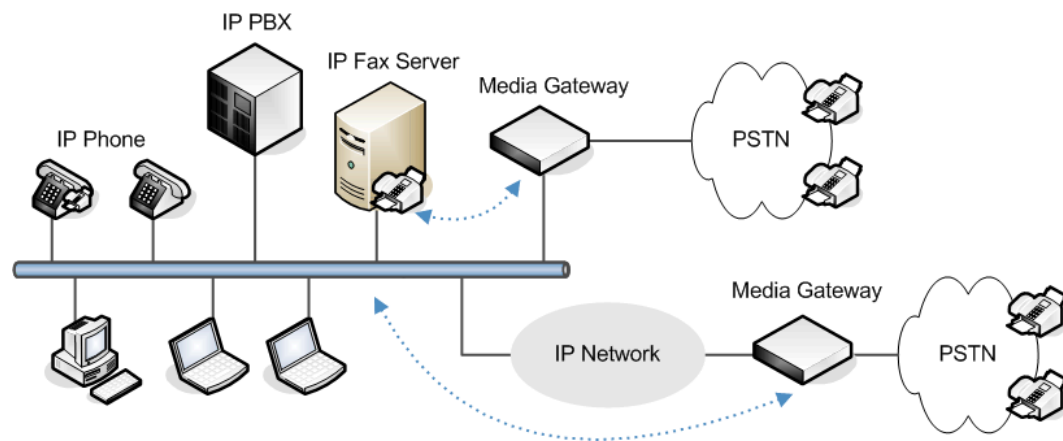
modem gateways at each of the remote office locations to enable the toll bypass.



**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 Fax over IP across the enterprise requires a Voice over IP 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

Key benefits of implementing Fax over IP are summarized below.

### Cost Savings

- Elimination of long-distance phone charges by driving long distance fax traffic over IP
- Reduced annual PBX maintenance 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

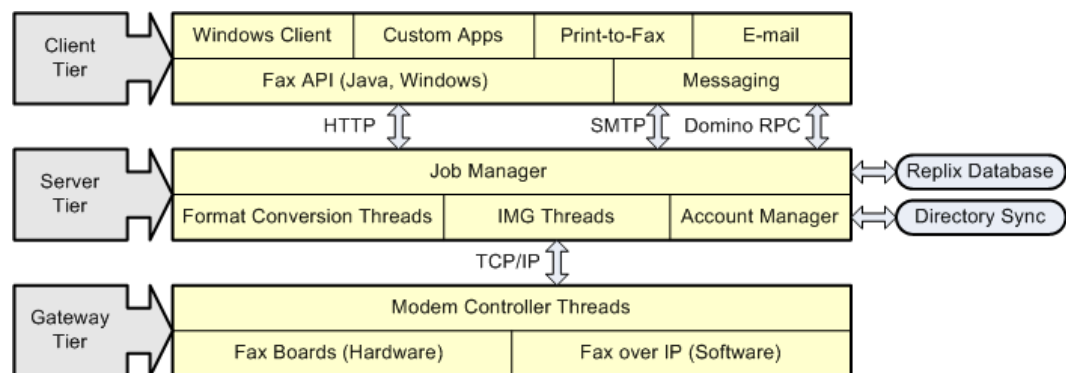
- Ability to provide fast, consistent IP fax services throughout the entire organization
- Ease of re-hosting Fax over IP software licenses on a new server, or disaster recovery configuration via server virtualization
- Elimination of fax hardware dependency or need to keep back-up fax boards (only applicable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

## ReplixFax Fax over IP System Overview

### 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. 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

The ReplixFax fax server supports Fax over IP 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- 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 networks, 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.

Available in both PCI and PCI Express (PCIe) formats, 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 Interoperability

ReplixFax T.38 Fax over IP 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 has 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
<b>Cisco</b>	<ul style="list-style-type: none"> <li>• Cisco Unified Communication Manager (Cisco Unified CallManager)               <ul style="list-style-type: none"> <li>- SIP, H.323, &amp; (MGCP via CallManager)</li> <li>- release 4.2.3 or later within the 4.2.x product line. H.323, MGCP</li> <li>- release 5.0.4(a) or later within the 5.0.x product line. SIP</li> <li>- release 6.0.1 or later within the 6.0.x product line. H.323, SIP, MGCP</li> <li>- release 6.1.x or later within the 6.1.x product line. H.323, SIP, MGCP</li> <li>- release 7.0.x or later within the 7.0.x product line. H.323, SIP, MGCP</li> </ul> </li> <li>• Cisco Integrated Services Router (IOS based gateways capable of supporting T.38)<sup>a</sup> <ul style="list-style-type: none"> <li>- SIP, H.323, &amp; (MGCP via CallManager)</li> <li>- IOS version 12.3 or later</li> </ul> </li> <li>• Cisco AS Universal Gateway Series (those capable of supporting T.38)<sup>a</sup> <ul style="list-style-type: none"> <li>- SIP, H.323, &amp; (MGCP via CallManager)</li> <li>- IOS version 12.3 or later</li> </ul> </li> <li>• Cisco High Performance Gatekeeper Series (H.323 IOS Gatekeepers)               <ul style="list-style-type: none"> <li>- H.323</li> <li>- IOS version 12.3 or later</li> </ul> </li> </ul>
<b>Avaya</b>	<ul style="list-style-type: none"> <li>• Avaya Communication Manager               <ul style="list-style-type: none"> <li>- H.323, SIP (CM release 5.0 or greater)</li> <li>- Release 3.01 (with update 628.6-11410) or later within the 3.x codeline.</li> <li>- Release 4.03 or later within the 4.x codeline.</li> <li>- Release 5.0 or later within the 5.x codeline</li> </ul> </li> <li>• Avaya Media Gateway Series (those capable of supporting T.38)<sup>b</sup></li> </ul>

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	<ul style="list-style-type: none"> <li>- H.323, SIP</li> <li>- Firmware version 26.31.0 or later</li> </ul>
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<b>Nortel</b>	<ul style="list-style-type: none"> <li>• Nortel Communication Server 1000 Release 5.5           <ul style="list-style-type: none"> <li>- SIP</li> <li>- Release 5.5 or later</li> </ul> </li> </ul>
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<b>Alcatel</b>	<ul style="list-style-type: none"> <li>• Alcatel OmniPCX Enterprise<sup>c</sup> <ul style="list-style-type: none"> <li>- SIP, H.323</li> <li>- Release 7.1 or later</li> </ul> </li> </ul>
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<b>Siemens</b>	<ul style="list-style-type: none"> <li>• HiPath 8000           <ul style="list-style-type: none"> <li>- SIP</li> <li>- Release V3.0 R2 PS19.E05 or later</li> </ul> </li> <li>• RG8702 Media gateway           <ul style="list-style-type: none"> <li>- SIP</li> </ul> </li> </ul>
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<b>Quantum</b>	<ul style="list-style-type: none"> <li>• Quantum Tenor Series<sup>a</sup> <ul style="list-style-type: none"> <li>- SIP, H.323</li> <li>- Release P104-12-10 or later</li> </ul> </li> </ul>
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<b>Dialogic</b>	<ul style="list-style-type: none"> <li>• Dialogic<sup>®</sup> DMG 1000 &amp; 2000 Series<sup>a</sup> <ul style="list-style-type: none"> <li>- SIP</li> <li>- Release 5.1.118_5n or later</li> </ul> </li> <li>• Dialogic<sup>®</sup> DMG 3000 &amp; 4000 Series<sup>d</sup> <ul style="list-style-type: none"> <li>- SIP</li> <li>- SUI-1_8.51 or later</li> </ul> </li> <li>• Dialogic<sup>®</sup> IMG 1010 Integrated Media Gateway<sup>a</sup> <ul style="list-style-type: none"> <li>- SIP, H.323</li> <li>- Release 10.3.2 or later</li> </ul> </li> </ul>
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<b>VMware</b>	<ul style="list-style-type: none"> <li>• SR140 SDK 5.1.3 or later. (TR1034 is not compatible with VMware at this time)</li> <li>• VMware ESX Server version 3.0.1 or later using Windows.           <ul style="list-style-type: none"> <li>- Windows 2003 Enterprise Edition, Service Pack 2</li> <li>- Windows 2003 Standard Edition, Service Pack 2</li> <li>- Windows 2000, Service Pack 4</li> <li>- Windows XP Professional, Service Pack 2</li> </ul> </li> </ul>
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- a. TR1034 and SR140 support these gateway products' maximum T.38 fax capability which includes ECM and modulation rates up to a max bit rate of 14.4 kbps.
- b. TR1034 and SR140 support these gateway products' maximum T.38 fax capability which includes Non-ECM and modulation rates up to a max bit rate of 14.4 kbps.
- c. TR1034 and SR140 support these gateway products' maximum T.38 fax capability which includes Non-ECM and modulation rates up to a max bit rate of 9600 baud.
- d. TR1034 and SR140 support these gateway products' maximum T.38 fax capability which includes ECM and modulation rates up to a max bit rate of 33.6 kbps.

## ReplixFax Fax Server Clustering and Server Virtualization

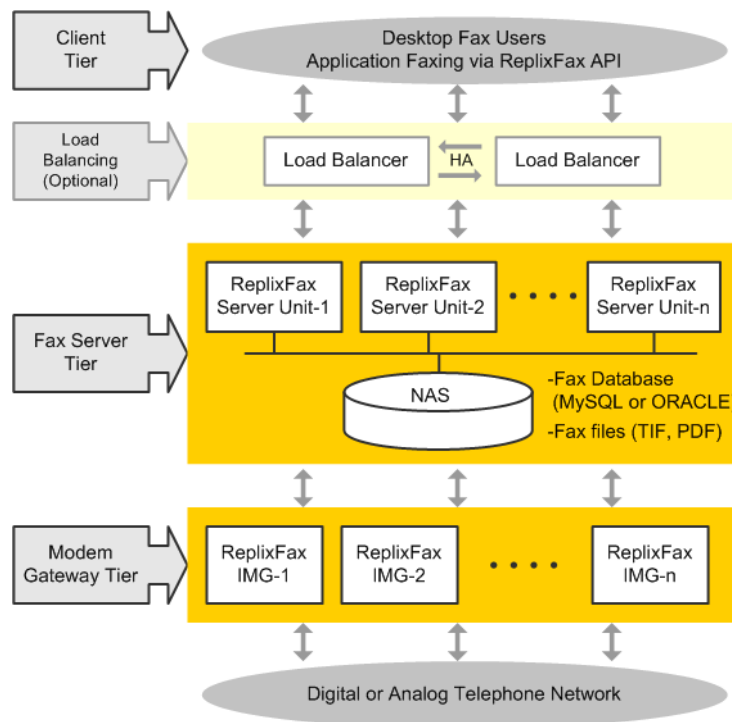
For the best utilization of centralized fax server resources, and highly available and scalable fax service provisioning, the ReplixFax FoIP solution supports the following enterprise fax server capabilities:

- 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 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 unit can be added or removed with ease to meet fluctuating fax capacity needs over time. (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, “Replix Fax Server Cluster Configuration.”)

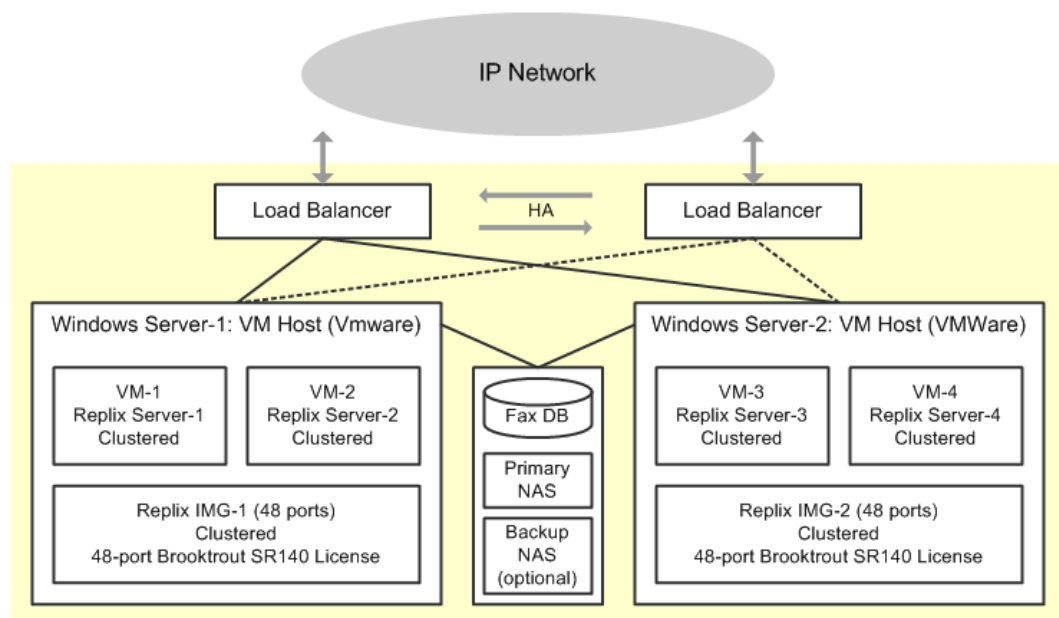


**Figure 6. ReplixFax Fax Server Clustering Architecture**

### 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 cluster units that share a single fax database.



**Figure 7. Example of ReplixFax Configuration**

### Advantages ReplixFax Fax over IP

The ReplixFax system is an industry-proven, scalable and highly reliable enterprise fax messaging system. Deployment of an IP fax service using ReplixFax and unified communications or VoIP systems offers considerable cost-savings over non-IP based fax service.

Key benefits and advantages of implementing the ReplixFax Fax over IP solutions are:

- Centralization and consolidation of fax services across the enterprise to reduce costs and eliminate remote system management

- Convergence of voice, fax and data communications onto a single IP network to streamline network infrastructure
- Ease of deployment with an all-software fax server solution
- 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 suited for centralized fax solution deployment
- 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
- Integration with other IP-enabled business applications to fax-enable host, legacy, ECM and ERP systems for e-document delivery automation such as high-volume delivery of invoices, purchase orders and other documents

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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