

# WHITE PAPER

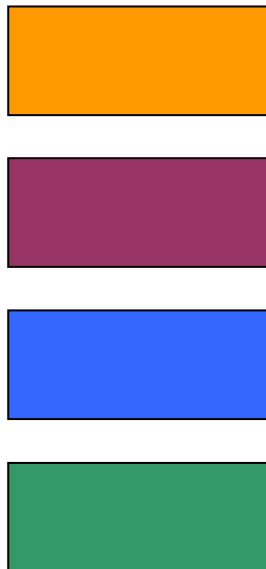


Zone wiring within commercial buildings:  
An innovative approach

By: Andrew R. Young

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## Zone wiring within commercial buildings: An innovative approach



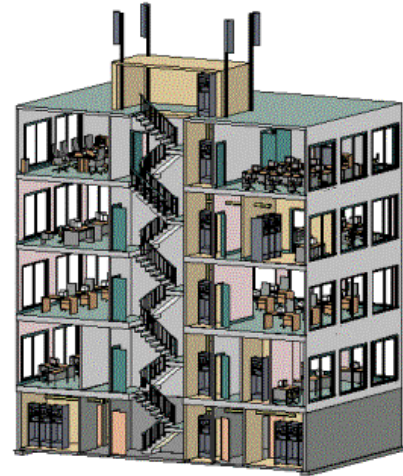
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Further information regarding structured cabling is available on the Internet.

# FORWARD

**W**ith every commercial industry now heavily relying on the solutions provided by Information Technology, the implementation of supporting infrastructure is more critical than ever. The cost to business for the installation and maintenance of this infrastructure is a major investment in finance, time and resource. Technology no longer demands the use of proprietary systems – in fact, these types of solutions are now typically avoided.



The intention of this document is to provide discussion relating to the implementation of a structured cabling system and associated network equipment based upon the changes in the draft ANSI/EIA/TIA 569B standard (Pathways and Spaces). These changes allow for the distribution of services (cabling and active equipment) within the Work Area (WA) from a locally positioned Telecommunications Enclosure (TE) – ***a zone wiring solution***. By taking advantage of these changes and the developments in networking and telephony products, a new approach to building infrastructure can be utilised.

This document considers implementation, performance, standards and cost - both upfront and ongoing - from the tenant and building owner's perspective. It is also to serve as a tool to show how changes in standards can allow contractors / system integrators to "look outside the square" and propose diverse solutions. The products and solutions presented in this document are readily available within today's market place. Upon review of their own exact requirements, building owners and tenants can immediately invest in this type of solution and take full advantage of the benefits – both short and long term.

It should however be noted that the White Paper has been compiled by one person and as such will not have considered all adaptations and concepts. Different vendor products, future changes to standards, interoperability, etc will allow further development and alternate intelligent solutions.

**ANDREW R. YOUNG**

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# STANDARDS

**T**he draft ANSI/EIA/TIA 569B (Commercial Building Standard for Telecommunications Pathways and Spaces) standard includes information for Telecommunications Enclosures (TE) and distribution of active network equipment within the Work Area (WA) – *a zone wiring solution*. This is in contradiction to the typical installation practice of installing a centrally located Telecommunications Closet on each building level.

A classic standards based structured cabling solution within a commercial building includes a main Equipment Room (Campus / Building Distributor) on a lower building level and Telecommunications Closets (Floor Distributors) on each building level. Connectivity between the Building Distributor (BD) and each of the Floor Distributors (FD) is typically via fibre optic cabling (data) and multi-pair copper cabling (voice) within a vertical riser shaft. Predominately a dedicated secure room is provided to house the Floor Distributor and associated equipment on each building level. Connectivity from the Floor Distributor to each Work Area is provided by multiple 4 pair high speed data cables - Category 5e or Category 6.

Changes to the cabling standards over the past few years permit the use of Consolidation Points (CP) and Multi User Telecommunications Outlets (MUTO). This includes cabling from the Floor Distributor to the Work Areas (WA) throughout each tenancy.

A Consolidation Point (CP) provides simplicity to tenants who make regular moves, adds and changes. Concealed floor or ceiling mounted enclosures are cabled with multiples of horizontal media and terminated onto a punch down (IDC) frame. Connectivity from the Consolidation Points is extended to the Work Area with the same media and terminated onto fixed outlets / face plates. This type of solution provides the tenant with increased flexibility and reduced cost as alterations and additions to the horizontal media need only be made in the local Work Area.

In the case of a MUTO, connectivity to Work Area equipment is facilitated directly by stranded cords (fly leads) from the MUTO – typically wall mounted. This allows great flexibility as moves, adds and changes can be completed by the tenant. It should however be noted that restrictions brought about by the lack of local pathways can be limiting.

These solutions provide greater cabling flexibility however do not reduce the requirement for Floor Distributors on each building level. It is anticipated that the draft ANSI/EIA/TIA 569B standard will be published in late 2004 allowing an innovative approach.....

# OVERVIEW

**F**or the purpose of discussion and analysis, this document is based on the implementation of a structured cabling system, network equipment and telephony system within a new twelve level multi-storey commercial office building. The building will be occupied by a single tenant who will purchase all new equipment and will bare the cost of the complete installation. The customer has signed a long term lease and wishes to ensure that their investment in this infrastructure is commercially sound, that the long term total cost of ownership is controlled and that the design is future proof.

The building includes the following:

- square layout - 60 metres<sup>2</sup> (200 feet<sup>2</sup>) per level.
- central concrete core - 20 metres<sup>2</sup> (66 feet<sup>2</sup>) per level.
- modern office design
- single vertical telecommunications riser shaft
- accessible tiled suspended ceiling
- partition walls
- multiple managerial offices per level
- multiple workstation pods per level
- two level basement – 10 levels of office space
- building generator system

For the basis of comparison the solutions are identified as follows:

## **1. Traditional:**

A system implemented utilising common cabling practices and traditional equipment technologies.

## **2. Innovative:**

A system taking full advantage of changes in Draft ANSI/EIA/TIA 569B standard and the latest developments in network and telephony equipment technology.

For the purpose of simplicity, this document only takes into financial consideration items that would differ due to the implementation of either solution. The pricing detailed within this document is indicative only and shown in Australian dollars (AUD).

# TRADITIONAL

The basis of the *traditional solution* will be the implementation of a structured cabling system, traditional PABX and switched Ethernet network.

## Overview

The traditional solution includes the implementation of a voice and data network throughout the building including all related infrastructure. A common design based on the current standard would include a Telecommunications Outlet (TO) in each 10 square metres (100 sq feet) of usable space. This would equate to 96 users per building level.

## Structured Cabling System

A Computer Room would be established on the ground level to serve as the centre of the hierarchy. The computer room would serve as the Campus / Building Distributor and house the core switch, PABX and server equipment. A Floor Distributor would be established in a dedicated room within the building core on each level and include a 45 Rack Unit free standing equipment cabinet.

The backbone data cabling will be based upon 12 core 50/125 multimode fibre optic riser cabling. Within the Building and Floor Distributors the fibre optic cabling will be terminated within 19" rack mounted enclosures and fitted with Small Form Factor (SFF) connectors. The backbone cabling will be installed within the central building riser.

The voice backbone will be served by Category 3 UTP cables with an allowance of 150 copper pairs per level. The copper pairs will be terminated onto a wall mounted IDC frame within the Building Distributor as well as 6 x 24 port RJ45 patch panels housed within each Floor Distributor's equipment cabinet – one pair per socket.

The horizontal subsystem will be cabled with Category 6 Unshielded Twisted Pair cable. By standardising on triple TO's, this would equate to 288 TO's per building level. Allowing an additional 12 single TO's for Wireless Access Points (8) and communal telephone handsets (4) will bring the total to 300 per level and a total quantity of 3000 TO's for the ten office levels of the building. The horizontal cabling will terminate on 19" rack mounted RJ45 patch panels within each Floor Distributor and onto surface or flush mounted RJ45 face plates at each Work Area.

### **Network Solution**

A fault tolerant central core switch will be established with the Building Distributor to provide Local Area Network (LAN) connectivity throughout the facility. The core switch will include 48 Gigabit Ethernet Ports, redundant power supplies, redundant supervisor modules and a backplane speed of 96 Gigabits.

Within each Floor Distributor, 6 x 24 port Ethernet switches will be provided allowing a total of 144 user ports. To maintain a maximum oversubscription ratio of 4.8:1, only groups of two 24 port switches will be stacked and connected to the core switch via a dedicated gigabit Ethernet channel. This method will provide three Gigabit Ethernet Channels to each Floor Distributor, allow for dedicated switch VLANs and ensure optimum network performance. Eight 802.11b wireless Access Points have also been allowed per level giving roaming users complete mobility.

### **Telephony Solution**

A traditional PABX system will be installed within the Building Distributor. It will include 1000 user extensions, 4 x PIMs, a rectifier with batteries providing 4 hours backup and 3 x E1 cards for carrier connectivity. 800 basic analog and 200 digital business handsets have been included.

### **Summary**

This solution provides the tenant with full functionality and established technologies.

# INNOVATIVE

The basis of the *innovative solution* will be the implementation of a zone cabling system, network telephony and switched Ethernet network. This solution will take full advantage of the changes in standards and network telephony convergence.

## Overview

The innovative solution includes the implementation of a voice and data network throughout the building including all related infrastructure. A typical design based on the current standard would include a Telecommunications Outlet (TO) in each 10 square metres (100 sq feet) of usable space. This would equate to 96 users per building level.

## Zone Cabling System

A Computer Room would be established on the ground level to serve as the centre of the hierarchy. The computer room would serve as the Campus / Building Distributor and house the core switch, network telephony and server equipment. Concealed ceiling mounted zone wiring enclosures would be established throughout the tenancy to provide connectivity to the local Work Area.

The backbone data cabling will be based upon 6 core 50/125 multimode fibre optic riser cabling. Within the Building Distributor and zone wiring enclosures, the fibre optic cabling will be terminated with 19" rack mounted enclosures fitted with Small Form Factor (SFF) connectors. The backbone cabling will be installed within the central building riser.

Utilising a Network Telephony approach negates the requirement of any dedicated voice backbone. The fibre optic backbone cabling is shared by both the voice and data solution.

The horizontal subsystem will be Category 6 Unshielded Twisted Pair cable. Where the traditional solution has standardised on triple TO's, the innovative solution can standardise on dual TO's. Network Telephony handsets include a dual port 10/100MB Ethernet switch allowing any local computing device to plug directly into the handset in lieu of a dedicated TO. This would equate to 196 TO's per building level. As Wireless Access Points can be positioned at each Zone Wiring enclosure, this further reduces the total TO count per level by 8. Allowing for communal telephone handsets (4) will bring the total to 200 per level and a total quantity of 2000 TO's for the ten office levels of the building. The horizontal cabling will terminate with 19" rack mounted RJ45 patch panels within each Zone Wiring enclosure and onto surface or flush mounted RJ45 face plates at each Work Area.

### **Network Solution**

A fault tolerant central core switch will be established with the Building Distributor to provide Local Area Network (LAN) connectivity throughout the facility. The Core switch will include 80 Gigabit Ethernet Ports, redundant power supplies, redundant supervisor modules and a backplane speed of 96 Gigabits.

Within each Zone Wiring enclosure, a single 24 port Ethernet switch will be provided, allowing for 8 zone wiring enclosures giving a total of 144 user ports per level. Being that each zone wiring enclosure will have a dedicated Gigabit link back to the core, a maximum oversubscription ratio of 2.4:1 is maintained. This solution ensures optimum network performance ensuring the required Quality of Service (QoS) for Network Telephony and streaming media. 802.11b wireless Access Points has also been allowed within each Zone Wiring enclosure providing roaming users with complete mobility. They will be directly connected to the zone wiring switch with a patch cord.

### **Telephony Solution**

A Network Telephony system will be installed within the Building Distributor. This system will include licensing for 1000 user extensions, a UPS and 3 x E1 cards for carrier connectivity. 800 basic analog and 200 digital business handsets have been included. It also includes web based administration and all of the benefits of CTI applications including TAPI.

### **Summary**

This solution provides the tenant with full functionality, reduced total cost of ownership, greater flexibility and every opportunity to utilise the latest technologies.

# REVIEW

## Traditional Solution

Negatives	Explanation
A dedicated room within the building core is required on each level.	Traditional structured cabling systems allow for a single point of administration on each building level – Floor Distributor. This room is not required with a Zone Wiring solution. This allows the building owner / architect additional space for other services / tenant office space.
A 45 Rack Unit free standing equipment cabinet is required on each level.	The single free standing equipment cabinet within the Floor Distributor is replaced with multiple Zone Wiring enclosures positioned throughout the Work Areas.
150 pairs of Category 3 UTP cables for the voice backbone to each level.	Network Telephony solutions utilise the data network for connectivity hence specific copper backbone cabling is no longer required.
A voice termination frame within the Building Distributor for 1500 pairs.	Network Telephony solutions utilise the data network for connectivity hence specific copper backbone cabling is no longer required.
Specialised technicians are required to complete moves, adds and changes on the PABX.	A number of Network Telephony solutions include simple GUI web based administration. This negates the requirement of cost and timing associated with traditional PABX programming and jumpering.

An additional 1000 TO's are required compared with the Innovative Solution.

A number of Network Telephony handsets include 10/100MB switches allowing local computer hardware to be connected directly to the handset reducing the TO count by 1 at each outlet.

Substantial increase in the quantity of horizontal media required.

As the backbone subsystem is located at a central location of each level the quantity of horizontal media is increased by around 60% compared with a Zone Wiring solution.

50% increase in size of the horizontal cabling pathways between the building level riser cupboard and the Work Area.

With the horizontal media being cabled from the centrally located Floor Distributor, the pathway size to the building riser has to cater for all of horizontal cabling.

**Traditional Solution**

**Positives**

**Explanation**

Established solution.

The traditional solution has a huge install base, is established and safe.

The support network.

There is a substantial quantity of PABX specialists capable of implementing and maintaining the traditional PABX solution.

**Innovative Solution**

Negatives	Explanation
Ten additional 24 port Ethernet switches are required.	As Zone Wiring enclosures are placed throughout the Work Area, there can be a reduction in port utilisation due to the demographic.
An additional 24 port Gigabit Ethernet blade is required on the core switch.	To facilitate connectivity to the Zone Wiring enclosures, an additional quantity of ports is required on core switch.
Increased number of fibre optic backbone cables.	The fibre optic core count to each building level will increase. Rather than installing a single 12 core cable to the Floor Distributor, single 6 core cables are installed to each Zone Wiring enclosure.
Purchase of Zone Wiring Enclosures.	In lieu of purchasing a single freestanding equipment rack for the Floor Distributor, Zone Wiring enclosures are purchased and placed within the work areas.

**Innovative Solution**

Positives	Explanation
Greater flexibility.	Convergent solutions offer the tenant greater flexibility as any device – be it computer or voice – can be immediately connected to any TO.
33% less TO's.	Utilising the 10/100 handset switch port, computing devices can be directly connected to the handset allowing a 33% reduction in horizontal cabling infrastructure.

<p>Reduced costs of Moves, Adds and Changes.</p>	<p>Tenants can simply relocate all of their Work Area equipment (telephone and desktop) without the requirement of a specialist technician.</p>
<p>No dedicated Voice backbone.</p>	<p>Network Telephony solutions utilise the data network for connectivity hence specific copper backbone cabling is no longer required.</p>
<p>No dedicated Floor Distributors.</p>	<p>Traditional structured cabling systems allow for a single point of administration on each building level – Floor Distributor. This room is not required with a Zone Wiring solution. This allows the building owner / architect additional space for other services / tenant office space.</p>
<p>Future proof.</p>	<p>A recent survey showed that the majority of traditional PABX vendors were all investing in Network Telephony solutions.</p>

# COMPARISON

## Traditional Solution

Increase	Explanation / Price
A dedicated room within the building core is required on each level.	This is an ongoing cost to the tenant through the lease to the building owner. Being that the tenant is leasing the complete building, the direct benefit in this example relates to the utilisation of space.
A 45 Rack Unit free standing equipment cabinet is required on each level.	10 x 45 RU free standing equipment cabinets.
150 pairs of Category 3 UTP cables for the voice backbone to each level.	3 x 50 pair cables per level @ an average of 50 metres (160 feet) length = 1500 metres (5000 feet) of Category 3 UTP cable. 6 x 24 port patch panels per level = 60 Category 5e patch panels.
A voice termination frame within the Building Distributor for 1500 pairs.	1500 pair termination frame within the Building Distributor.
Specialised technicians required to complete moves, adds and changes on the PABX.	An on going cost either via a service agreement or on an as needed basis.
A substantial increase in the quantity of horizontal media is required.	Using a conservative allowance of 20 metres per TO with a Zone Wiring model, the horizontal cable distance would be increased to 60 metres (200 feet) of cable per TO location using the traditional model. 2000 x 40 metres (130 feet) of UTP cable = 80,000 metres (262,000 feet) of Category 6 cable.

An additional 1000 TO's are required compared with the Innovative Solution.

1000 Category 6 Jacks

4 x 24 port patch panels per level = 40 Category 6 patch panels

1000 x 60 metres (200 feet) of UTP cable = 60,000 metres (197,000 feet) of Category 6 cable.

50% increase in size of the horizontal cabling pathways between the building level riser cupboard and the Work Area.

Where 150mm (6 inch) cable tray can be utilised in the Innovative Solution, the cable tray would need to be increased to 300mm (12 inch) for the traditional solution. Assuming 48 lengths per level:

480 lengths x 300mm (12 inch) cable tray against:

480 lengths x 150mm (6 inch) cable tray.

## **Innovative Solution**

### **Increase**

### **Explanation / Price**

Increased number of fibre optic backbone cables.

Assuming 50 metres (160 feet) average cable length, a deduction of 10 levels x 50 metres (160 feet) of cable = 500 metres (1,600 feet) of 12 core cable.

Allowing for 8 Zone Wiring Enclosures per level and an average distance of 80 metres (260 feet) of cable = 6400 metres (21,000 feet) of 6 core cable.

There is also an increase in the quantity of fibre optic termination frames and connecting hardware.

Assuming 10 levels x 12 cores @ 2 ends = 240 terminations and 5 x 24 port and 10 x 12 port fibre enclosures / draws.

Allowing 10 levels of 8 sets of 6 core cable @ 2 ends = 960 terminations and 20 x 24 port patch panels and 80 x 12 port enclosures / draws.

Ten additional 24 port Ethernet switches are required.	10 x 24 port 10/100 Ethernet switches including a Gigabit interface.
An additional 24 port Gigabit Ethernet blade is required on the core switch.	1 x 24 port Gigabit Ethernet blade.
Purchase of Zone Wiring Enclosures.	10 levels x 8 zone wiring enclosures = 80 zone wiring enclosures

# PRICE

Traditional Solution		Innovative Solution		Price
<b>Telephony</b>				<b>Delta</b>
<b>Traditional PABX</b> including: 800 basic handsets 200 advanced handsets PIMs 3 x E1 interfaces Installation and commissioning	\$250,000.00	<b>Network Telephony</b> including: 800 basic handsets 200 advanced handsets Convergence Server 3 x E1 interfaces Installation and commissioning	\$350,000.00	\$100,000.00
			<b>Additional</b>	<b>\$100,000.00</b>
<b>Network</b>				<b>Delta</b>
No requirement	\$ -	20 x 10/100 Ethernet switches	\$20,000.00	\$25,000.00
No requirement	\$ -	2 x 16 port Gigabit Ethernet blades	\$30,000.00	\$30,000.00
			<b>Additional</b>	<b>\$55,000.00</b>
<b>Cabling</b>				<b>Delta</b>
10 x Equipment Racks	\$15,000.00	80 x zone wiring enclosures	\$40,000.00	\$25,000.00
1000 additional Category 6 TO's	\$130,000.00	No requirement	\$ -	-\$130,000.00
2000 x 40 metres of additional Category 6 cabling	\$60,000.00	No requirement	\$ -	-\$65,000.00
Voice backbone - 1500 metres of 50 pair Category 3 cable, 1500 way IDC frame and 60 Category 5e patch panels	\$50,000.00	No requirement	\$ -	-\$50,000.00
Horizontal Pathways - 300mm tray	\$40,000.00	Horizontal Pathways - 150mm tray	\$25,000.00	-\$15,000.00
Fibre Optic cabling - 500 metres of 12 core, 5 x 24 port and 10 x 12 port patch panels	\$20,000.00	Fibre Optic cabling - 6400 metres of 6 core, 20 x 24 port and 80 x 12 port fibre enclosures.	\$100,000.00	\$80,000.00
			<b>Reduction</b>	<b>-\$155,000.00</b>

*“Arguably, there is little to no difference in the initial cost of the implementation of either solution”.*

# CONCLUSION

**T**here is no doubt that the cost analysis set out within this document can readily be disputed and argued about; eg. Different markets, vendor solutions and pricing structures always ensure debate relating to this style of document. Whether there is an advantage within the initial cost or not, it is hard to dispute the long term benefits of investing in and implementing this type of *innovative solution*.

The benefits include:

- More usable real estate due to the removal of the Floor Distributor on each level.
- Reduced pathway size within the office tenancy.
- Substantial reduction in cost and disruption to staff when making changes within Work Areas.
- In house administration of Telephony services – no specialist technicians.
- Reduced size of the computer room – Standard 19" rack mounted Network Telephony equipment.
- 30% less Telecommunications Outlets to administer and maintain.
- Single media technology for all devices – Ethernet.
- One skill set for in house staff.
- Improved network performance.
- Double the switching speed – 2.4:1 oversubscription ratio.

The changes drafted within the ANSI/EIA/TIA 569B standard will allow the adoption of new technology within the business world - particularly convergence. Now, more than ever it may be time to rethink your strategy. Should you be looking to complete a major network upgrade or relocate your business, considering this type of solution may be of great future benefit?

# VENDORS

There are numerous independent vendors within the structured cabling systems and network / convergence space. A sample of these includes:

## **Structured Cabling Systems**

- Avaya
- Krone
- Molex Premise Networks
- Panduit
- Siemon
- Tyco Electronics / AMP Netconnect

## **Network / Convergence**

- 3Com
- Avaya
- Cisco Systems
- Extreme Networks
- Nortel Networks

All of the companies listed have quality products and solutions. A review of the vendor's specific product offerings and your own unique requirements will ensure you implement the solution that meets your requirement – now, and in the future.

Following is a summary list of companies that offer zone wiring enclosures:

- American Access Technologies
- Corning Cable Systems
- Holocom Networks
- Hubbell Premise Wiring
- Tyco Electronics / AMP Netconnect

# THE AUTHOR

**A**ndrew Young is a specialist Project Manager / Consultant based in Melbourne Australia. With more than 20 years of technical training and experience, Andrew spends his time consulting, designing and managing cabling and network integration projects throughout Asia Pacific.

Andrew has been a Shareholder and Director of DESA Australia Pty. Ltd since 1991.

Andrew holds the following technical certifications:

### **3Com**

Solution Associate  
Solution Expert  
Network Telephony Specialist

### **3M**

Certified Copper and Fibre Optic Installer

### **Avaya**

Design & Engineering

### **BICSI**

Registered Communications Distribution Designer (RCDD)  
LAN Specialist  
Outside Plant Specialist

### **Cisco**

Certified Network Administrator (CCNA)  
Cisco Sales Expert (CSE)  
Cisco Wireless LAN Sales Specialist  
Cisco Wireless LAN Design Specialist  
Cisco Wireless LAN Support Specialist

### **Krone**

Master Installer (Copper and Fibre)

### **Microsoft**

Certified Professional (MCP)  
Certified Systems Administrator (MCSA)  
Certified Systems Engineer (MCSE)  
Certified Database Administrator (MCDBA)

### **Molex**

Certified Installer

### **Panduit**

Registered Panduit Communications Designer

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