A User's Guide to Trunking

by Ralph Strader

RTS™

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Very Large Systems, Split Operation and Trunking

Trunking is similar to the long distance telephone system. In the case of RTS™ ADAM™ matrix intercom systems, that analogy is very close to reality. Before we get deeply into trunking, let's discuss the different ways available to make large systems.

First of all, exactly what do we mean by a large system? How big is "BIG?" With older technology (pre-TDM), systems were limited to a certain size (as a practical matter, in the "few" hundreds of ports) because of physical size and cost, not because of any particular technological or logistics limitations.

Today, intercom matrices in general, and RTS™ intercom matrices in particular, have a higher absolute limit, and a larger "typical size". For example, in the early 1980s, a well appointed high end Sports Truck of the type which would do an NFL game likely had 12 or so channels of PL, 6 IFB channels and 6 ISO channels. Today most "network size" trucks carry 64+ ports of ADAM™ matrix, and in some cases, over 100 ports. The intercoms have grown to carry program audio for monitoring, support 10, 15, or 20+ cameras, a host of graphics operators, and statistics personnel. Clearly, what is typical today was unimaginable less than 20 years ago.

Let's consider matrix sizes for a moment, again sticking to those I know best:

- RTS™ Zeus™ Matrix Intercom System: 24 ports fixed.

- RTS™ ADAM™-CS Matrix Intercom System: 8 – 64 ports in groups of 8.

- RTS™ ADAM™ Matrix Intercom Single Frame: 8 – 136 ports in groups of 8.

- RTS™ ADAM™ Matrix Intercom Multiple Frames: 136 – 1,000 ports in groups of 8.

Figure 1.1   A Comparison of Relative System Sizes

ZEUS 24 PORTS

ADAMCS 64 PORTS

ADAM 136 PORTS

ADAM 256 PORTS
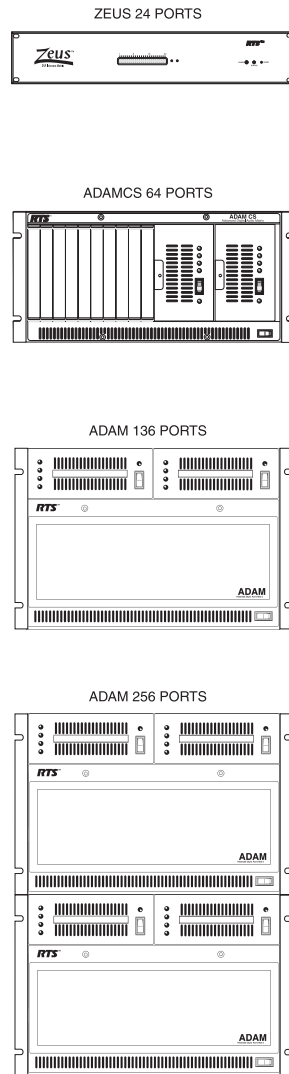
These are the numbers of ports that are available in a single RTS™ intercom matrix from Telex®. Other manufacturers offer systems in sizes from eight to approximately 500 ports. As you can see, size is not a limitation in most cases. At the time of this writing, the largest known single matrix intercom system in service is a RTS™ ADAM™ of 672 ports at NBC in New York.

Size and capability are not the limiting factors in most cases; let's examine what is:

Many factors may guide the design in favor of smaller individual systems. If the system is needed for four separate studios in a facility, which never or very rarely work together, then it may make more sense, for a number of reasons, to use four separate systems. Some of the very good reasons for doing this might include:

• Cost: Four 128-port systems cost less than one 512-port system.

• Reliability: A fire in one rack room does not destroy the single entire system.

• Manageability: Four different control studios have four different crews only affecting the setup of their operation.

• Shorter cable runs: The matrix for a given group of panels can be physically closer to those panels.

• Easier to expand a single matrix if the needs for one area grow.

Now let's take the opposite tack; what would be the reasons for going to a single large matrix? Some of the reasons might include:

- Operations require ability for any of the 512 users to communicate with any of the other users.

- Desire for single point of administration, control, troubleshooting and monitoring.

- Design of the facility is highly decentralized operationally, and day to day, different portions of the facility must work together.

- Certain users must work with all the facilities, and giving them four separate keypanels (one per system) is just not an option.

Ok, so now we have helped to identify whether to use one large matrix or a number of smaller ones. What happens when you get mixed answers to the questions above? Certain requirements drive you inexorably to separate matrices, but one or two key factors seem to demand a single matrix.

A couple different options or "hybrid designs" can be used in these cases.

The first and simplest is to define a few common points of contact between the intercom matrices. Take the following example: A television complex has two studios and two control rooms. Normally Control A works with Studio A, and Control B with Studio B. Occasionally, the wall between the two studios opens, (never mind how; that's the architects problem!) and there is a need for Control A to work with the cameras in the combined Studio AB.

Let's further presume that the normal method of operating has the cameras in each studio receiving two channels of intercom; a "Technical PL" created in the intercom configuration, and a "Production PL" also created in the intercom configuration of the respective matrices for Studio A and Studio B.

Figure 1.2   Seperate Studios, Seperate Intercom

INDEPENDENT MATRICES IN 2 STUDIOS
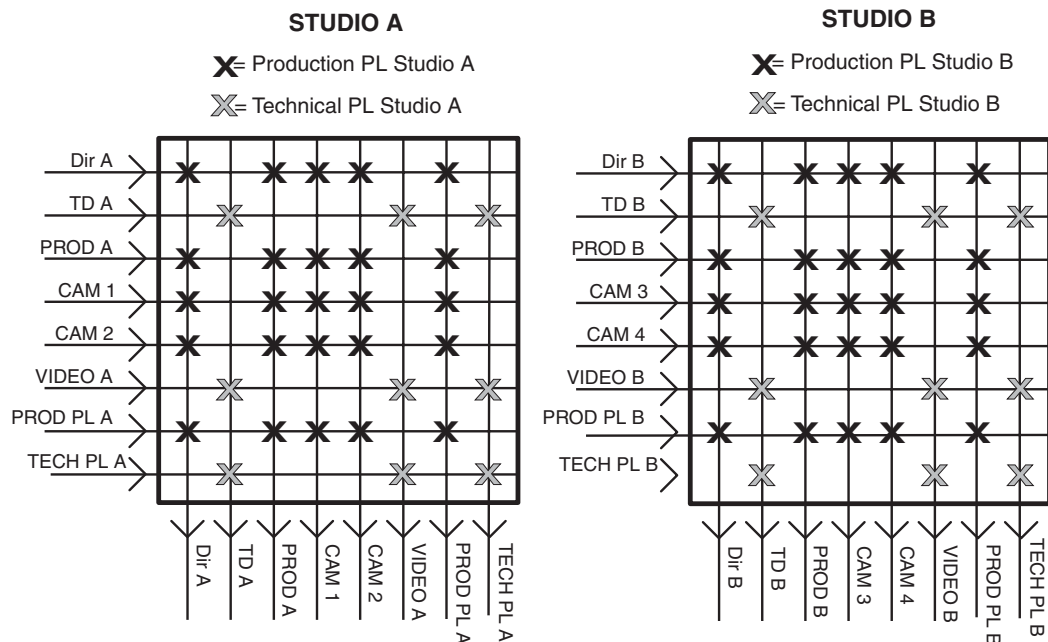
A quick way of allowing the combined operation would be to configure (in ADAM™-EDIT) the Production and Technical PLs of each matrix to include two available sets of

ports on a jackfield. Then simply connect the output of Production PL from Studio A to the input of Production PL for Studio B, the output of Production PL from Studio B to the input of Production PL for Studio A, and the same for Technical PLs.

Figure 1.3 Fixed Trunking

INDEPENDENT MATRICES IN 2 STUDIOS
with Fixed or Unitelligent Trunking
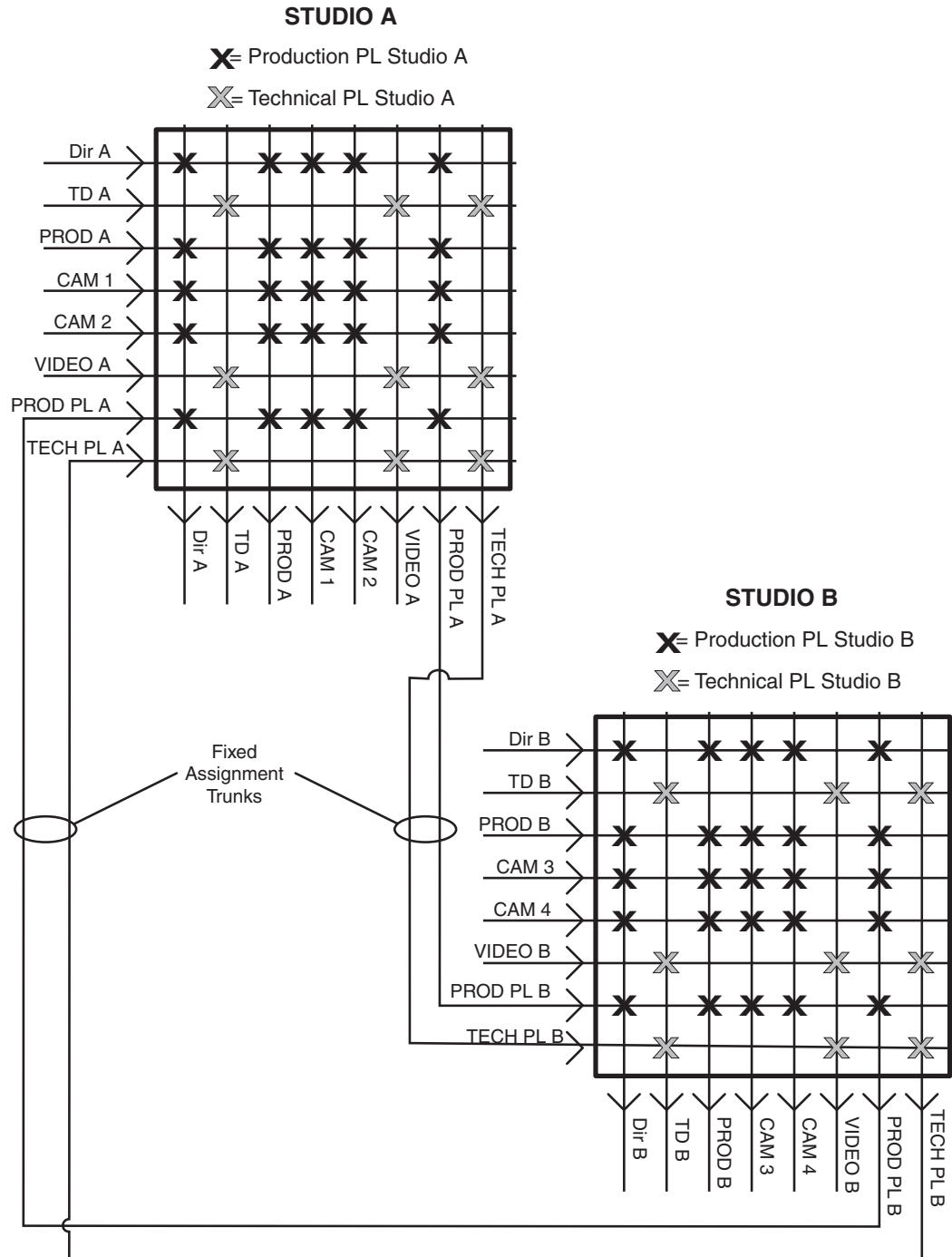
Now, any conversations on Production PL for A control will also be available to the Studio B cameras for both talking and listening, and the same is true for the Technical PL. Our problem is solved.

The technique we have just described is Trunking; the two ports of each system assigned to PLs have been "trunked" to one another. For reasons that will become clear later, we refer to this as "dumb" or unintelligent trunking. That isn't to say that it isn't a brilliant idea or solution. It just means that no system intelligence was employed in establishing the trunks.

To go back to our telephone system analogy, this is early-20th century technology, harkening back to the days of an operator in your hometown asking the long distance operator for a "trunk" to Chicago. That trunk then connected you to your Aunt in Chicago.

But, "Wait," you say, "didn't the telephone make this much easier back in the fifties by going to long distance area codes and direct distance dialing?" Yes, you are absolutely correct, give the reader a prize!

Today, some Intercom Matrices (including at least one from someone other than Telex® offer varying degrees of improved trunking that eliminates the manual patching described above. WARNING – sales pitch coming – Telex® has the largest, most intelligent, most proven trunking system available today, offering the ability to trunk more than 20 ADAM™ or ADAM™-CS systems together. This can all be done without human intervention, and in a system very comparable to the long distance telephone system. Let's look at some of the features and attributes of the system.

Taking the example of the two Production and Technical party-lines manually trunked together given earlier, let's make a couple small changes. Make the "trunking ports" assignable, and give them the designations "Trunk A" and "Trunk B," Connect a "computerized operator" between the two systems, communicating via a standard RS-232 serial port with both matrices. Let's call the computerized operator the "Trunk Master."

Figure 1.4 Intelligent Trunking

INDEPENDENT MATRICES IN 2 STUDIOS
with Telex Intelligent Trunking
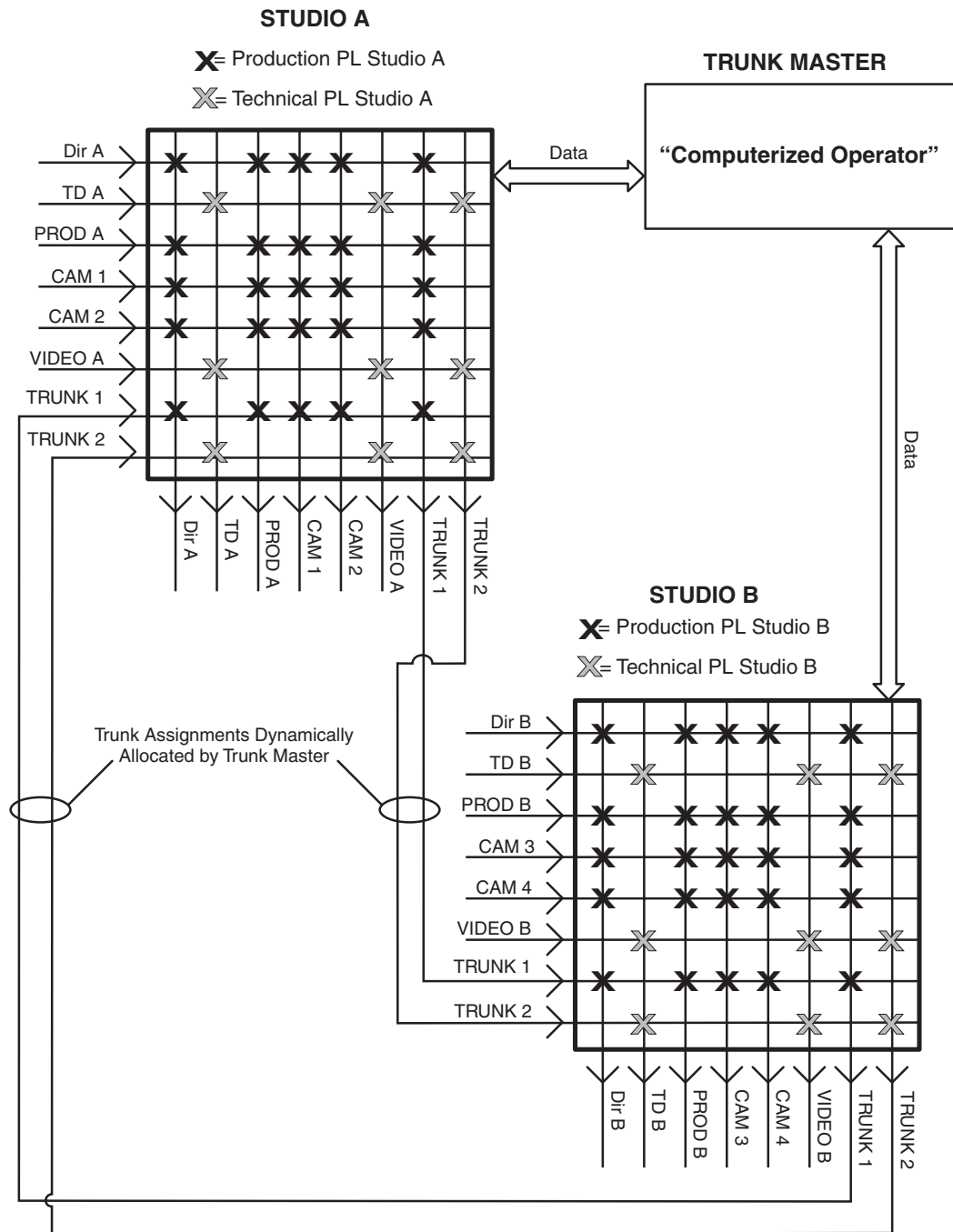
Now all we need to do is assign "area codes" to identify which matrix has which port. In actuality, in the Telex® Intelligent Trunking system, the trunk master figures out which matrix has which ports and keeps track of it for you. If you assign "ADIR" from the Studio A matrix to a panel on the Matrix for Control Room B, the system "knows" that it will have to configure and establish a trunk to allow that conversation to take place. It does so automatically, establishing the trunk, monitoring trunk usage, and releasing the trunk when the conversation is completed.

"Great" you say, "Why not always trunk and avoid HUGE matrices?" I'm glad you asked that question….

First, there is what I refer to as the "Mother's Day Syndrome." Mother's Day rolls around, and all good sons and daughters decide to call their dear sweet mom and wish her the best, and many of them don't get through. They hear a nice recording of someone saying, "All circuits are busy, please try your call again later." If you think about it, you have probably gotten that message a few times in your life when calling long distance, and never when calling someone down the block. That is because local calls (large metropolitan areas excluded) go through a single matrix (single central office), and there is a dedicated crosspoint (or a close equivalent) for each path. You get the message because there are a limited, finite number of long distance trunks available, and the heavy traffic volume keeps all of them busy at times.

Looking at the last example, imagine what would happen when the first person from Matrix A calls someone in Matrix B, Trunk A (or B) gets assigned, and life is good. A second person (maybe from B calling A this time) initiates a call, the other trunk is assigned and life is good. Now a third person in Matrix A decides to try to call someone in Matrix B. - oops - "All circuits are busy, please try your call again later."

In actuality, no voice is heard, but the calling party does get a busy indication on their panel, and the call does not go through. Therefore, we can see that trunking systems need to be sized appropriately for the anticipated traffic. Appropriately is the key. The Telephone Company (actually "companies" in the post AT&T breakup era) set aside enough trunks to handle all of the traffic most of the time – sounds suspiciously like "You can fool all the people some of the time," doesn't it?

Telex® Intelligent Trunking shares something else in common with the telephone company, the trunk master continuously monitors and reports on status of trunk utilization. The telephone companies do it in great "war rooms" with multi-story maps with lighted paths. Telex® does it with a constantly updated and logged report of trunk utilization on a conventional PC. It keeps track of (amongst other things) the maximum number of trunks you used simultaneously in the past x amount of time. With good historical data, you can determine the number of trunks you set aside for trunking.

However clever you think you are in setting aside trunks, there will always exist the unforeseen possibility that you may run out of trunks at some point.

For example: you have two studios, trunked together with five trunks, and in the past year have never used more than four at one time. Today, both studios are manned, and in Studio B is a news program being directed by Steven Spielberg, produced by George Lucas, with Tom Brokaw interviewing Madonna and Jerry Falwell (it could happen!). Studio A is busy doing a documentary on the history of dental appliances in South America. Care to take a guess how many of the crew in studio A will decide to listen in to the director, producer, talent IFB, program audio, cameras from B? All at the same time? Know what'll happen? Yep, "All circuits are busy, please try your call again later."

The other significant limitation may be that for each trunk you assign (which does require a port), you have given up a port that could have otherwise been used for two keypanels (one at each matrix). Make your system too long distance "friendly" by allocating a lot of ports as trunks, and you either limit the number of keypanels on each matrix, or spend more money to buy additional ports for each matrix.

All of these limitations aside, trunking can be a very good solution for many applications. Trunking works best when limited numbers of trunks are required to support occasional usage. Trunking works very well when many matrices need to be interconnected. As noted earlier, Telex® Intelligent Trunking can simultaneously handle automated routing between more than 20 matrices. A side benefit of such a multiple matrix trunked system is that the trunk master can figure out and establish trunk paths via multiple hops if needed due to trunk usage. If the trunks from Matrix A to B (see Figure 1.5) are all in use, the

possibility exists for the trunk master to route a signal from A to C and from C to B, thereby bypassing the bottleneck.

Figure 1.5 Multistage Trunking

MULTISTAGE TRUNKING
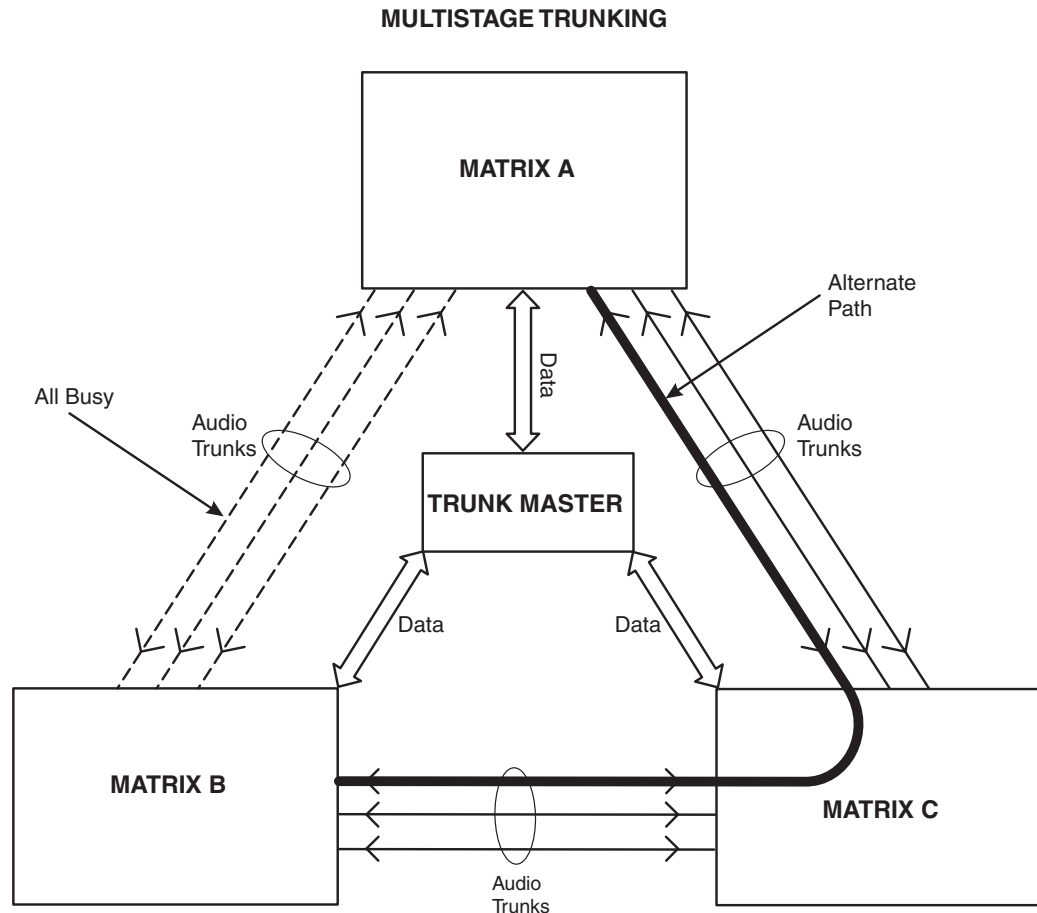
Another advantage of trunking is that there is no requirement for the individual matrices involved to be in close proximity. Systems, which are hundreds, or even thousands of miles away, have been successfully trunked using a variety of media for transporting the 9600 bps data and audio between sites. Telex Intelligent Trunking has been implemented using LAN, WAN, copper, satellite feeds, microwave links, fiber, and combinations of these to transport the audio and data between matrices and the trunk master.

A final methodology for distributing large matrices is a function of the manner in which multiple ADAM™ frames are interconnected. When two ADAM™ frames, each 128 ports, are connected together, they become functionally a single 256-port intercom system. The interconnect between the two frames is via a Bus Expander, which transports all 128 ports between the two frames without rendering any of them unusable for keypanels.

The physical interconnect between the frames with bus expanders can either be via a pair of coaxial cables, which can be used for distances up to 1,000 feet, or via a pair of fiber optic cables, which can run for over 1,000 meters. The signal sent over the fiber or coax is a multiplexed data stream, running at approximately 220 megabits/second. Since this data rate is lower than the 270 megabit CCIR-601 serial digital video standard, many of the asynchronous devices that can transport serial digital video can be used for this signal to achieve even greater distances.

By using the Bus Expander with multiple ADAM™ frames, a single electrical matrix can be located floors or buildings apart within a complex, and yet function as a single large matrix.