The New Branch Office Network

By Jim Metzler

Ashton, Metzler & Associates

This paper was written by Dr. Jim Metzler, Vice President of Ashton, Metzler & Associates. Dr. Jim Metzler is widely recognized as an authority on both network technology and its business applications. In over 28 years of professional experience, Jim has assisted tens of vendors to refine their product strategies and helped over a hundred enterprises evolve their network infrastructure.

Dr. Metzler has worked in many positions in the IT industry. This includes being a compiler writer for a branch of the US intelligence community; creating software tools to design customer networks for a major IXC; being an Engineering Manager for high-speed data services for a major Telco; being a Product Manager for network hardware; managing networks at two Fortune 500 companies; directing and performing market research at a major industry analyst firm; and running a consulting organization.

Jim holds a Ph.D. in Numerical Analysis from Boston University. He is a member of the Networld + Interop Planning Committee. He has co-authored a book, published by Prentice Hall, entitled "Layer 3 Switching: A Guide for IT Professionals".

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1. The Challenges of Branch Office Networking

A few short years ago, the conventional wisdom was that branch offices were heading towards obsolescence. One industry in particular that embraced this belief was the banking industry. The banking industry looked at branch offices as expensive and unnecessary, and believed that many of them would soon be replaced by ATMs.

The fact that there are now roughly four million branch offices supported by US businesses gives evidence to the fact that branch offices are not going away. However, while many business leaders, including those in the banking industry, were wrong in their belief that branch offices were unnecessary, they were clearly right in their belief that branch offices are expensive.

One of the reasons that branch offices are expensive is the sheer number of branch offices that need to be supported. For example, while a typical company may have only one or two central sites, they may well have tens, hundreds or even thousands of branch offices.

From an IT perspective, there are additional issues that increase the expense associated with branch office networking. One such issue is that many applications are written in a way that they perform well when they are run over a campus Local Area Network (LAN). However, these same applications can perform poorly when they are run over the Wide Area Network (WAN) that connects branch offices to the corporate data center.

Another issue that increases the expense associated with branch office networking is that enhanced functionality is continually being added to branch offices. In many cases, this functionality is added in a piece-meal function. As is the case with any aspect of IT evolution, a lack of planning drives up the cost of evolving a company's branch office network.

In order to be successful, IT organizations must avoid a piece-meal approach to evolving their branch office networks. In particular, as IT organizations respond to the need to deploy enhanced functionality in their branch office networks, they must do so in a way that allows them to easily scale these networks. In this context, the scalability of a branch office network refers to the ability to easily and cost-effectively increase both the size and the functionality of these networks.

In order to help IT organizations deploy scalable branch office networks, this document will identify the factors that are driving the evolution of branch office networking. The document will also create a detailed financial model of the IT costs that are associated with a typical branch office network. Finally, the document will quantify the costs associated with two disparate approaches to evolving a company's branch office network.

2. Today's Branch Office Network

The most common type of branch office WAN is a hub and spoke network based on Frame Relay, as shown in Figure 2.1. By "hub and spoke network" is meant a network in which there is a Permanent Virtual Circuit (PVC) that connects each branch office to one or more central sites, typically the company's data centers. Note that in a hub and spoke network, any communications between branch offices has to transit through a central site.

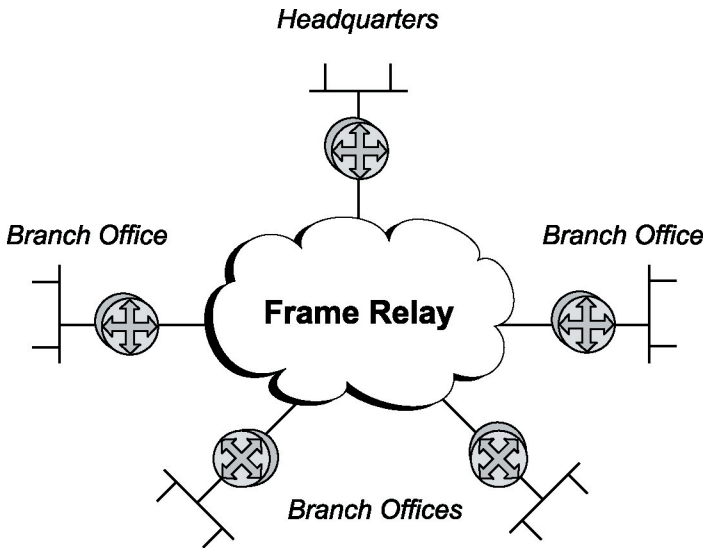

Figure 2.1: A typical hub and spoke network

Today's branch office networks have two other key characteristics. One of these characteristics is that they typically implement only relatively primitive electronic security. The second characteristic is that they seldom implement bandwidth management techniques such as Quality of Service (QoS).

However, there are a number of factors driving the evolution of branch office networks. One of these factors is that some companies are now beginning to migrate away from Frame Relay and towards an IPSec based VPN. This migration is intended to reduce the cost of wide area transmission, as well as provide increased security. In addition to deploying IPSec based VPNs, many IT organizations are responding to the requirement to increase electronic security by deploying a firewall in every branch office.

Another factor that is driving the evolution of branch office networking is that the traffic mix that transits the branch office WAN is continually changing. In particular, most existing branch office data networks were deployed with the goal of supporting traditional data applications, such as e-mail. Later these branch office networks had to evolve to also support Internet access. Now these branch office networks need to evolve to support both voice and video traffic.

It is worth noting that the requirement to support Internet access puts additional traffic onto branch office networks, and hence can drive the requirement to increase the capacity of these networks. However, since Internet access is typically not time-sensitive, the requirement to support Internet access does not result in the requirement to deploy QoS. Throughout this document, an application will be deemed to be "time-sensitive" if it requires sub-second response time.

As was the case with Internet access, the requirement to support voice and video adds additional traffic to a branch office network. For example, based on the encoding scheme that is used, it is common for a Voice over IP (VoIP) call to require between 32 Kbps and 64 Kbps of bi-directional bandwidth.

Video conferencing has differing requirements for the audio and the video components. The audio component of a videoconference requires the same capacity as a VoIP call, while the video component requires between 128 Kbps and 512 Kbps.

However, unlike Internet access, voice and video are time-sensitive applications. For example, the ITU recommends that voice should have a one-way latency of 150 ms or less. Hence, supporting voice and video traffic on a branch office network drives the need to deploy QoS at each branch office in order to ensure that the branch office network can satisfy this stringent latency requirement.

3. Financial Analysis

The Importance of Performing a Financial Analysis

While the value that IT brings to an organization is indisputable, it is also indisputable that IT is expensive. Table 3.1 depicts how much selected industries spend on IT as a percentage of their annual revenues.

INDUSTRY	PERCENTAGE OF REVENUES SPENT ON IT
Financial Services	14%
Banking	8%
Insurance	6%
Consulting and Business Services	4%
Health Care and Medical	3%
Automotive	2%

Table 3.1: IT Budget as a Percentage of Revenues
Source: Information Week

Driven in part by the harsh economic environment of the last few years, there currently is significant pressure inside virtually all companies to closely manage the money spent by the IT organization. In order to quantify this pressure, Ashton, Metzler & Associates recently asked over two hundred network professionals how important it was in their organization to do a financial analysis of possible technology and service alternatives. Their answers are summarized in Figure 3.1 on the next page.

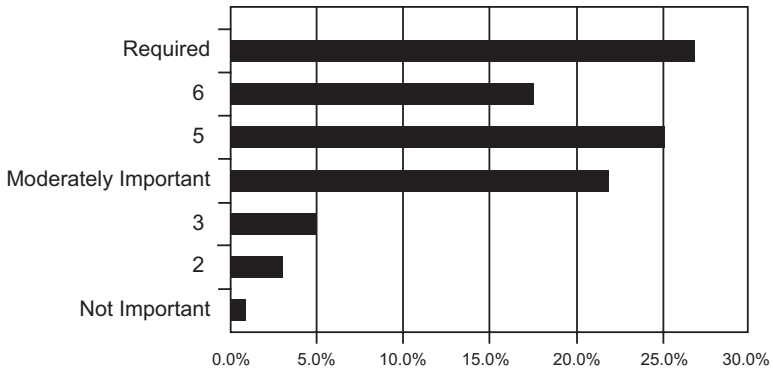

Figure 3.1: Importance of Doing an RoI Analysis
Source: Ashton, Metzler & Associates

One clear conclusion that can be drawn from Figure 3.1 is that in order to be successful, network professionals must be able to do a financial analysis. Put another way, in order to be successful, network professionals must become as facile with performing a financial analysis as they are with performing a technology analysis.

Total Cost of Ownership (TCO) Analysis

As the name implies, a TCO analysis quantifies the total costs associated with an investment in IT over the life cycle of the investment. A TCO analysis is used to compare the costs associated with alternative IT solutions. This type of analysis is particularly helpful in those cases in which it is difficult to quantify any significant financial benefits that result from the IT investment.

Within this document a TCO analysis will be performed to compare the costs associated with two fundamentally different approaches to branch office networking. One approach, which will be referred to in this document as The Integrated Approach, has a single piece of networking equipment in each branch office. In The Integrated Approach, the single piece of networking equipment in the branch office performs a variety of networking functions.

The second approach, which will be referred to in this document as The Component Approach, has multiple pieces of equipment in each branch office. In The Component Approach, each piece of networking equipment in the branch office performs one specific function.

In order to quantify the totality of costs associated with an investment in IT, it is often helpful to assign those costs into three categories: Facilities, Capital, Personnel.

Facilities costs include the expenses associated with activities such as heating and air conditioning, cabling, floor space, and rack space. Facilities costs also include the expenses associated with Wide Area Network (WAN) transmission links.

Capital costs include the expenses associated with the initial acquisition and implementation of hardware and software.

Personnel costs include the loaded salaries of the internal personnel, as well as third parties, that are associated with the ongoing support of the IT infrastructure.

The life cycle of an IT investment is a metric that will vary, based on both the type of investment, as well as the accounting practices of the company making the investment. In those situations in which the IT investment includes the acquisition of new hardware, it is common to use the length of the depreciation cycle for the hardware as the life cycle of the IT investment. Throughout this document, it will be assumed that the life cycle of an IT investment is three years.

4. The Financial Model of a Branch Office

This section will create a model of the IT costs that are associated with a typical branch office network. Throughout this document, this model will be referred to as The Financial Model. Note that the costs that are incorporated into The Financial Model are intended to be realistic. However, the actual costs that a company will experience will vary somewhat based on that company's particular situation.

The Financial Model quantifies the Facilities, Capital and Personnel costs that are associated with a Frame Relay based hub and spoke network that connects branch offices to a single central site. The Financial Model assumes that the company is evaluating upgrading its branch office network and is evaluating component versus integrated solutions. The Financial Model allows for multiple connectivity options between a branch office and the Frame Relay network, as well as between the central site and the Frame Relay network.

Facilities Costs

There are three primary cost components of a branch office Frame Relay network. They are the costs associated with:

Access Circuits
This component includes the circuits that connect the branch offices to the Frame Relay network. This component also includes the circuit(s) that connects the central site(s) to the Frame Relay network.

PVC Speed
This component refers to the committed transfer rate between a branch office and the central site. In no case can the committed transfer rate be greater than either the speed of the access circuit or the port speed.

Port Speed
This component defines the maximum rate of data transfer that is possible.

In order to strike a balance between simplicity and completeness, The Financial Model will assume that there are six different connectivity options that are viable for use by a branch office. Those connectivity options are depicted in Table 4.1.

CONNECTIVITY OPTION	PVC SPEED	PORT SPEED	TYPE OF ACCESS CIRCUIT
1	64 Kbps	128 Kbps	T1
2	128 Kbps	256 Kbps	T1
3	192 Kbps	384 Kbps	T1
4	256 Kbps	512 Kbps	T1
5	320 Kbps	640 Kbps	T1
6	384 Kbps	768 Kbps	T1

Table 4.1: Branch Office Connectivity Options

The way to interpret Table 4.1 is that Connectivity Option #1 consists of a 64 Kbps PVC, a 128 Kbps Frame Relay port, and a T1 access circuit.

Table 4.2 contains representative prices for each component of the branch office network. Note that in addition to the components listed in Table 4.1, Table 4.2 also contains the cost of a T3 access circuit and a T3 Frame Relay port. These were included because these higher speed network components may be the appropriate choice in order to provide connectivity between the central site and the Frame Relay network.

COST COMPONENT	MONTHLY COST
Access Circuits	
T1	$200
T3	$1,800
PVC Speeds	
64 Kbps	$16
128 Kbps	$35
192 Kbps	$40
256 Kbps	$45
320 Kbps	$60
384 Kbps	$75
Port Speeds	
128 Kbps	$170
256 Kbps	$260
384 Kbps	$350
512 Kbps	$425
640 Kbps	$490
768 Kbps	$550
T1	$650
T3	$5,200

Table 4.2: Frame Relay Cost Components

Capital Costs

The Financial Model assumes that the installed cost of the new branch office router is $2,000 per office. As will be shown in section 5 of this document, the acquisition cost of the branch office router is only a relatively minor contributor to the TCO of a branch office network.

Personnel Costs

There are a number of ongoing management and operations functions, such as reporting and trouble-shooting, that are associated with branch office networking.

Some IT organizations choose to support a branch office network with internal personnel. Other IT organizations choose to use a third party, particularly in those cases where the third party has personnel in close proximity to each of the branch offices. Whether the IT organization is supporting the branch office network with internal resources or through a third party, The Financial Model will assume that the support costs are $300 per month for each piece of networking equipment in a branch office. The $300 includes the entire overhead associated with the ongoing monitoring and management of the equipment.

5. The Getting Started Scenario

This section will quantify the TCO of three representative branch office networks. These networks will be referred to collectively as The Three Networks, and will be referred to individually as The Small Network, The Medium Network, and The Large Network. These networks are comprised of 5, 50, and 200 branches respectively.

The TCO that is calculated in this section makes use of the assumptions that are outlined in the preceding section. The scenario that is described in this section will be referred to in this document as The Getting Started Scenario.

Table 5.1 details the connectivity options that are utilized in each of The Three Networks. For example, as shown in Table 5.1, The Large Network is comprised of 100 branches that utilize connectivity option #1 (i.e., 64 Kbps PVCs, 128 Kbps Frame Relay ports, and a T1 access circuit), and another 100 branches that utilize connectivity option #2; i.e., 128 Kbps PVCs, 256 Kbps Frame Relay ports, and a T1 access circuit.

CONNECTIVITY OPTION	THE SMALL NETWORK	THE MEDIUM NETWORK	THE LARGE NETWORK
1	5	40	100
2	0	10	100

Table 5.1: Branch Connectivity – The Getting Started Scenario

Facilities Costs

Table 5.2 (next page) contains the cost for just the Frame Relay component of The Three Networks depicted in Table 5.1. Note that Table 5.2 contains both the monthly recurring Frame Relay costs, as well as the total of these costs over a three-year life cycle.

	MONTHLY RECURRING COSTS	TOTAL FRAME RELAY COSTS OVER THREE YEARS FOR THE GETTING STARTED SCENARIO
The Small Network	$2,780	$100,080
The Medium Network	$22,940	$825,840
The Large Network	$95,100	$3,423,600

Table 5.2: Frame Relay Costs

Capital Costs

Table 5.3 contains the capital costs associated with each of The Three Networks over a three-year life cycle. Note that the costs contained in Table 5.3 represent the installed cost of the new branch office routers.

	TOTAL CAPITAL COSTS OVER THREE YEARS FOR THE GETTING STARTED SCENARIO
The Small Network	$10,000
The Medium Network	$100,000
The Large Network	$400,000

Table 5.3: Three-Year Life Cycle Capital Costs

Personnel Costs

Table 5.4 contains the personnel costs associated with the ongoing support of each of The Three Networks over a three-year life cycle.

	TOTAL PERSONNEL COSTS OVER THREE YEARS FOR THE GETTING STARTED SCENARIO
The Small Network	$54,000
The Medium Network	$540,000
The Large Network	$2,160,000

Table 5.4: Three-Year Life Cycle Personnel Costs

Total Cost of Ownership: The Getting Started Scenario

Table 5.5 depicts the TCO of each of The Three Networks over a three-year life cycle.

	FACILITY COSTS	CAPITAL COSTS	PERSONNEL COSTS	TOTAL COSTS
The Small Network	$100,080	$10,000	$54,000	$164,080
The Medium Network	$825,840	$100,000	$540,000	$1,465,840
The Large Network	$3,423,600	$400,000	$2,160,000	$5,983,600

Table 5.5: TCO for The Three Networks – The Getting Started Scenario

The data in Table 5.5 clearly supports the assertion that was made in the introduction to this document – that branch office networks are expensive. The data in Table 5.5 also demonstrates that personnel costs are a major component of the TCO of a branch office network.

6. Upgrading the Branch Office Network

This section of the document assumes that two factors are driving upgrades in The Three Networks. The first factor is an increase in traffic in general, as well as the deployment of time-sensitive traffic such as voice and video in particular. The second factor is the requirement to increase security.

This section will do a financial analysis of three scenarios for upgrading The Three Networks. Those scenarios are:

The Increase Bandwidth Scenario
Bandwidth is added to support additional traffic, some of which is time-sensitive and some of which is not.

The QoS Scenario
QoS functionality is deployed in order to provide better support for voice and video traffic while simultaneously minimizing the cost of WAN bandwidth.

The Security Scenario
Security functionality is added.

For both the QoS and security scenarios, the financial analysis will examine two approaches to branch office networking: The Component Approach and The Integrated Approach.

The Increase Bandwidth Scenario

In this scenario, QoS is not deployed as part of upgrading The Three Networks. Since QoS is not deployed, a significant bandwidth upgrade is necessary in order to support both the additional traffic as well as to increase the probability that voice and video will perform well.

Note that since additional hardware is not deployed, this scenario has the same capital and personnel costs as does The Getting Started Scenario. Since no hardware is added, there is also no difference in the TCO of The Integrated Approach and The Component Approach.

This scenario assumes that after the bandwidth upgrades, The Three Networks are comprised of a mix of connectivity options 5 and 6. Table 6.1 shows how many branches utilize each of these two connectivity options. Table 6.2 serves as a reminder of what those connectivity options represent.

CONNECTIVITY OPTION	THE SMALL NETWORK	THE MEDIUM NETWORK	THE LARGE NETWORK
5	5	40	100
6	0	10	100

Table 6.1: Branch Connectivity – The Increase Bandwidth Scenario

CONNECTIVITY OPTION	PVC SPEED	PORT SPEED	TYPE OF ACCESS CIRCUIT
5	320 Kbps	640 Kbps	T1
6	384 Kbps	768 Kbps	T1

Table 6.2 Connectivity Options for the Increase Bandwidth Scenario

Because of the significant increase in bandwidth, there is a significant increase in the TCO of The Three Networks. Table 6.3 depicts TCO of The Increase Bandwidth Scenario and compares it to the TCO of The Getting Started Scenario.

	TCO OF THE GETTING STARTED SCENARIO	TCO OF THE INCREASE BANDWIDTH SCENARIO	INCREASE IN THE TCO
The Small Network	$164,080	$260,200	$96,120
The Medium Network	$1,465,840	$2,108,800	$642,960
The Large Network	$5,983,600	$8,734,000	$2,750,400

Table 6.3: TCO of the Increase Bandwidth Scenario

The data in Table 6.3 demonstrates the significant costs that are associated with throwing bandwidth at a branch office network.

The QoS Scenario

In this scenario, instead of a raw bandwidth upgrade, QoS is deployed at each branch office. The purpose of QoS is to ensure that voice and video traffic performs well, as well as to minimize the cost of wide area bandwidth.

This section will analyze two approaches that a company might use to implement this scenario. In The Component Approach, the company installs a new device in order to implement QoS. In The Integrated Approach, the company utilizes functionality that was already in its branch office router.

This scenario assumes that The Three Networks are comprised of a mix of connectivity options 3 and 4. Table 6.4 shows how many branches utilize each of these two connectivity options. Table 6.5 serves as a reminder of what those connectivity options represent.

CONNECTIVITY OPTION	THE SMALL NETWORK	THE MEDIUM NETWORK	THE LARGE NETWORK
3	5	40	100
4	0	10	100

Table 6.4: Branch Connectivity – The QoS Scenario

CONNECTIVITY OPTION	PVC SPEED	PORT SPEED	TYPE OF ACCESS CIRCUIT
3	192 Kbps	384 Kbps	T1
4	256 Kbps	512 Kbps	T1

Table 6.5: Connectivity Options for the QoS Scenario

Table 6.6 contains the TCO of The Component Approach to The QoS Scenario. It should be noted that in computing the TCO contained in Table 6.6, The Financial Model assumed an installed cost of $3,000 per branch office for the QoS Component in addition to the $2,000 for the branch office router.

	FACILITY COSTS	CAPITAL COSTS	PERSONNEL COSTS	TOTAL COSTS
The Small Network	$136,800	$25,000	$108,000	$269,800
The Medium Network	$1,305,000	$250,000	$1,080,000	$2,635,000
The Large Network	$5,040,000	$1,000,000	$4,320,000	$10,360,000

Table 6.6: TCO of The QoS Scenario – The Component Approach

Table 6.7 contains the TCO of The Integrated Approach to The QoS Scenario.

	FACILITY COSTS	CAPITAL COSTS	PERSONNEL COSTS	TOTAL COSTS
The Small Network	$136,800	$10,000	$54,000	$200,800
The Medium Network	$1,305,000	$100,000	$540,000	$1,945,000
The Large Network	$5,040,000	$400,000	$2,160,000	$7,600,000

Table 6.7: TCO of The QoS Scenario – The Integrated Approach

Table 6.8 compares the TCO of The Increased Bandwidth Scenario to both of the approaches of The QoS Scenario.

	TCO OF THE INCREASED BANDWIDTH SCENARIO	TCO OF THE QoS SCENARIO - THE COMPONENT APPROACH	TCO OF THE QoS SCENARIO - THE INTEGRATED APPROACH
The Small Network	$260,200	$269,800	$200,800
The Medium Network	$2,108,800	$2,635,000	$1,945,000
The Large Network	$8,734,000	$10,360,000	$7,600,000

Table 6.8: Comparison of TCOs

One obvious conclusion that can be drawn from the data in Table 6.8 is that the use of an integrated approach to QoS deployment can significantly reduce the TCO of a branch office network by reducing the cost of WAN bandwidth. However, based on the assumptions made by The Financial Model, the use of a component approach to QoS actually increases costs. That follows because the

monthly transmission savings that is associated with QoS is less than the combination of the cost of the additional QoS device plus the extra $300 per month that is required to support the device.

The Security Scenario

This scenario builds on The QoS Scenario. In particular, this scenario assumes that QoS has been deployed and that the decision has now been made to increase the security of The Three Networks.

This scenario will also build on the two approaches used in The QoS Scenario; i.e., The Component Approach and The Integrated Approach. The Component Approach assumes that in addition to deploying a separate Component for QoS, a separate Component is deployed to provide firewall functionality. The Financial Model assumes that the installed cost of this security Component is $1,000.

	TCO OF THE SECURITY SCENARIO - THE COMPONENT APPROACH	TCO OF THE SECURITY SCENARIO - THE INTEGRATED APPROACH	SAVINGS WITH THE INTEGRATED APPROACH
The Small Network	$328,800	$200,800	$128,000
The Medium Network	$3,225,000	$1,945,000	$1,280,000
The Large Network	$12,720,000	$7,600,000	$5,120,000

Table 6.9: TCO of The Security Scenario

Table 6.9 depicts the TCO of the two approaches to implementing security in The Three Networks. Note that The Financial Model assumed that there were no extra costs associated with turning on security functionality in The Integrated Approach.

The data in Table 6.9 reinforces the conclusion that was drawn previously. That conclusion being that The Integrated Approach to branch office networking can significantly reduce the TCO by reducing the capital and the personnel costs.

7. Summary and Recommendations

Branch office networks are inherently complex and expensive. Much of this complexity and expense stems from the sheer number of branches that have to be supported. However, as shown in this document, there is a very significant difference between a one time capital expense and an ongoing personnel expense.

To demonstrate the difference between these two types of expenses, consider The Medium Network; i.e., a network with 50 branch offices. For The Medium Network, every $100 of capital that is spent in a branch office translates into an overall expense of $5,000. However, every $100 per month of personnel costs in a branch office translates to an overall expense of $180,000.

In addition to being complex and expensive, branch office networks are continually evolving to support new requirements. These requirements have two primary components. One component of the new requirements is to carry ever-increasing amounts of traditional data traffic, along with time sensitive traffic such as voice and video. The second component of the new requirements is to support new functionality such as security.

Because of these new requirements, branch office networks are continually evolving. In order to be successful, IT organizations must avoid a piece-meal approach to evolving their branch office networks.

There are two fundamentally different approaches that IT organizations can use to evolve their branch office networks. In The Component Approach, a new Component is added every time new functionality is needed in a branch office. In The Integrated Approach, a platform that can perform a wide range of functions is deployed in each branch office.

As was shown in this document, there are very significant savings associated with using The Integrated Approach to evolving branch office networks. In particular, by using The Integrated Approach, IT organizations can respond to the need to deploy enhanced functionality in their branch office networks in an extremely cost effective manner.

Kentrox, LLC, 20010 NW Tanasbourne Drive, Hillsboro, OR 97124
Phone 503-643-1681 • Toll Free 800-733-5511

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