Dialogic®
Making Innovation Thrive™

White Paper

How Many Phone Lines Does a Fax Server Need?

How Many Phone Lines Does a Fax Server Need?

White Paper

Executive Summary

By asking relevant questions and examining factors that typically exist in businesses planning to buy a fax server, such as how much existing and potentially new fax traffic will the fax server have to support, what are the peak hour requirements for faxing, what are the acceptable queuing delays when sending faxes, and others, this white paper presents cogent information for businesses to determine how many phone lines a fax server needs to suit their individual situations.

This white paper also presents fax transmission rates and compression methods (MH, MR, MMR), as well fax speed and compression tables that can be useful for selecting a suitable fax board. Also, some special considerations are discussed, such as how many lines a fax server needs when sending and receiving faxes, and the consequences of installing too many or too few phones.

How Many Phone Lines Does a Fax Server Need?

White Paper

Table of Contents

Introduction

One of the difficult assessments IT buyers make when planning to buy a fax server is how many fax server phone lines to install. Although some rough industry guidelines exist—anywhere from 7 to 25 fax users per phone line—the guidelines may be either ill-suited or just too vague to be applied successfully to some specific fax server installations. Ultimately, this becomes a decision that hinges on the specifics of each fax server installation.

Given the potential variances for each installation, the number of lines needed for each fax server may be assessed according to factors specific to each business, department, and/or workgroup that the fax server will support. Below are a few questions to consider when determining how many phone lines a particular installation will require:

- How much existing fax traffic will the fax server have to support?
- How much new fax traffic will the existence of a fax server create?
- How much fax traffic must be handled during peak hours and/or during the execution of major fax applications, like broadcasts?
- Does the fax server have the features to manage peak-hour volumes?
- What kind of fax boards will be used, and what are the relative throughput speeds they support, and
  - — What throughput speeds are supported by the installed base of fax devices to which the fax server will transmit?
  - — What are the page densities of the faxes the fax server will process?
- How much queuing delay is tolerable for outbound faxes?
- Are faxes being received as well as transmitted? If so, how many lines or how much line time is required to effectively handle inbound fax volume?

Although, in most cases, VARs, systems integrators, or fax server vendors will analyze the factors at work relative to specific installations and then make their best recommendations, buyers are still advised to understand and scrutinize fax server sizing dynamics to make informed decisions.

Estimating How Much Existing and New Fax Traffic a Fax Server Must Support

A fax server must have capacity to support existing and new fax traffic, and ways to calculate and estimate this capacity are discussed in this section.

Estimating Existing Fax Traffic

Existing fax traffic includes calls that will migrate to the fax server; this includes the amount of faxing a business does **before** it installs the fax server, usually via PC fax systems and fax machines, which will be subsequently handled through the fax server.

Calculating the overall existing fax traffic sometimes can be done by analyzing telephone system call-detail records. Lacking that resource, fax traffic levels can be roughly estimated by printing periodic reports at fax machines and then extrapolating load levels. Assessing how much existing fax traffic will migrate to a fax server can be a challenge because it depends on the following:

- How much of the traffic originates as computer files and how much originates as paper.
- The computer skills and resources of individual users, with users with strong computer skills more likely to computer-fax more often, and those with limited computer skills more likely to continue extensively using fax machines.

Estimating New Fax Traffic

New fax traffic includes calls that were not made prior to the installation of a fax server. New fax traffic typically increases upon installing fax servers because:

- Many users find that computer-based fax makes it easier and quicker to send "everyday" faxes, so they send more faxes.
- Fax broadcast traffic often picks up as end users discover that initiating ad hoc fax broadcasts via fax servers is as simple as clicking on multiple recipients in a computer-based address book, and this can lead, for example, to sending a single fax broadcast to six recipients rather than sequentially making six phone calls.
- Businesses often use fax servers to fax-enable one or more relatively high-volume strategic applications (for example, auto faxing purchase orders, financial statements, inventory lists, and other regularly generated paper documents that previously had been distributed as physical mail). This can add hundreds or thousands of fax pages to overall daily volumes.

Amounts of new fax traffic obviously can only be approximate. However, it may at least be possible to estimate new fax traffic by extrapolating from existing volumes of document pages already generated by another medium; for example, estimates can be made based on a delivery's traditional delivery by physical mail, which may become fax traffic instead.

Factoring in Peak Hour Requirements

Factoring peak hour requirements for faxing can be a challenge. With fax servers, a cost-effective number of server lines for daily use can be determined, and yet more lines may be needed sometimes to handle potentially very long fax transmissions at critically peak periods. However, fax servers provide a way to maintain the minimum number of lines and still adequately respond to peak hour requirements.

For example, a financial institution may receive a particular set of information every morning at 10 am that it must then timely and equitably transmit to 100 customers. Although the company's fax server might perform well at all other hours of the day with just four lines, that single 10 am broadcast could create both a need and cost-justification for a server with 16 lines (that is, 12 lines used to complete the broadcast in just 20 to 30 minutes, with the other 4 lines used to continue to support normal business-hour fax volume). If the company tried to handle that same broadcast with just the 4 lines that would otherwise suffice (assuming that the broadcast would use 2 of the 4 lines), the results could include the following scenarios:

- The broadcast could then take two to three hours, thus losing its timeliness.
- During those two to three hours, other fax traffic would have access to only two lines instead of four. That could mean
  - — 50% of such ad hoc faxing could get backlogged over that two to three hour period, with those backlogs possibly not working themselves back to levels of tolerable delay until several hours after the two to three hour broadcast finally ends

  and/or

  - — The fax server could become so highly utilized with outbound traffic that it becomes nearly impossible to receive inbound traffic

With fax servers' capabilities, however, users can schedule non-critical faxes and fax broadcasts for transmission before or after core business hours in order to even out hourly traffic loads and enable the same amount of fax traffic to be supported by fewer overall telephone lines.

Transmission Rates and Compression Methods

Transmission Rates

How quickly faxes are transmitted can vary tremendously depending on the page transmission speeds (for example, 9.6, 14.4, or 33.6 kbps) supported by both the sending and receiving fax devices involved in a fax phone call:

- If both fax systems transmit at 33.6 kbps, pages will be faxed at that speed.
- If a fax server is equipped with a 33.6 kbps intelligent fax board, it will fax at 33.6 kbps with other 33.6 kbps fax devices or drop down to 14.4 kbps when faxing to receive-end devices that only support that slower speed.
- If equipped with only 9.6 kbps fax modems, fax servers can transmit no faster than 9.6 kbps, regardless of whether receive-end fax machines can transmit at 14.4 or 33.6 kbps.

Compression Methods

Although not nearly as widely known about or understood as transmission speed, fax compression methods can lengthen or reduce fax phone call times more dramatically than transmission speed. Compression is used to "squeeze down" the amount of data to be faxed prior to transmission; that is, the less data that needs to be faxed, the more quickly the fax phone call can be completed. Virtually all fax machines and computer-based fax systems used today are Group 3 (G/3) devices, which use the mandatory standard G/3 compression method, Modified Huffman (MH). However, MH compression is less efficient than two other optional G/3 compression methods, known as Modified Read (MR) and Modified Modified Read (MMR). Table 1 shows fax page transmission times depending on combinations of transmission speed plus the three different compression methods.

Transmission Speed	MH	MR	MMR
9.6 kbps	45 seconds	30 seconds	15 seconds
14.4 kbps	30 seconds	20 seconds	9 seconds
33.6 kbps	N/A	N/A	5 seconds

Source: Davidson Consulting, 2003

Table 1. Page Throughput by Transmission Speed Plus Compression Method [Davidson] (estimated times to fax a benchmark page)

Fax Board Selection: Running the Numbers

The type of fax board selected for the fax server installation (9.6, 14.4, or 33.6 kbps, as well as MH, MR, or MMR compression) can have a significant effect on the number of phone lines that will need to be ordered. Fax traffic handled by the estimated 125 million fax machines in the U.S. (as shown in Table 2) is dominated by fax devices and the MR and/or MMR compression standard that is used.

Using the data in Table 2 and Table 3, it is possible to calculate that to process 500 four-page faxes would have the following outcomes:

- A 14.4 kbps/MH fax server line takes twenty-three hours.
- A 14.4 kbps/ MMR fax server line (with faster compression) takes sixteen and two-third hours.
- A 33.6 kbps/MMR system with a 33.6 kbps/MMR server line takes sixteen and one-third hours.

This translates into fewer lines required for a 14.4 kbps/MMR and 33.6 kbps/MMR system to support the same amount of traffic as a 16-line 14.4 kbps/MH system. Typically, today's intelligent fax boards supporting mid-volume or higher systems are 33.6 kbps/MMR (or V.34) and 14.4 kbps/MMR devices, while most Class 1 and Class 2 fax modems cards are 14.4 kbps/MH or 9.6 kbps/MR devices.

Intelligent fax boards also offer additional throughput advantages over Class 1 and 2 modems relative to the following:

- More efficient bit-stuffing
- More efficient handling of image-conversion and other associated overhead processing tasks than Class 2 modems

Device	% of Traffic	Compression Method and Per-Page Speeds for 14.4/MH Units	Compression Method and Per-Page Speeds for 14.4/MMR Units	Compression Method and Per-Page Speeds for 33.6/MMR Units
9.6/MH	11%	9.6/MH 45 Seconds	9.6/MH 45 Seconds	9.6/MH 45 Seconds
9.6/MR	29%	9.6/MH 45 Seconds	9.6/MR 30 Seconds	9.6/MR 30 Seconds
14.4/MH	7%	14.4/MH 30 Seconds	14.4/MH 30 Seconds	14.4/MH 30 Seconds
14.4/MR	10%	14.4/MH 30 Seconds	14.4/MR 20 Seconds	14.4/MR 20 Seconds
14.4/MMR	28%	14.4/MH 30 Seconds	14.4/MMR 9 Seconds	14.4/MMR 9 Seconds
33.6/MMR	15%	14.4/MH 20 Seconds	14.4/MMR 9 Seconds	33.6/MMR 5 Seconds

Source: Davidson Consulting, 2003

Table 2. Page Throughput by Transmission Speed Plus Compression Method [Davidson] (estimated times to fax a benchmark page in seconds)

Device	% of Traffic	Compression Method and Per-Page Speeds for 14.4/MH Units	Compression Method and Per-Page Speeds for 14.4/MMR Units	Compression Method and Per-Page Speeds for 33.6/MMR Units
9.6/MH	11%	212 Seconds/Call 11,660 Seconds Total	212 Seconds/Call 11,660 Seconds Total	212 Seconds/Call 11,660 Seconds Total
9.6/MR	29%	212 Seconds/Call 30,740 Seconds Total	152 Seconds/Call 22,040 Seconds Total	152 Seconds/Call 22,040 Seconds Total
14.4/MH	7%	152 Seconds/Call 5,320 Seconds Total	152 Seconds/Call 5,320 Seconds Total	152 Seconds/Call 5,320 Seconds Total
14.4/MR	10%	152 Seconds/Call 7,600 Seconds Total	112 Seconds/Call 5,600 Seconds Total	112 Seconds/Call 5,600 Seconds Total
14.4/MMR	28%	152 Seconds/Call 21,280 Seconds Total	68 Seconds/Call 9,520 Seconds Total	68 Seconds/Call 9,520 Seconds Total
33.6/MMR	15%	112 Seconds/Call 8,400 Seconds Total	68 Seconds/Call 5,100 Seconds Total	52 Seconds/Call 3,900 Seconds Total
TOTALS		85,000 Seconds Total **23.61 Hours Approx./Day**	59,240 Seconds Total **16.46 Hours Approx./Day**	58,040 Seconds Total **16.12 Hours Approx./Day**

Source: Davidson Consulting, 2003

Table 3. Volume of 2003 U.S. Fax Traffic Speed Plus Compression Method [Davidson] (plus modes supported and seconds-per-page by mode)

How Much Queuing Delay is Tolerable?

With outbound faxes, fax servers whose phone lines are already busy handling fax calls can manage additional fax job submissions by storing them in memory (for example, on a hard drive), where they are "queued." Then, as phone lines become free, the stored faxes are relayed to the fax server's phone lines for transmission.

Due to this kind of capability, it is possible to have a 2-line fax server support 100 active users. For example, if it is assumed that each active user submits two 2-minute fax jobs per hour during every hour of an eight-hour day using a 2-line fax server, here is what can happen:

- At the end of the first hour, assuming 120 minutes of faxes have been processed (60 minutes x 2 lines), 80 minutes of the total of 200 minutes of fax jobs submitted will still be queued up. A fax job initiated right at the end of the first hour, then, will not actually be transmitted until after 40 minutes has passed, because the fax server will have to work through the 80 minutes of queued jobs first, which it will do in 40 minutes due to its two phone lines.
- For each successive hour throughout the day, the length of queue delays will increase by another 40 minutes, so:
  - — At the end of two hours, the delay would be 80 minutes.
  - — After three hours, a two-hour delay would exist.
  - — At the end of eight hours, a 5-hour and 20-minute delay would exist, which means that about 5 hours and 20 minutes after the eight-hour day ends, the last of the queued faxes would finally be delivered.

For some situations, it may be acceptable for faxes to be delivered after considerable delays, or for a fax server to be equipped with so few phone lines relative to its traffic volume, for example, where:

- Next-day delivery suffices
- The fax server is installed in a region, such as in an underdeveloped country, where:
  - — Phone lines are very expensive to install
  - — It may require months or even years to get additional phone lines installed

But while recognizing that such situations can exist, it may not be in the best interest of a company to under-power its fax servers because:

- Faxes often involve documents that drive business transactions, and delaying faxes risks losing business represented by those transactional documents.
- Delayed faxes can interrupt the work processes of a company's own workforce, causing lower worker productivity due to workflow interruptions and task delays.
- Delayed fax deliveries can result in customers having negative impressions of the way the company does business.

Special Considerations Relative to Receiving Faxes

Some fax servers are used predominately or entirely to send outbound faxes; assessing the number of lines they need involves figuring out how many lines are necessary to handle peak-hour traffic and to maintain queue delays within tolerable limits. Having outbound-only fax server phone lines highly utilized most of the time is a goal, not a problem.

When fax servers also receive faxes, the situation changes. Fax lines cannot be highly utilized for outbound faxing and be ready to receive faxes; they have to be dedicated to one or the other:

- If a fax line is busy 75% of the time, most inbound fax calls will initially receive busy signals. An unacceptably high number of calls, more than one-third, will not be received, even if they automatically redial three times.
- In order for fax server phone lines to be ready to receive faxes, they cannot be busy almost all the time or even most of the time. A single fax server line used for reception should be free to receive calls more than half the time during fax-reception time periods.

With multi-line fax servers, important considerations include:

- That an adequate percentage of lines (for example, 25%–50%) be free to receive faxes at any given time.
- In many cases, to prevent outbound fax broadcasts from monopolizing a fax server's phone lines, a company can dedicate some lines solely to receiving faxes. For one, this allows the company to fine-tune queue delays on outbound faxes without diminishing the ability to receive faxes efficiently. On the other hand, the overall efficiency with which a fax server can expedite the sum total of fax calls passing through it is greater when most or all lines can be used for both sending and receiving.

A notable option for a company is to decide that all but the very lowest-volume fax servers, when used to receive as well as send faxes, be equipped with at least two lines, so faxes can be received even while others are being transmitted outbound.

Another option is Direct Inward Dialing (DID), which is one of the most widely used forms of automated inbound routing (whereby faxes received at a fax server are automatically routed to LAN-based inboxes of individual recipients) because DID lines are receive-only.

Consequences of Too Many or Too Few Phone Lines

Although line capacity can be managed and optimized after the initial implementation of a fax server, a business may pay a price for installing too many or too few fax server phone lines. If too few lines are installed, the results can include:

- Outbound message delivery is delayed by many minutes or hours, potentially disrupting, delaying, or even occasionally undermining certain business endeavors. For instance, although a delivery delay of 45 minutes for an accounting report being faxed to a regional office usually is insignificant, if the same delay occurs when faxing back an approval for a retail credit request or loan application, the delay itself can cause a loss of business.
- Inbound faxes frequently may be blocked if all lines are often busy, which may usually cause relatively trivial delays, but in worst-case scenarios, for example, can completely block the reception of sales orders, with the result that senders of those sales orders may eventually fax them to competitors instead of the company with the overloaded fax server.
- If a fax server is generally heavily loaded, it may become problematic to execute business-hour fax broadcasts, creating a lost opportunity in which potential time and money savings can be lost.
- The ability to fax something immediately, such as when called with an urgent information request, may become unpredictable at best, and impossible at worst. A business can project a negative image to customers by being unable to fax information quickly. For example, the airline that can only promise that faxes containing ticketless flight information will arrive within 24 hours may lose business with frequent flyers who often buy same-day and next-day tickets (or it may just create an such inconvenience for such frequent flyers that, at a later time, it may influence them to choose a more responsive competitor).
- As it becomes clear that additional lines are needed, and businesses install those new lines, it means additional installation costs, and often significantly impacts normal business operations during the time the fax server is being upgraded.

If too many lines are installed, typical results include:

- Extra, and at least temporarily unnecessary, expense for fax board ports, if only for those ports greatly underutilized. Generally though, providing workers with computer fax capabilities allows them to fax more documents (for example, faxing instead of mailing documents or making time-consuming voice calls or just not communicating the information), and having "too much" capacity initially often translates into having enough capacity to grow into as traffic volume rises over time.
- Similarly, in cases where telephone lines are installed directly to a fax server (as opposed to through a PBX relative to shared lines)—and no one canceled the service for the currently unnecessary and extra lines—unnecessarily high and ongoing payments will be disbursed to the phone company.
- In terms of the effect on fax server performance — performance should be favorable, with both outbound and inbound fax calls handled in an extremely timely fashion.

Moreover, it is important to understand that initially having extra capacity can make sense because it supports the potential growth in fax traffic that can occur with computer-based fax implementations. Businesses may opt to — after calculating that their traffic volumes can be handled satisfactorily by four ports — install eight-port boards precisely to give themselves room to grow.

Finally, relative to having extra capacity to grow into, buyers should remember that installing up to twice actual current capacity levels can have value, and that in most situations, a fax server should be scalable to support up to ten times its original actual line requirements. For example, if the fax server absolutely needs four lines (but eight are installed for room to grow in the near-term), plan for the fax server to also support future expansion, whether on one or multiple servers, to support up to a minimum of 40 lines (that is, ten times the original four-line volume level).

Conclusion: Making the Decision

Although some rough industry averages exist as to how many fax server users can effectively share a line, optimal ratios of users to lines varies widely according to numerous site-specific factors such as how many pages of fax traffic users generate, peak-hour traffic volumes, fax board efficiency, acceptable levels of queue delay, whether inbound as well as outbound fax traffic is supported, and how much new fax traffic the existence of a fax server will create.

Too few lines can result in delayed communications, lost opportunities, and lost sales due to inbound faxes that never reach an open line. Too many lines may cause businesses to incur some unnecessary expenses, but having ample capacity ensures timely transmissions and provides room to grow as fax traffic volumes increase.

The real task of determining fax server line capacity involves identifying or estimating current fax traffic levels, and estimating what percentage of that traffic will move to the fax server. In addition, consider the following:

- How much new traffic is likely to be generated
- How much critical peak-hour volume must be supported
- How much business-hour fax traffic can be shifted to before or after core business hours delivery through delayed-transmission commands
- How long it takes, on average, to transmit faxes, which in large part depends on fax board capabilities and the type of installed machines to which faxes are sent and received
- How much queuing delay is tolerable because, with outbound faxes, a fax server can store transmissions in long queues, eventually faxing out all jobs, but potentially causing delays up to many hours long by the time it delivers most or all faxes
- Whether special factors relating to inbound faxes should be considered, including the fact that adequate percentages of lines (for example, 25% to 50%) should be free to receive faxes at any given time.

Businesses that understand that situations arise where even well-intentioned sizing estimates can miss the mark will be prepared to make post-installation adjustments. However, if close attention is paid to the factors and situations discussed above, most businesses will be better able to select the optimal amount of phone lines for their fax server needs.

Dialogic® Brooktrout® Fax Products

Dialogic supports fax with the following Brooktrout products:

Dialogic® Brooktrout® TruFax® Fax Boards — Offer small businesses and departmental workgroups dependable network fax capabilities. These intelligent fax boards support a variety of applications, such as fax server and workflow fax, and offer enterprise-level quality and performance to small businesses.

Dialogic® Brooktrout® TR1034 Fax Boards — Send and receive TDM or IP faxes up to 33.6 kbps, based on the V.34 fax standard (the DID/Combo model receives faxes up to V.17 and sends up to 33.6 kbps). Not only can a Brooktrout TR1034 process fax at twice the speed of 14.4 kbps fax boards, it also supports V.8 fast handshaking and advanced compression, which can cut call setup and session-management time by one-third. A document that can be faxed in one minute with a 14.4 kbps intelligent fax board can be sent in less than 30 seconds with a TR1034. This can translate into significant savings on long distance toll charges.

Dialogic® Brooktrout® SR140 Fax Software — Can provide exceptional options for application developers because Brooktrout SR140 supports the Dialogic® Brooktrout® Bfv API, the same API used throughout Dialogic's line of fax products. Developers can choose to write one application to the Bfv API and deploy it on both TDM and IP equipment. This dual-network support also allows developers who wish to sell into both TDM and IP accounts to use either Dialogic® Brooktrout® TR1034 Fax Boards or the Brooktrout SR140.

References

[Davidson] Davidson Consulting, Peter J. Davidson, "How Many Phone Lines Does Your Fax Server Need?", 2003.

Dialogic®
Making Innovation Thrive™

www.dialogic.com

Dialogic Corporation
9800 Cavendish Blvd., 5th floor
Montreal, Quebec
CANADA H4M 2V9

12/08 10873-01