

# How Many Lines Does My Fax Server Need?

A White Paper Designed to Help Buyers Make Informed  
Fax Server Purchase Decisions

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## Executive Summary

Buyers need a firm grasp of fax phone line capacity issues, in part because one less than optimal way to sell fax servers is to keep the initial bid price low by specifying fax servers that are under-equipped with lines. That sales tactic can win bids, but in the end does a disservice to buyers who get less than expected performance at the budgeted price. **Buyers may be left with the dilemma of either going over budget, taking out the fax server and starting over again, or settling for subpar performance** for meeting their fax dissemination needs, which translates into subpar performance in meeting customer service needs. This report is intended to give buyers enough understanding of line-sizing factors so that they can make informed purchase decisions in order to protect themselves from unwelcome price/performance trade-off surprises.

**Although some rough industry averages exist** as to how many fax server users can effectively share a line -- e.g., **7 to 25 fax users per line** -- optimal ratios of users to lines depends on and varies widely according to numerous site-specific factors.

**Site-specific factors** include 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 will the existence of a fax server create?

**Too few lines** can result in delayed communications and 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 expenditures, but having ample capacity ensures timely transmissions and provides room to grow as fax traffic volumes increase.

Another rule of thumb for estimating line requirements is to take a page from single-line 4-page-per-minute **business** fax machines, which are typically shared by 10 to 25 users.

**The real task of determining fax server line capacity needs** comes down not only to identifying or estimating current fax traffic levels, but also estimating what percentage of that traffic will move to the fax server. In addition, consideration must be given to:

1. How much new traffic will emerge
2. What critical peak-hour volumes must be supported
3. How much business-hour fax traffic can be shifted to after-hours delivery

through easy computer-based fax invoking of delayed-transmission commands

4. How long it actually takes, on average, to send faxes, which in large part depends on fax board capabilities and the type of installed machines to which you send and receive faxes

5. How much queuing delay is tolerable because, with outbound faxes, fax servers can store transmissions in long queues, eventually faxing out all jobs, but potentially causing delays up to many hours long relative to delivering most or all faxes.

6. Whether special factors relating to inbound faxes should be considered, including the fact that adequate percentages of lines (e.g., 25% to 50%) should be free to receive faxes at any given time (lest one's business lose orders and other opportunities because inbound fax calls are blocked). Also, where direct-inward-dial (DID) lines are used to support automated routing of inbound faxes to individual recipients, capacity sizing must be done separately for inbound and outbound traffic because DID services only use receive-only lines.

### **How Many Lines Does My Fax Server Need?**

One of the most difficult assessments fax server buyers must make is how many fax server phone lines to install. Ultimately, this becomes an issue that hinges on the specifics of each fax server installation. Although some rough industry averages exist -- broadly, 7 to 25 fax users per line, or more narrowly, 12 to 20 users per line (according to Davidson Consulting) -- they may be either ill-suited or just too vague to be applied successfully to some specific fax server installations. Moreover, some dealers resort to winning business by offering lowball pricing -- with that pricing not reflecting a narrowing of their margins or commissions, but an unstated under-equipping of fax server ports that buyers often don't comprehend til the system is up and running.

Rather than using anyone's rule of thumb -- after all, Davidson Consulting has come across sites where there are multiple phone lines for each user (and there should be because each user is initiating large broadcast fax jobs) as well as sites where more than 50 users share a line and management professes that no performance penalty results (however, Davidson Consulting generally will not recommend sharing a line among more than 25 users and believes that, where greater numbers of users successfully share a fax line, it usually means either that many counted as users don't actively computer fax, or that sites are located in countries where phone lines are so expensive and hard to get that users simply accept less than optimal performance as the norm).

Given the potential variances, then, it follows that the number of lines needed for each fax server should be assessed according to factors specific to each business, department and/or workgroup that the fax server will support, including:

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 the execution of major fax applications, like broadcasts? Can fax server features be used to manage peak-hour volumes?

What kind of fax boards will be used and what are the relative throughput speeds they support -- and, to complete this equation, (a) what throughput speeds are supported by the installed base of fax devices to which the fax server will transmit, and (b) what are the page densities of the faxes the fax server will process? Systems using intelligent fax boards with 14.4 Kbs transmission speed and MMR compression often can handle the same amount of fax traffic as Class 2 fax modems with about 33% fewer lines.

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 recommendations, buyers are still advised to understand and scrutinize fax server sizing dynamics well enough to assess whether the number of ports recommended is based on the needs of the buyer's business or on some sellers' propensity to try to win sales via pricing that is artificially low due to under specifying initial ports.

Also, although line capacity can be managed and optimized after the initial implementation of a fax server (and businesses must understand that situations arise where well-intentioned sizing estimates miss the mark and post-installation adjustments must be made), a business may pay a price for installing too many or too few fax server phone

lines. If too **few** lines are installed, typical results 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 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 go by the wayside.

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 ticket-less flight information will arrive within 24 hours may lose business with frequent flyers that often buy same-day and next-day tickets (or may just create a subtle level of mistrust in such frequent flyers that, down the road, may feed into their being quicker to decide to switch their allegiance to another airline).

As it becomes clear that additional lines are needed, businesses must install new lines, which 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 card ports -- if only for any that are greatly underutilized. Generally, though, computer fax-enabling workers allows them to fax more documents (e.g., instead of mail documents or making time-consuming voice calls -- or just not communicating the information at all) -- 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 figures out to cancel the service for currently unnecessary and extra lines -- unnecessarily high and ongoing payments will be disbursed to one's phone company.

In terms of the effect on fax server performance -- well, performance should be terrific, with both outbound and inbound fax calls handled in extremely timely fashion.

Moreover, it is important to understand that initially having extra capacity can make sense because it supports the virtually inevitable growth in fax traffic that occurs with computer-based fax implementations. In fact, there is clearly a market trend whereby businesses, upon calculating that their traffic volumes can be handled satisfactorily by four ports, are instead installing 8-port cards precisely to give themselves room to grow (and, at least in advanced countries, you can add phone service on a line-by-line basis as extra lines are required). Finally, relative to having extra capacity to grow into, buyers should remember not only that installing up to twice actual current capacity levels can have value, but that in most situations, any fax server should be scalable to support up to ten times its original actual line requirements. In other words, if it absolutely needs 4 lines (but you install 8 for room to grow in the near-term), the fax server should also support future expansion, whether on one or multiple servers, to support up a minimum of 40 lines (i.e., ten times the original 4-line volume level).

### **Rules of Thumb Can Help: But Don't Become "All Thumbs"**

A few rules of thumb for estimating fax server capacity needs:

**Taking a cue from fax machines:** One-line **business** fax machines (e.g., laser fax machines that print at 4 pages per minute or faster) are typically shared by 10 to 25 users, according to Davidson Consulting. Producing similar information over the 5 years they have been conducted, annual Pitney Bowes/Gallup polls of corporate fax usage patterns have shown results indicating corporate fax machine sharing by average numbers of users ranging from a low of 14 users per line one year to a high of 21 users per line another year (note that an average of 14 users per fax machine suggests a range of perhaps 8 to 20 users sharing most corporate fax machines). Such ranges, whether **8 to 20 users or 10 to 25 or**

**even 12 to 30**, provide an indication of how many users comfortably **share a single fax machine phone line**.

However, because fax servers automate the process of sending faxes (e.g., make it easier to broadcast faxes to multiple recipients), fax servers tend to generate higher volumes of outbound faxes per user than fax machines (and such increases in outbound traffic tend to create a reciprocity that in turn increases inbound fax server traffic too). Assuming a 25% increase in fax traffic per user due to computer-based fax automation, the users-per-fax-line ranges listed above for fax machines would, for **fax servers**, become: **6 to 15 users or 8 to 18 or 9 to 23**, respectively.

**The time to fax a page:** It can take a shorter or longer time to send a fax or even an identical fax page, depending on (a) the capabilities of **both** the sending and receiving fax devices in a fax phone call, and (b) on the make-up of fax pages (the more text and other print on a fax page, the longer that page takes to transmit). However, **a longstanding and widely-used rough estimate of the time it takes to fax a single page is 1 minute** (including call setup time, between-page retraining, actual page transmission time, and allowances for redialing time too). Where departments within large corporations have leading-edge 14.4 Kbs machines and tend to fax often to corporate recipients, a more accurate rule-of-thumb is 30 seconds per page.

**Don't rely solely on rules of thumb!** Don't automatically assume that rules of thumb fit your specific needs. There are corporate workgroups comprised of frequent fax broadcasters where anything less than **multiple lines for each single user** would create serious under capacity situations! Moreover, the very term **"user"** is fraught with ambiguity: a business may have 100 users on a LAN, but only 20 or 50 or 80 that fax frequently at all and, of those, only 10 or 25 or 40 may use **computer fax** frequently. If you know that only 20 users on the LAN actually fax, then the initial number of fax server users should be considered 20, not 100.

Finally, relative to the actual duration of different types of fax calls, note that intra-company fax calls involving state-of-the-art fax transmission and compression technology (and simple text documents) can bring the average time to fax a page down to under 15 seconds, making the one-minute average a recipe for overcooking one's fax server capabilities.

## **Determining Fax Server Line Capacity Needs**

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

A fax server must have capacity to support:

**Existing fax traffic** that will migrate to the fax server, as in that share of faxing that a business does (*before* it installs the fax server), via PC fax systems and fax machines, that subsequently will be handled through the fax server. Calculating overall existing fax traffic sometimes can be done (more often it can't) 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 tricky because it depends on (a) how much of the traffic originates as computer files and how much originates as paper, and (b) 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.

**New fax traffic**, as in fax traffic involving calls that were not made prior to the installation of a fax server. New fax traffic typically arises upon installing fax servers because:

(a) Many users find that computer-based fax makes it easier and quicker to send 'everyday' faxes, so they send more faxes

(b) 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 fax phonebook -- and this can lead, for example, to doing a single fax broadcast to 6 recipients rather than sequentially making 6 phone calls

(c) Businesses often use fax servers to fax-enable one or more relatively high-volume strategic applications (e.g., 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 'guess-timated,' although, relative to automating specific applications, it may at least be possible to extrapolate from existing volumes of document pages already generated for the application, for example, relative to its traditional delivery by physical mail.

## What Are Peak Hour Requirements?

The number of lines a fax server should support may be substantially impacted by strategic needs to meet peak-hour traffic delivery requirements. For example, a financial institution may receive a particular set of information every morning at 10 am -- that it must then turn around and transmit, in as timely and equitably a fashion as possible, 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 (with 12 lines used to complete the broadcast in just 20 to 30 minutes, while the other 4 lines continue to support normal business-hour fax volume). Meanwhile, if the company tries to handle that same broadcast with just the four lines that would otherwise suffice (assuming that the broadcast would take over two of the four lines), the results would include:

The broadcast would then last two to three hours, losing its timeliness

During those two to three hours, other fax traffic would have access to only 2 lines instead of four. That could mean (a) that 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 2-to-3-hour broadcast finally ends, and/or (b) the fax server could become so highly utilized with outbound traffic that it becomes nearly impossible to receive inbound traffic.

Conversely, however, the capabilities of fax servers to let users easily delay fax jobs can be used, when appropriate, to reduce peak-hour traffic. Non-critical faxes and fax broadcasts can be scheduled for after-hours transmission in order to even out hourly traffic loads and enable the same amount of fax traffic to be supported by fewer overall telephone lines.

## The Time It Takes to Process and Transmit a Fax

How quickly fax phone calls are actually completed can vary tremendously depending on:

The **page transmission speeds** -- e.g., **9.6 or 14.4 Kbs** -- supported by both fax devices involved in a fax phone call. If both fax systems transmit at 14.4 Kbs, pages will be faxed at that speed. If a fax server is equipped with 14.4 Kbs fax modems, it will fax at 14.4 Kbs with other 14.4 Kbs fax devices (as of year-end 1996, about 30% of corporate fax traffic in the US was transmitting at 14.4 Kbs) or drop down to 9.6 Kbs when faxing to receive-end devices that only support that slower speed. If equipped with only 9.6 Kbs fax modems, fax servers can transmit no faster than 9.6 Kbs, regardless of whether receive-end fax machines can transmit at 14.4 Kbs or not.

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, more often. That is, compression is used to "squeeze down" the amount of data to be faxed prior to transmission; 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 **all** use the mandatory standard G/3 compression method, Modified Huffman (MH) -- which is less efficient than two other optional G/3 compression methods, Modified Read (MR) and Modified Modified Read (MMR). Table 1 below shows fax page transmission times depending on combinations of transmission speed plus the three different compression methods. Notably, the 9.6/MR combination can send a page in just 15 seconds, while the 14.4/MH combination results in a sending time that is 33% longer at 20 seconds per page, which indicates the relative power of MR versus 14.4 Kbs transmission speed on overall fax phone call duration.

Table 1

### Page Throughput By Transmission Speed and Compression Method

(Estimated times to fax a benchmark page in seconds)

	<b>MH</b>	<b>MR</b>	<b>MMR</b>
<b>9.6 Kbs</b>	30	15	9
<b>14.4 Kbs</b>	20	10	6

Source: Davidson Consulting, Burbank, CA, 1997

Moreover, the breakout of fax traffic handled by the US installed base of over 20 million fax machines in 1996, as shown in Table 2, is still dominated by MR fax devices with a 52% share of traffic, and by MR and/or MMR units, which generated 75% of all 1996 US-based fax traffic.

Table 2

### Volume of 1996 US Fax Traffic By Speed and Compression

(Plus modes supported and seconds-per-page by mode)

	<b>% of Traffic</b>	<b>Modes &amp; Per-Page Speeds for 14.4/MH Units</b>	<b>Modes &amp; Per-Page Speeds for 14.4/MMR Units</b>
<b>9.6/MH</b>	21%	9.6/MH 30 seconds	9.6/MH 30 seconds
<b>9.6/MR</b>	52%	9.6/MH 30 seconds	9.6/MR 15 seconds
<b>9.6/MMR</b>	5%	9.6/MH 30 seconds	9.6/MMR 9 seconds
<b>14.4/MH</b>	4%	14.4/MH 20 seconds	14.4/MH 20 seconds
<b>14.4/MR</b>	-----	-----	-----
<b>14.4/MMR</b>	18%	14.4/MH 20 seconds	14.4/MMR 6 seconds

Source: Davidson Consulting, Burbank, CA, 1997

If Table 2 data is used as a reference for an installed base of devices to which a 14.4 Kbs/**MH** fax server line and a 14.4 Kbs/**MMR** fax server line each transmit 100 four-page faxes per day, what takes the MH system 4 hours per day to process will take only two-and-three-fourths hours with an MMR system. This translates, for example, into an 11-line 14.4/MMR system supporting the same volume of traffic as a 16-line 14.4/MH system, despite having 32% fewer lines. Typically, intelligent fax boards (fax modem cards with on-board microprocessors) supporting mid-volume or higher systems are 14.4/MMR devices, while most Class 1 and Class 2 fax modems are 14.4/MH devices.

Table 3

### Daily Utilization in Minutes, 14.4/MH Vs 14.4/MMR

(All per-call times include identical handshaking and retraining overhead time)

	<b>% of Traffic</b>	<b>Modes &amp; Per-Page Speeds for 14.4/MH Units</b>	<b>Modes &amp; Per-Page Speeds for 14.4/MMR Units</b>
<b>9.6/MH</b>	21%	152 seconds/call 3192 seconds total	152 seconds/call 3192 seconds total
<b>9.6/MR</b>	52%	152 seconds/call 7904 seconds total	92 seconds/call 4784 seconds total

<b>9.6/MMR</b>	5%	152 seconds/call	68 seconds/call
		760 seconds total	340 seconds total
<b>14.4/MH</b>	4%	112 seconds/call	112 seconds/call
		448 seconds total	448 seconds total
<b>14.4/MMR</b>	18%	112 seconds/call	56 seconds/call
		2016 seconds total	1008 seconds total
<b>Totals</b>	-----	14,320 seconds total	9,772 seconds total
		4 hours approx./day	2.75 hrs approx./day

Source: Davidson Consulting, Burbank, CA, 1997

Meanwhile, intelligent fax boards may offer additional throughput advantages over 'Class' modems relative to (a) more efficient bit-stuffing (see the Davidson Consulting publication, *Hidden Fax Board Costs & Secrets to Savings*), and (b) their on-board microprocessors tend to handle image-conversion and other associated overhead processing tasks more efficiently (i.e., on-the-fly) than Class 2 modems -- with the less efficient Class modem/host-related processing potentially causing delays in between fax phone calls and thereby taking yet more time overall to complete series of fax jobs.

### 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 (e.g., on a hard drive), where they are "queued" and then, as phone lines become free, sequentially relayed to the fax server's phone lines for transmission. Due to this kind of capability, it is possible, for example, to have a 2-line fax server support 100 active users. If we assume that each active user submits two 2-minute fax jobs per hour during every hour of an eight-hour day, here's what happens:

At the end of the first hour, assuming 120 minutes of faxes have been processed (60 minutes times 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, won't 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.

Each successive hour throughout the day, the length of queue delays will double. At the end of two hours, the delay will be 80 minutes; after three hours, a two-hour delay will exist. At the end of eight hours, a 5-hour-and-20-minute delay will exist. And, about 5 hours and 20 minutes after closing time, the last of the queued faxes would finally be delivered.

There are situations where it is acceptable for faxes to be delivered after considerable delays -- i.e., where next-day delivery suffices. If the fax server is installed in a region, such as in an underdeveloped country, where phone lines are very expensive to install or it may require months or even years to get additional phone lines installed, then it may be understandable for a fax server to be equipped with so few phone lines relative to its traffic volume. But Davidson Consulting, while allowing that such situations can be understandable, does not ever recommend under-powering fax servers in this manner. Here's why:

Faxes often involve documents that drive business transactions; delaying faxes risks losing business represented by those transactional documents.

Delayed fax deliveries can create negative impressions in the minds of trading partners.

Delayed faxes can interrupt the work processes of a company's own workforce, lowering worker productivity by repeatedly causing workflows to be disjointed and high numbers of tasks to be pending for longer than necessary periods of time

### Special Considerations Relative to Receiving Faxes

Some fax servers are used predominately or totally to send outbound faxes; assessing the number of lines they need simply 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 **and** be ready to receive faxes. Its one or the other:

**If a fax line is busy 75% of the time**, most inbound fax calls will initially receive busy signals and **unacceptably high numbers 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 all fax-reception time periods.

With multi-line fax servers, important considerations include:

(a) That adequate percentages of lines (e.g., 25% to 50%) be free to receive faxes at any given time

(b) In many cases, to prevent outbound fax broadcasts and the like from monopolizing all of a fax server's phone lines, it can make sense to 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 all fax calls passing through it is greater when most or all lines can be used for both sending and receiving

It is strongly recommended 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.

**Direct-inward-dialing (DID)**, which is the most widely used form of automated inbound routing (whereby faxes received at a fax server are automatically routed to LAN-based inboxes of individual recipients), creates an additional consideration because **DID lines are receive-only**.

## Conclusions

A general rule of thumb is 7 to 25 fax users per line (needs may vary; see page 6 for details).

Only analysis of site-specific factors can really begin to zero in on the number of lines needed -- and even those efforts can miss the mark a bit due to poor information upfront (e.g., extrapolating volume from fax machine log printouts isn't exactly a science) and some not uncommon post-installation surprises, usually involving extra usage generated spontaneously by the very introduction of the fax server resource.

Surprises can always happen (without it being anyone's fault, but merely a potentially unpredictable situation), so buyers need to understand that post-installation adjustments may have to be made.

Having "**too many**" lines may or may not be a problem, but having **too few lines** almost always has negative consequences.

In the end, it is critical that buyers have a firm grasp of fax phone line issues, in part because one less than optimal way to sell fax servers is to keep the initial bid price low by specifying fax servers that are under-equipped with lines. That sales tactic can win bids, but then do a disservice to buyers who get less than expected performance at the budgeted price and are left with the dilemma of either going overbudget, taking out the fax server and starting over again, or settling for subpar performance for meeting their fax dissemination needs, which translates into subpar performance in meeting customer service needs.