

Industrial Communications & Controls

ANKER.











Industrial Communications & Control





Industrial Ethernet Network Design





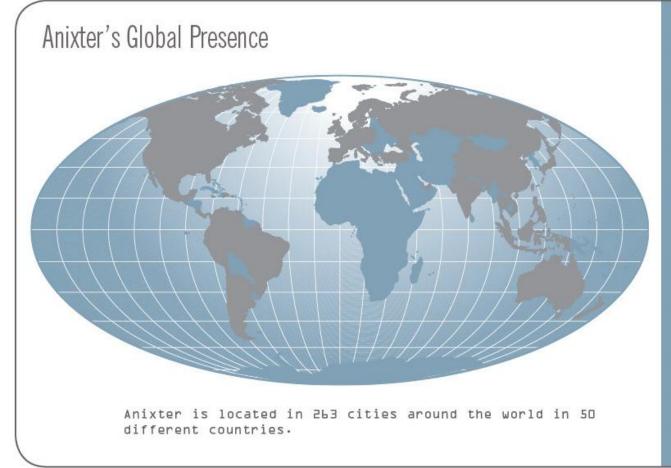
The Company - Who is Anixter?

- Anixter is the global leader in the value-added distribution of:
 - Communications and physical security systems
 - Industrial electrical and electronic wire and cable products
- We help our customers specify solutions and make informed buying decisions based on technologies, applications and relevant standards.
- All around the world we offer innovative Supply Chain Service
 Solutions that reduce the total cost of production and execution of projects and programs for our customers.

"Service is Our Technology"



Our Global Presence

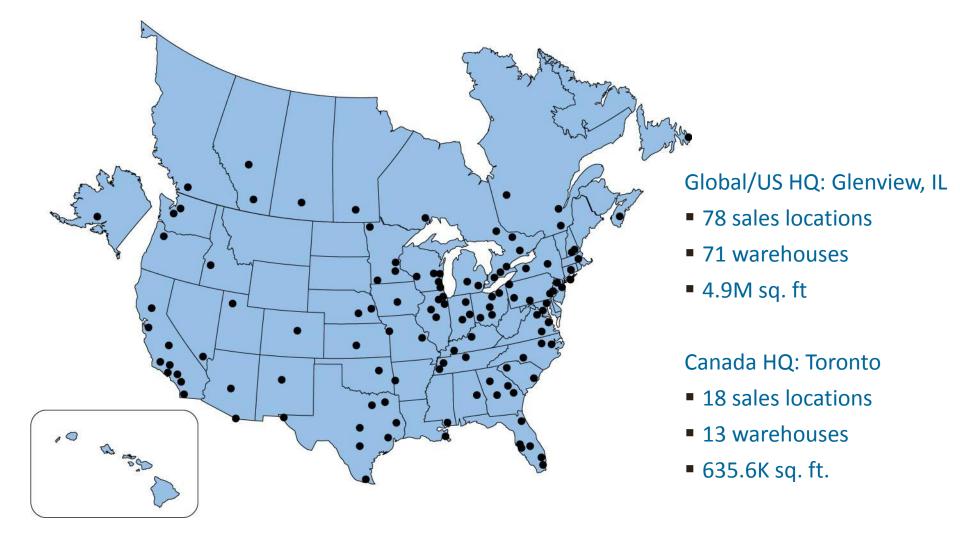


Corporate Snapshot: Year founded: 1957 Number of employees: Over 7,900 2010 Revenues: \$5.5 billion Products: 450,000 Inventory: Over \$1 billion Customers: Over 100,000 Stock symbol: AXE Countries: 50

Anixter Notable Achievements and Awards: • Fortune 500 List • BusinessWeek's Top 100 Info Tech List • Forbes' Global Superstars List • Forbes' Best Managed Companies List • Fortune's Most Admired Companies List • InformationWeek 500 • B-to-B Magazine's Top 500 eBusinesses List



Global Capabilities - North America





Global operational consistency and infrastructure

 Same systems, process and services provided globally but with local personnel, language and currency

Supply chain optimization to reduce customers' overall costs

- Preinstallation product preparation
- Feed the job just-in-time
- Direct line feed
- Industry-leading customized electronic tool sets

Technical expertise

- Infrastructure design support
- Product recommendation based on applications
- Proof of concept and quality testing in the Anixter Lab

Global supplier partnerships

- Relationships with the leading manufactures in our industry
- #1 or #2 customer globally
- We have leverage to "make it happen"



Anixter's Supply Chain Solutions

Our solutions help our customers:

- ✓ Reduce Costs
- Enhance Competiveness
- ✓ Improve Quality
- ✓ Fulfill Sustainability Objectives





READY!SM **Material Management Services** by Anixter leverage our distribution and Supply Chain Services to help our customers optimize a just-in-time material management program in their production facility. Our replenishment solutions lower the total cost of ownership, improve productivity and scale to meet production demands.



READY! Deployment Services by Anixter maps our distribution and Supply Chain Services to the construction or deployment process of any technology project. We combine sourcing, inventory management, kitting, labeling, packaging and deployment services to simplify and address the material management challenges at the job site(s). READY! Deployment Services by Anixter will help you improve the speed to deployment, lower your total cost of deployment and ensure the customer's product specification are delivered as planned.



OEM

- Cable Assbly/Wire Harness
- Contract Mfg.
- Panel Shops
- Electrical Equipment Mfg.
- Electronic Equipment Mfg.
- Communications Equipment Mfg.

Contractors

- EPCs
- Electrical Industrial
- Electrical Commercial
- Security / Audio Video
- Telecom
- Automation





Markets Served

Industrials

- Chemical
- Food & Beverage
- Shipbuilding
- Steel
- Pharmaceutical & Biotech
- Automotive

Power Generation

- Fossil Fuel
- Wind / Solar
- Nuclear

Natural Resources

- Oil, Gas, Petroleum
- Pulp & Paper
- Mining





Other

- Government
- Entertainment
- Broadcasting
- Transportation
- Services

Redistribution

- Electrical Wholesale
- Electronic
- Data Comms
- Automation
- Broadcast



Proprietary a



Our Industrial Communication & Control Vendor Partners





Industrial Communications & Control



- Cellular Wireless Routers
- Hardened Ethernet Switches
- Ethernet Connectivity for utilities, OEM's and machine builders
- Industrial Cyber-security Solutions
- Wireless Point to Point and AP's
- Serial Connectivity
- Industrial Cordsets

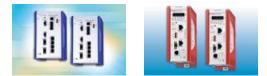
Industrial Communications & Controls: Industrial Networking Products & Solutions







The Hirschmann line of networking devices manages virtually every communication connection requirement among the various layers of the network: information, control and device. There are products that support both copper and optical fiber media, with data speeds as high as 10 Gigabitss per second. The Hirschmann brand represents experience and expertise in automation technology, developed since pioneering the development of Ethernet as a common standard for industry networks. Today, Hirschmann products ensure hassle-free and secure data communication under the toughest conditions.



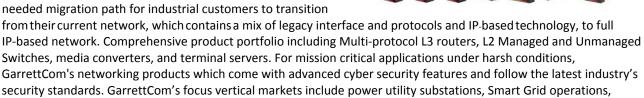
Tofino Xenon and Eagle Firewall Routers





GarrettCom manufactures networking solutions

designed for industrial applications. Products provide the much needed migration path for industrial customers to transition



surveillance and physical security, traffic control, oil and gas, water and waste- water management.



Transition Networks, With over 25 years of growth and expertise in fiber solution manufacturing, Transition Networks offers the ability to affordably integrate the benefits of fiber optics into any data network - in any



application - in any environment. Offering support for multiple protocols, any interface, and a multitude of hardware platforms; Transition's portfolio gives you the power to deliver and manage your network traffic reliably over fiber.

Based in the US, Transition Networks provides 24-7, American-based Tech Support, Life-Time Warranties on many of their branded products, exceptional and responsive Sales and Customer Service teams, and an overall 99% quality rating on their copper to fiber networking equipment.

Industrial Communications & Controls: Industrial Networking Products & Solutions





B&B Electronics designs, builds and delivers connectivity and communication solutions

optimized for an ever-expanding range of applications. B&B is an expert in connecting and network-enabling your legacy equipment. The main products they manufacture are gateways, serial devices, wireless, media converters, and surge protection.





ComNet Communication Networks is a Fiber Optic communication and hardened Ethernet product manufacturer. ComNet focuses on providing innovative communications



optic video, data and audio transmission products as well as a broad fiber optic, copper and wireless Ethernet product line, designed to the specific requirements for Access Control, Intrusion, Burglar and Fire Alarms and CCTV Surveillance/ Incident Detection and the Intelligent Transportation System Market.



Network Enabling Devices Comtrol Corporation has been a manufacturer and provider of quality

networking and industrial data communication products. Since introducing the industry's first multi-port serial card, Comtrol has not only continued to



offer and expand this product line but has also launched other innovative solutions such as DeviceMaster® Ethernet device servers and gateways, RocketLinx® industrial grade Ethernet and Power over Ethernet switches and most recently IO-Link master industrial gateways. By providing a variety of unique product capabilities, features and options, Comtrol has the ability to solve many data connectivity requirements. Through exceptional product and technical support, Comtrol has established solutions for a wide range of industrial automation, security, energy and traffic and transportation applications.



Digi International provides mission critical M2M solutions. Digi provides the industry's broadest range of wireless products, a cloud computing platform tailored for devices, and development services to help customers get to market fast with wireless fevices and



applications. Digi has a very diverse breadth of products including cellular routers and gateways, wireless communication adapters including ZigBee, Wi-Fi and proprietary RF, serial and terminal servers, console servers,

multi-port serial boards, USB connected products and cameras. Digi offers targeted vertical specific solutions for the nergy, Government, Medical, Industrial, Retail and Transportation markets.

ICC Product Manager – Glenview Dan French <u>dan.french@anixter.com</u> (224) 521-8182



Industrial Network Specialist – Atlanta Steve Bowles <u>steve.bowles@anixter.com</u> (770) 718-7437



Industrial Ethernet Network Design Workshop

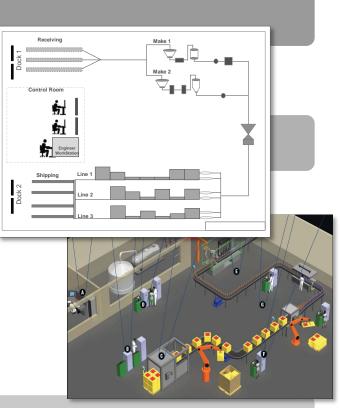
Objectives

- · Complete the steps to design Industrial Ethernet networks
- Specify and select active and passive network components
- Identify and plan project and operational success factors

Agenda:

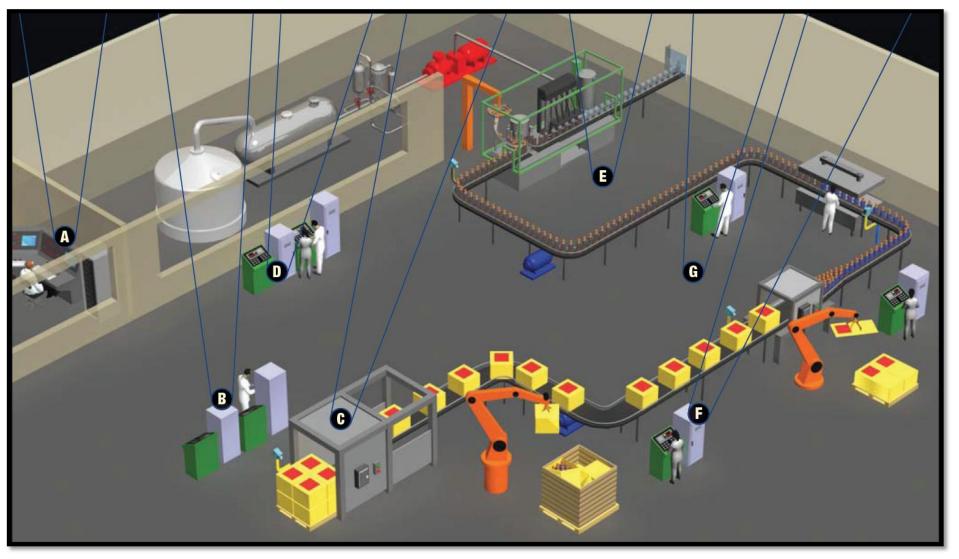
- Logical Design
 - Collect information
 - Segment
 - Add routers and switches
 - Add network security
 - Add redundancy / resiliency
- Physical Design
 - Determine critical factors
 - Conductors, shield, jacket,
- Project and Operations Success

We'll focus on mainstream and easy. We can help with the exceptions afterwards.



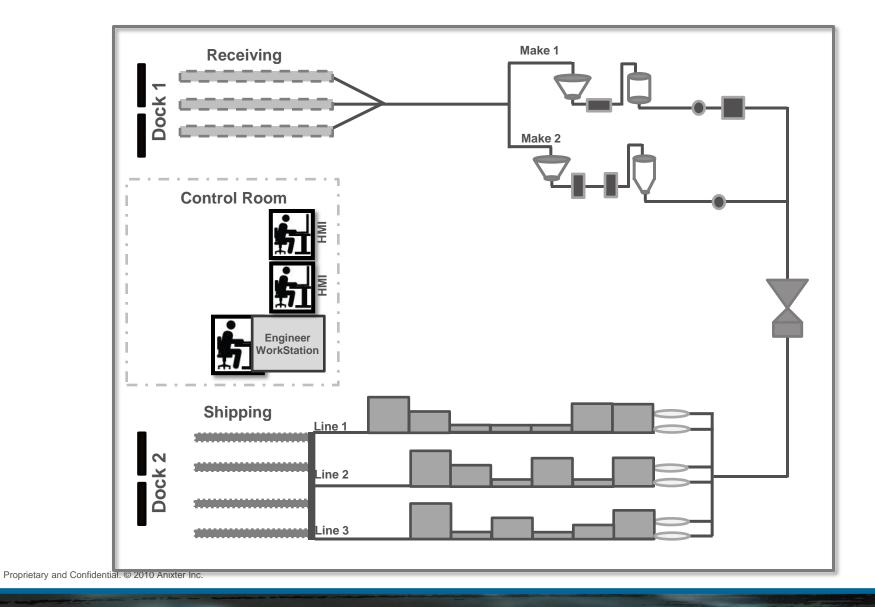


The Application - Manufacturing



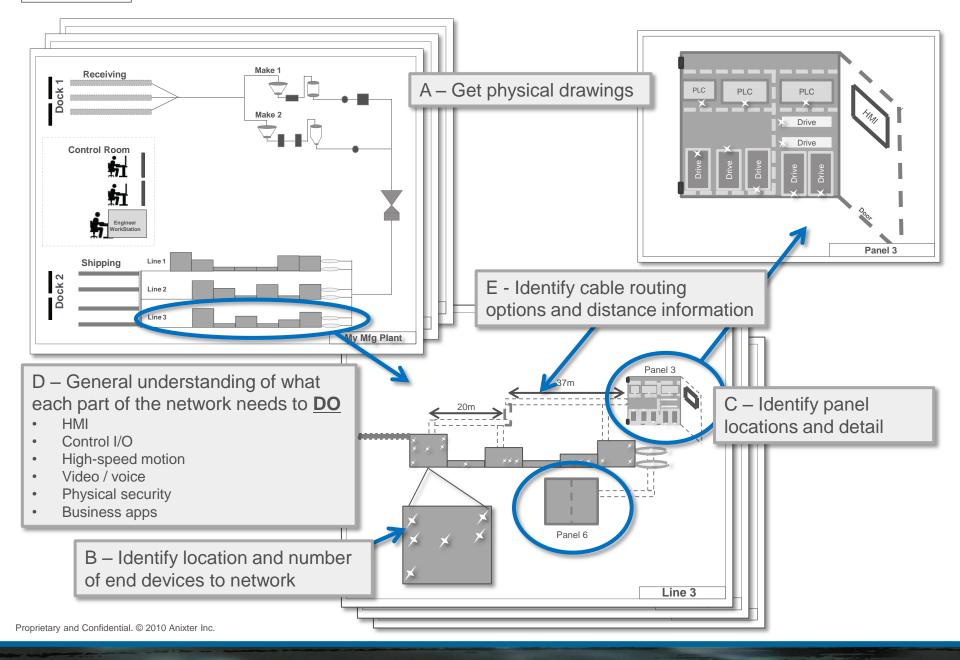


The Application - Manufacturing





Step 1 – Collect Information



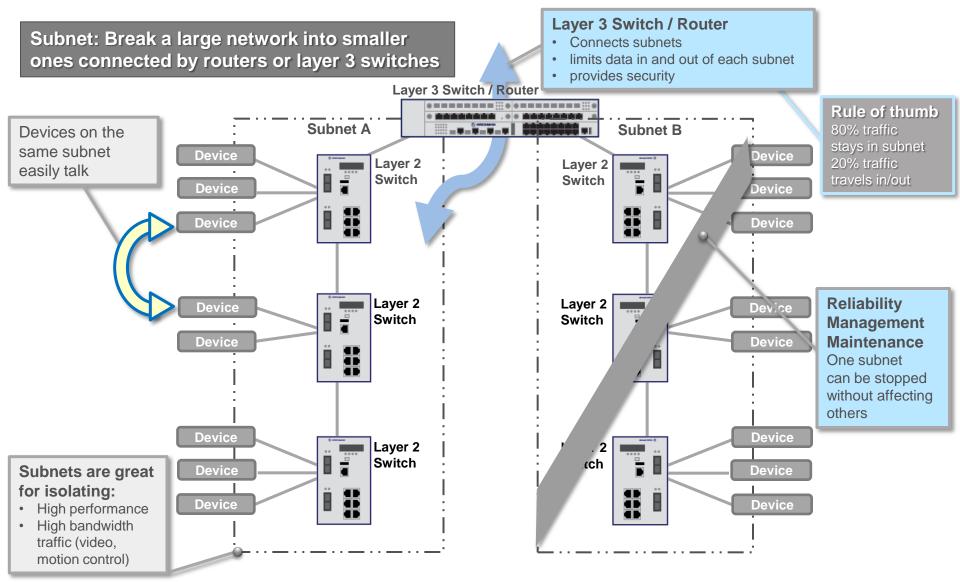


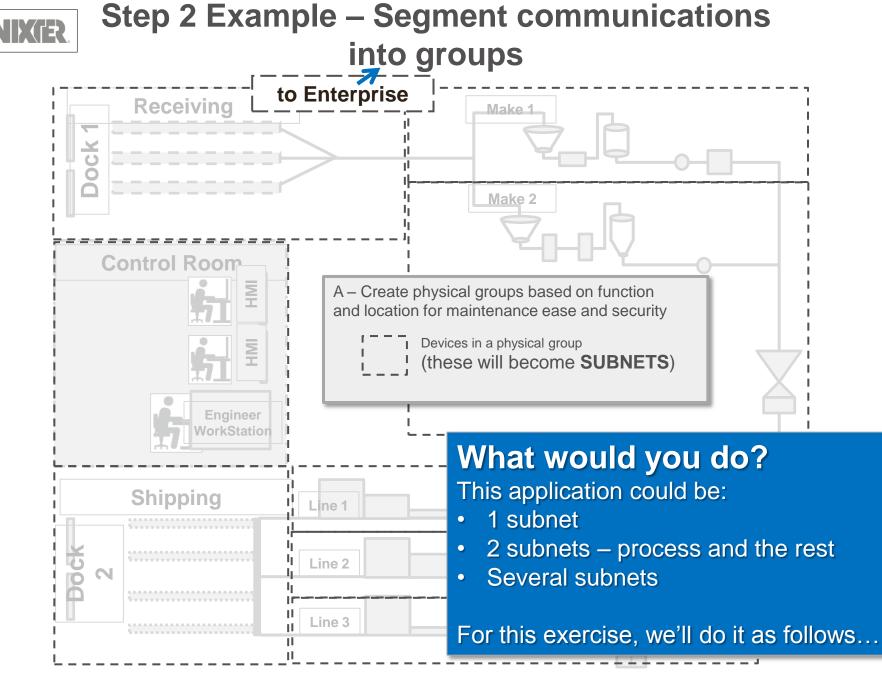
Step 1 – Collect Information

Project	My Factory																						
Project Engineer	David Adams																						
FIOJECT Engineer	David Adams																						
Use	Location /Name	L2	L3	10G ports		10/100 ports	PoE ports	PoE Watts	1588	IP-67	2x power	Redun nets	USB memory	special requirements	N	Model	Cata	log Numbe	er		Accessor	ies	Accessory Catalog Numbers
Backbone	Control Room / Ship / Receive	x		3																			
	Make Area	x		3																			
	Packaging Area	×		3					-														
								LE	- X (el	sh	leei	ts t	o keej	n ti	rack	Ot v	0U	r de	SI(n c	hoic	es
.3	Control Room / Ship / Receive L3		×	1	3				-//		011						<u> </u>	U U		U.	<i></i>	1010	00
	Make Area L3		×	1	2			-															
	Packaging Area L3		×	1	ર																		
										Ph	ysica	al Me	dia Li	st - Networ	'k De	esign							
.2	Make 1 East	×																					
	Make 1 West	×			Project	t																	
	Make 2 East	×	Dro	ject Er	ginee	r																	
	Make 2 West	×	FIQ		5.000	1																	
	Line 1 East	×																					
	Line 1 Central	×																					
	Line 1 West	×																Con	sideration	S			
	Line 2East	×																					
	Line 2Central	×	-								distance	2		То		Electrical			Hi				
	Line 2 West	×	S	witch		Port	#	spee	d	connec	tor	(meters)) To :	witch or device	port #	connector	Noise	Temp	Chemical	Flex	other	Industrial	Ethernet Cordset
	Line 3 East	× /	Make 1 E	ast		1		100)	IP-67 1	n12	0.3	Mak	e Area1 FW	sec	RJ-45	×	×	×			M224P	VCSTJG00.3M
	Line 3 Central	×				2		100)	IP-67 1	n12	10	Mak	e 1 West	3	IP-67 m12	×	×	x			M224P	VCSTMU10.0M
	Line 3 West	×				3		100)	IP-67 I	n12	2		block 22	1	IP-67 m13	×	×	×				VCSTMU02.0M
	Control Room North	×				4		100		IP-67 1		2		block 23	1	IP-67 m14	×	×	×				VCSTMU02.0M
	Control Room South	×				5		100		IP-67 r		7		block 24	1	IP-67 m15	×	×	×				VCSTMU07.0M
	Receiving West	×				-																	
	Receiving NorthEast	×				6		100		IP-67 I		6	Flov	meter 8	1	IP-67 m16	x	×	×			M224P	VCSTMU06.0M
	Receiving SouthEast	×				7		100		IP-67 I		spare											
	Shipping North	×				8		100)	IP-67 I	n12	spare											
		F	Receivin	a North	Fast	1		1g					Rec	eiving SouthEast	2								
		-		,		2		1g						camera		fiber		x					
		-				3		-6					0.8	cannera		1.50		~					
		-				4																	
		-																					
		-				5																	
		-				6																	
		_				7																	
		_				8																	
		_				9																	
						10																	
						11																	
						12																	



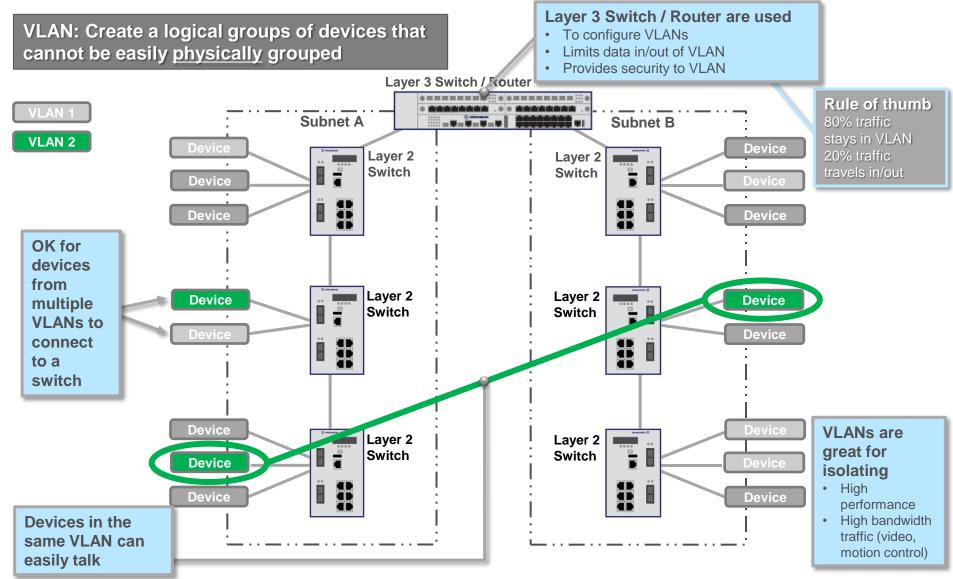
Step 2 – Segment Communications into Groups (Subnets)







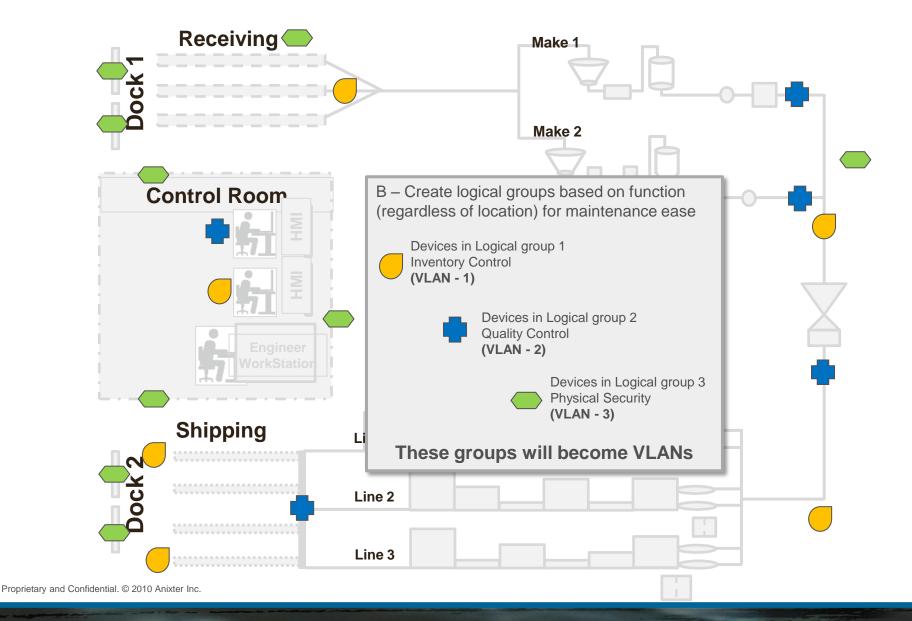
Step 2 – Segment Communications into Groups (VLANs – Virtual LANs)



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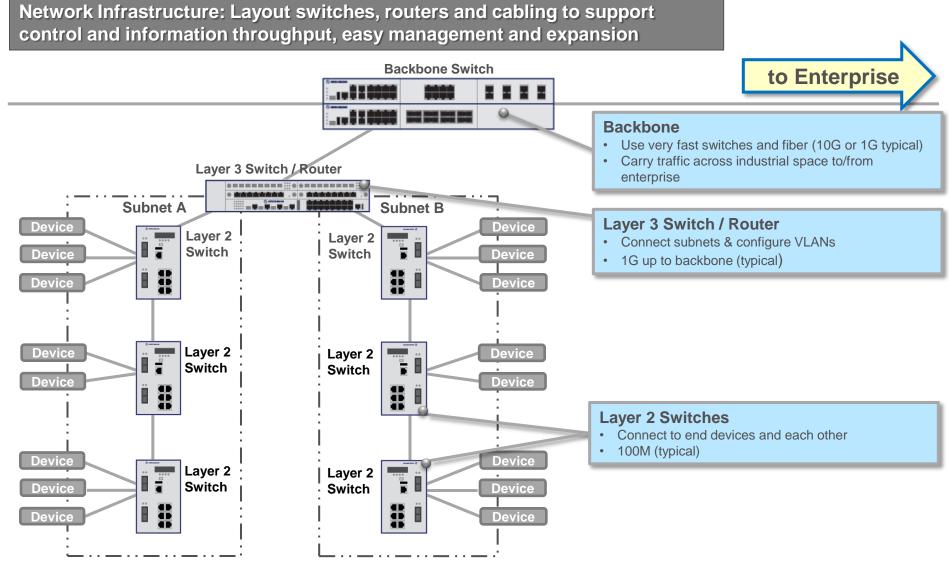


Step 2 Example – Segment Communications into Groups



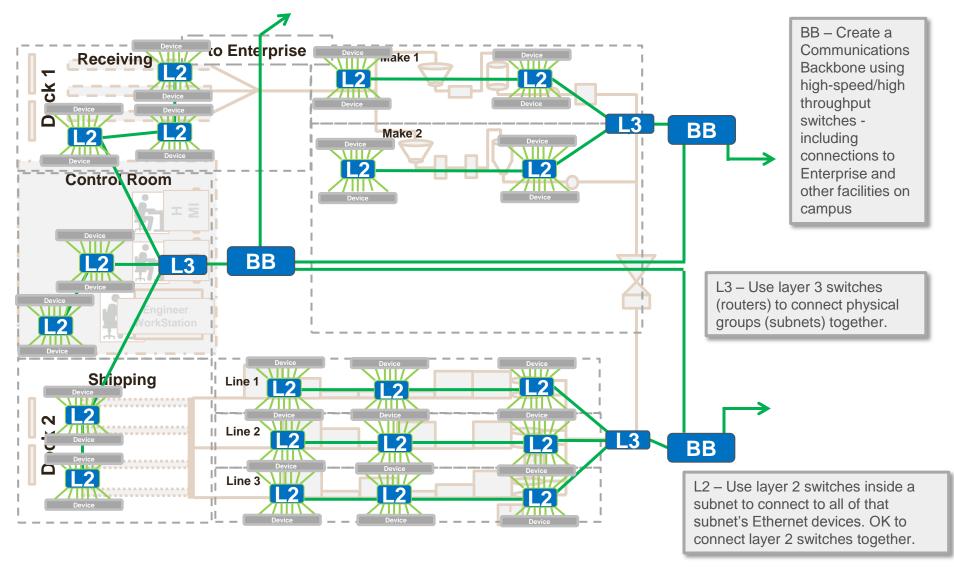


Step 3 – Create a Network Infrastructure





Step 3 Example – Create a Network Infrastructure (add routers and switches)





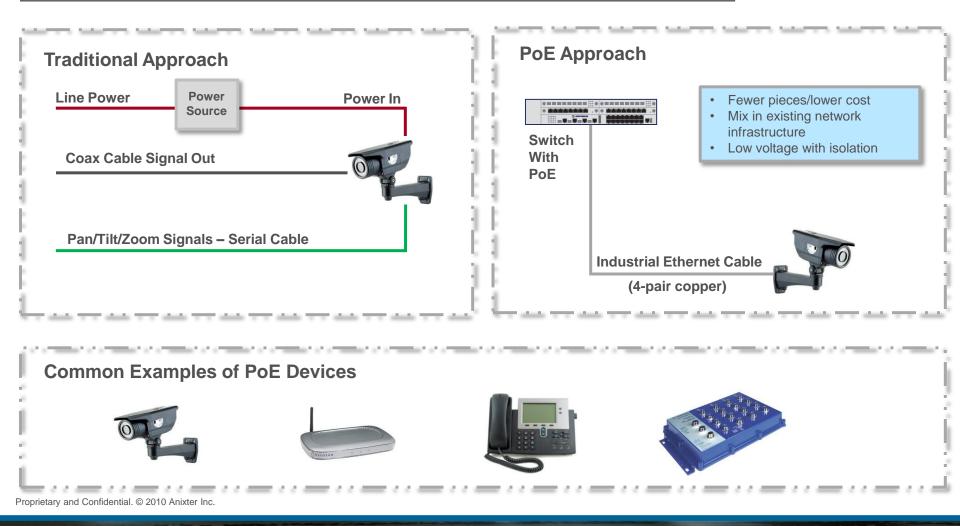
Step 3 Example – Record Your Choices

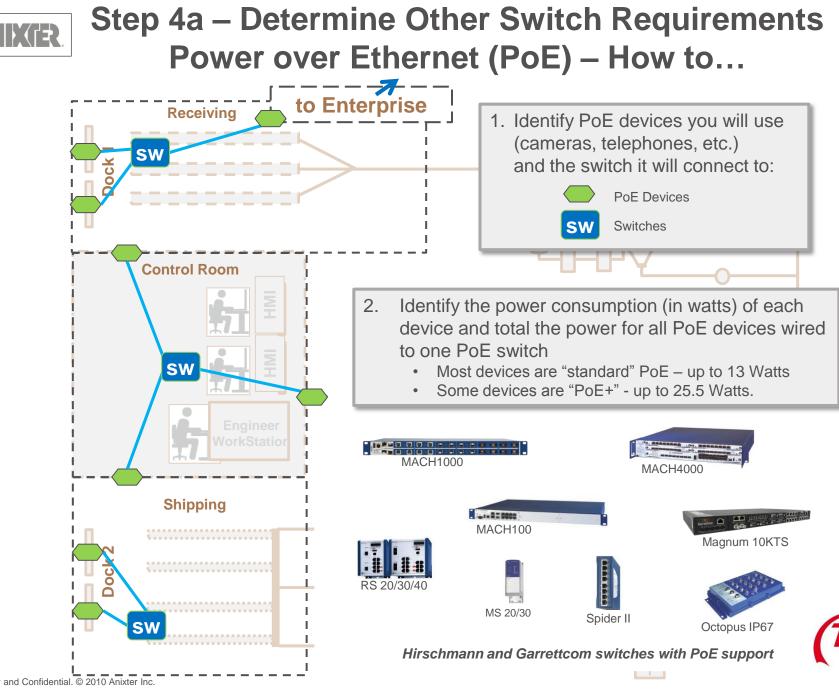
Create a list of switches by use and location and note key attributes needed for each

Proje	ect My Factory					
Project Engine	er David Adams					
					_	
				10G	1G	10/100
Use	Location /Name	L2	L3	ports	ports	ports
D = = . - = = =				0		
Backbone	Control Room / Ship / Receive Make Area	X		3		
	Packaging Area	X X		3		
	i achaying Area	^		5		
L3	Control Room / Ship / Receive L3		х	1	3	
	Make Area L3		х	1	2	
	Packaging Area L3		х	1	3	
L2	Make 1 East	х				8
	Make 1 West	х				8
	Make 2 East	х				16
	Make 2 West	х				6
	Line 1 East	х				6
	Line 1 Central	х				10
	Line 1 West	X				20



Power over Ethernet (PoE) : use a single industrial Ethernet cable to provide power and Ethernet communications to devices



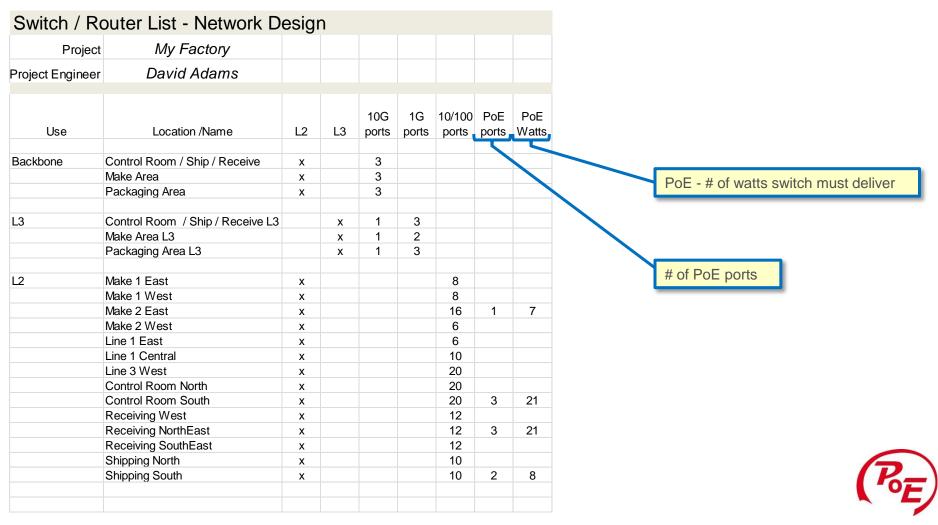


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Step 4a – Record your choices

Create a list of switches by use and location and note key attributes needed for each





Step 4b – Determine Other Switch Requirements Time Synchronization (IEEE-1588)

What?

 IEEE 1588 is designed for devices on a LAN requiring extremely precise timing accuracy (<1 microsecond). A similar older technology used is IRIG-B. These signals often are synchronized to a GPS or another master clock.

Typical Applications

- Motion control / automation
- First-fault detection
- Measurement and Testing

How?

- · Determine if application needs sub-millisecond time accuracy
- Select devices for application that support IEEE-1588
- Identify/select device to provide timing reference (example: GPS)
- Ensure all switches in the path between devices needing synchronization support IEEE-1588





4b – Record Your Choices

Create a list of switches by use and location and note key attributes needed for each

Project	My Factory									
Project Engineer	David Adams									
Use	Location /Name	L2	L3	10G ports	1G ports	10/100 ports	PoE ports	PoE Watts	1588	IP-67
Backbone	Control Room / Ship / Receive	х		3						
	Make Area	х		3						
	Packaging Area	x		3						
_3	Control Room / Ship / Receive L3		x	1	3					
	Make Area L3		x	1	2					
	Packaging Area L3		x	1	3					
L2	Make 1 East	х				8				x
	Make 1 West	х				8				x
	Make 2 East	х				16	1	7		х
	Make 2 West	х				6				x
	Line 1 East	х				6				
	Line 1 Central	х				10				
	Line 1 West	х				20			x	
	Line 2East	х				10				
	Line 2Central	х				10				
	Line 2 West	х				20			х	
	Line 3 East	х				12				
	Line 3 Central	х				12				
	Line 3 West	х				20			х	
	Control Room North	х				20				
	Control Room South	х				20	3	21		



Step 4c – Determine other requirements Choose IP Ratings for your switches and routers

What?

• IP ratings describe a device's protection against solids and liquids

Why?

- Ensure industrial network infrastructure devices will survive in their environments
- Ratings can enable installation without control cabinets, reducing cost and space

Level	Object Size Protected Against	Details	Level	Protected Against	Details
			0	Not protected	-
0	—	No protection against contact and ingress of objects.	1	Dripping water	Dripping water (vertically falling drops) shall have no harmful effect.
1	>50 mm	Any large surface of the body, such as the back of a hand, but no protection against deliberate contact with a body part.	2	Dripping water when tilted up to 15°	Vertically dripping water shall have no harmful effect when the enclosure is tilted at an angle up to 15° from its normal position.
2	>12.5 mm			Spraying water	Water falling as a spray at any angle up to 60° from the vertical shall have no harmful effect.
<u> </u>			4	Splashing water	Water splashing against the enclosure from any direction shall have no harmful effect.
3	>2.5 mm	Tools, thick wires, etc.	5	Water jets	Water projected by a nozzle against enclosure from any direction shall have no harmful effects.
4	>1 mm	Most wires, screws, etc.	6	Powerful water jets	Water projected in powerful jets against the enclosure from any direction shall have no harmful effects.
5	Dust protected	Ingress of dust is not entirely prevented, but it must not enter in sufficient quantity to interfere with the	7	Immersion up to 1m	Ingress of water in harmful quantity shall not be possible when the enclosure is immersed in water under defined conditions of pressure and time (up to 1m of submersion).
		satisfactory operation of the equipment; complete protection against contact.			The equipment is suitable for continuous immersion in water under conditions which shall be specified
6	Dust tight	No ingress of dust; complete protection against contact.	8	Immersion beyond 1m	by the manufacturer. Note: Normally, this will mean that the equipment is hermetically sealed. However, with certain types of equipment, it can mean that water can enter but only in such a manner that produces no harmful effects.



Step 4c – Determine Other Switch Requirements Choose IP ratings of your switches and routers – How to:





4c – Summary Record Your Choices

Create a list of switches by use and location and note key attributes needed for each

Project	My Factory									
Project Engineer	David Adams									
- J										
Use	Location /Name	L2	L3	10G ports	1G ports	10/100 ports		PoE Watts	1588	IP- rating
Backbone C	Control Room / Ship / Receive	х		3						
	/ake Area	X		3						
F	Packaging Area	х		3						
L3 C	Control Room / Ship / Receive L3		х	1	3					
N	<i>N</i> ake Area L3		х	1	2					
F	Packaging Area L3		х	1	3					
L2 N	<i>l</i> ake 1 East	x				8				67
	Aake 1 West	x				8				67
	Aake 2 East	x				16	1	7		67
	Aake 2 West	x				6				67
	ine 1 East	x				6				0,
	ine 3 Central	x				12				
	ine 3 West	x				20			х	
	Control Room North	X				20				
	Control Room South	X				20	3	21		
	Receiving West	X				12	-			
	Receiving NorthEast	х				12	3	21		
	Receiving SouthEast	х				12				
	Shipping North	х				10				
	Shipping South	X				10	2	8		



Step 5 – Add Network Security

What?

- Design appropriate security into your network infrastructure, including:
 - Layer 3 switches
 - Firewalls
 - Features in layer 2 switches

Why?

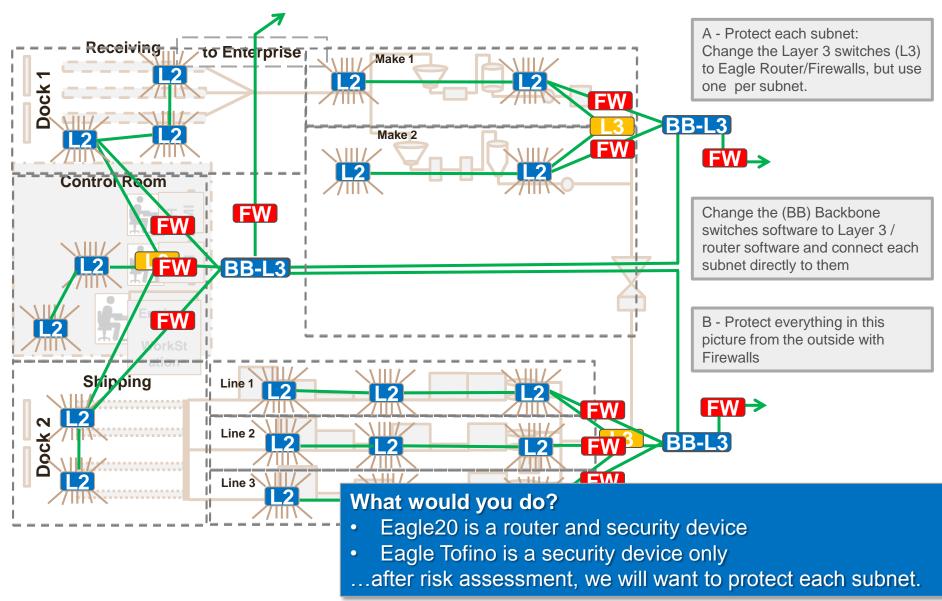
- Physical security + network security + computer security + policies/procedures help protect your process, equipment and people
- A risk assessment helps you to match your security solution to your needs
- Security especially if designed in can be easy and unobtrusive

Why Not?

• Adds some cost (but prevents a lot more)



Step 5 – Add Network Security – How to:





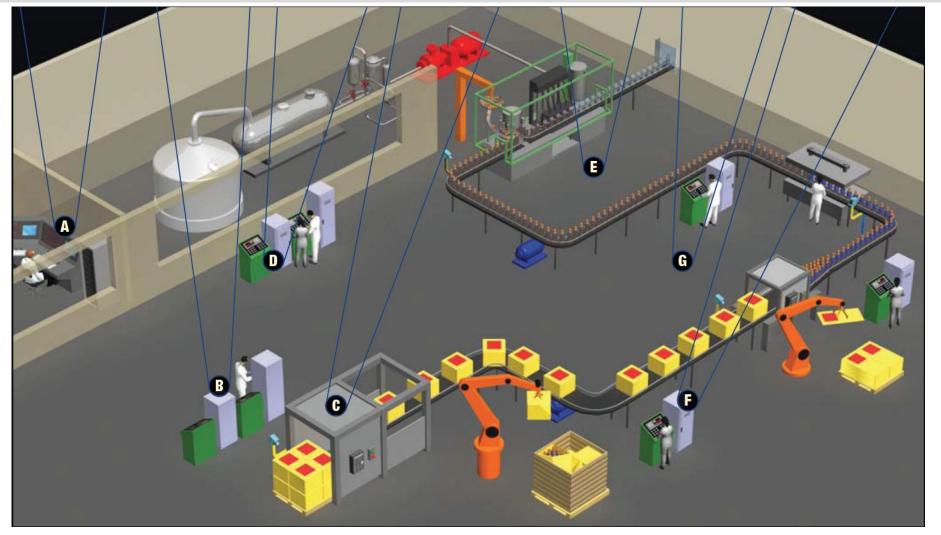
Step 5 – Record your choices

Project	My Factory										
Project Engineer	David Adams										
Use	Location /Name	L2	L3	10G ports	1G ports	10/100 ports		PoE Watts	1588	IP-67	
Backbone	Control Room / Ship / Receive		x	3							Change the (BB) Back
	Make Area		x	2							switches software to L
	Packaging Area		x	3							router software and co
	O and the L D a set of DW										each subnet directly to
Firewalls	Control Room FW		?								
	Shipping FW		?								
	Receiving FW		?								
	Make Area 1 FW		?								
	Make Area 2 FW		?								
	Line 1 FW		?								
	Line 2 FW		?								
	Line 3 FW		?								
	Enterprise Edge FW	_	x								B - Protect everything
	NorthEast Edge FW		X								picture from the outsid
	SouthEast Edge FW		x								Firewalls
L2	Make 1 East	x				8				x	
	Make 1 West	X				8				x	
	Make 2 East	x				16	1	7		x	
	Make 2 West	X				6				x	
	Line 1 East	x				6					
	Line 1 Central	X				10					
	Line 1 West	X				20			x		
	Line 2East	X				10			~		
	Line 2Central	X				10					
	Line 2 West	X				20			x		
	Line 3 East	x				12			^		
	Line 3 Central	x				12					
	Line 3 West					20					
	Line 3 West Control Room North	X				20			x		
		X						04			
	Control Room South	X				20	3	21			
	Receiving West	x				12	_				
	Receiving NorthEast	x				12	3	21			
	Receiving SouthEast	x				12					
	Shipping North	x				10					
	Shipping South	x				10	2	8			



Step 6 – Evaluate Redundancy Needs

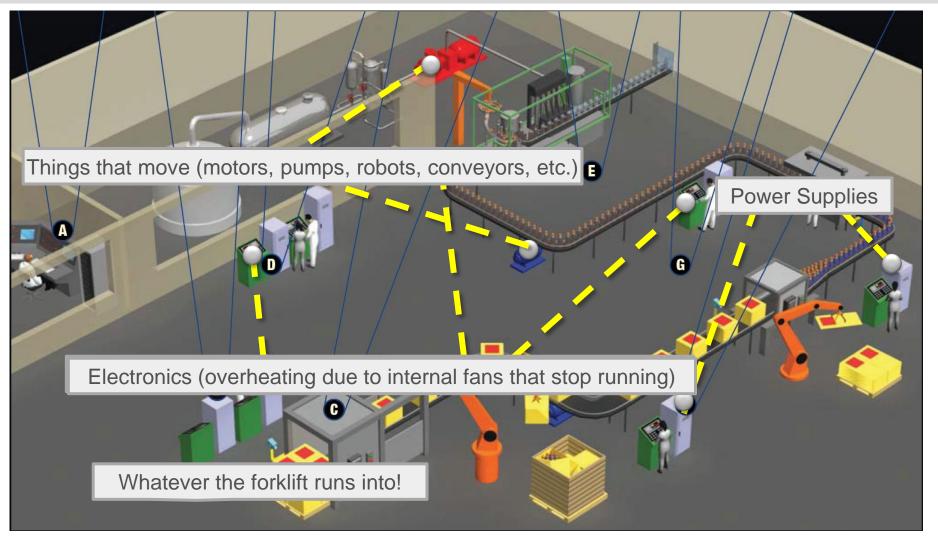
Identify the most critical parts of your system





Redundancy Needs and Evaluation

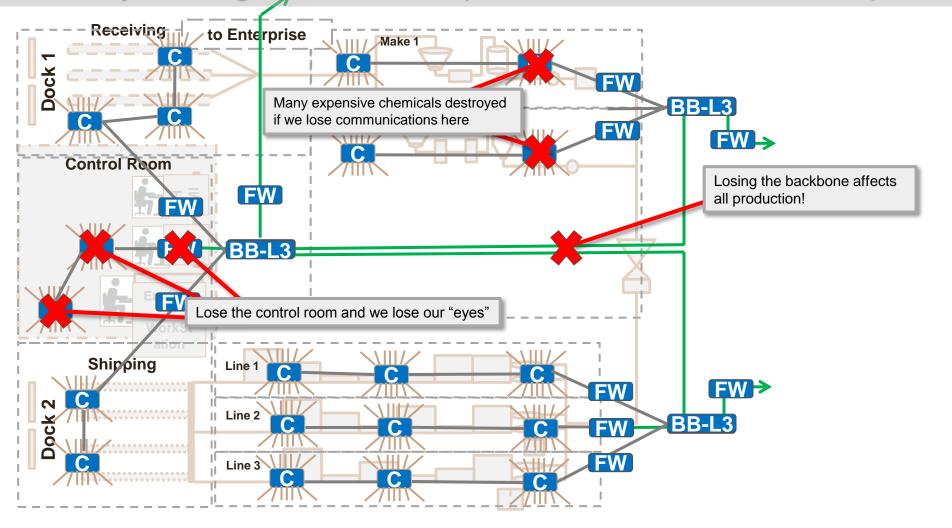
What are potential points of failure?





Step 6 – Evaluate Redundancy Needs

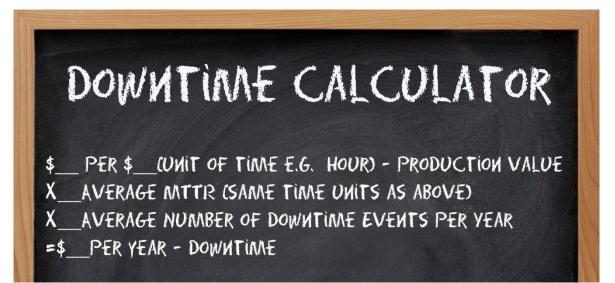
Identify the largest needs for uptime - Rank and Assess Impact





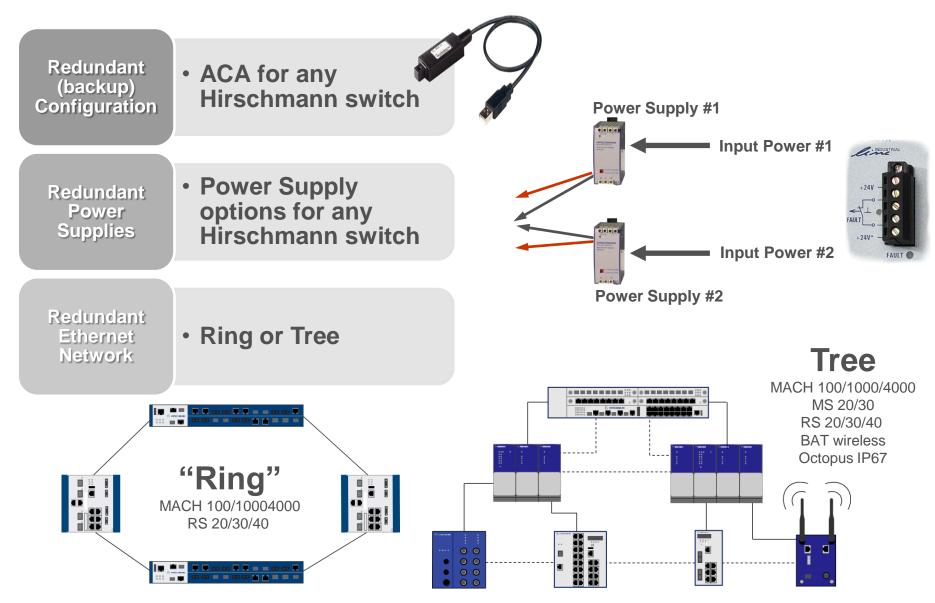
Math you can do to justify an investment in redundancy

- Unplanned downtime calculator
 - How long will production be impacted?
 - Will product be **lost**?
 - How much effort is needed to **recover** and **restart** your process?
- Calculate your downtime cost per minute, per hour, per day





Step 6 – Evaluate Redundancy Needs





Step 6 – Record Your Redundancy Choices

				10G	1G	10/10 0	PoE	PoE			2x	Redun	USB
Use	Location /Name	L2	L3	ports	ports	-		Watts	1588	IP-67		nets	memory
Backbone	Control Room / Ship / Receive		х	3							X	ring 1	X
	Make Area		x	3							X	ring 1	X
	Packaging Area		X	3							X	ring 1	X
Firewalls	Control Room FW		?								X	ring 2	X
	Shipping FW		?										
	Receiving FW		?										
	Make Area 1 FW		?										
	Make Area 2 FW		?										
	Line 1 FW		?										
	Line 2 FW		?										
	Line 3 FW		?										
	Enterprise Edge FW		x										
	NorthEast Edge FW		х										
	SouthEast Edge FW		x										
L2	Make 1 East	х				8				x	x		X
	Make 1 West	x				8				х			X
	Make 2 East	X				16	1	7		X	X		X
	Make 2 West	x				6		· ·		X	~		X
	Line 1 East	x				6				~			~
	Line 1 Central	x				10							
	Line 1 West	x				20			х				
	Line 2East	x				10			~				
	Line 2Central	x				10							
	Line 2 West	X				20			х				
	Line 3 East	X				12							
	Line 3 Central	X				12							
	Line 3 West	х				20			х				
	Control Room North	X				20					Х	ring 2	X
	Control Room South	х				20	3	21			Х	ring 2	X
	Receiving West	х				12						Ŭ	
	Receiving NorthEast	X				12	3	21					
	Receiving SouthEast	X				12	-						
	Shipping North	х				10							
	Shipping South	х				10	2	8					









Add any additional standards, specifications, concerns

				Swi	itch /	Route	er Lis	t - Ne	twor	k Der	sign							
Project	ct My Factory																	
Project Engineer						1		1									Area includes corrosive gas	sses
				10G	i 1G	10/100	POE	ΡοΕ			2x	Redun	USB	(corrosive, moisture) Conformal	.)	- Profi-	& extreme moisture	
Use	Location /Name	L2	L3		s ports			s Watts	1588	IP-67			memory				requirements	
Backbone	Control Room / Ship / Receive		×			· · · · · · · · · · · · · · · · · · ·		· · · · · · · · · · · · · · · · · · ·			×	ring 1						
	Make Area		×	3							×	ring 1						
I	Packaging Area		×	3	3	'	'	'	'		x	ring 1			'			
Firewalls	Control Room FW		2			'	+	+'			x	ring 2	2 ×		'		EtherNet/IP and PROFINET	TUO
	Shipping FW	+	2	+	+		-	+	-	+	~	- e'''' -	^	-	+'			11/0
	Receiving FW	+	2	+	+	+'	+	+	<u> </u>	+	+	+'	+	+	+'	+		
	Make Area 1 FW	+	?	+	+	+'	1	+	-	+	+	+'	1	+	+'			
	Make Area 2 FW	+	?			+	1	+		1				+		1		
	Line 1 FW	+	?	+	+			+		1						h		
	Line 2 FW	+	3	+	+			+		1								
· · · · · · · · · · · · · · · · · · ·	Line 3 FW		?					'				′						
· ['			<u> </u>			'	"	'	[']			'						
	Enterprise Edge FW		×			'		'				'		/	A'		Expecting electrical poice p	
	NorthEast Edge FW		×					'									Expecting electrical noise ne	
ļ'	SouthEast Edge FW		×					'						-		+	some very large drives in the	iese
L2	Make 1 East	×			+	8	+	+'	<u> </u>	x	×	+'	×	×	×	+	areas	
	Make 1 West	×	_	+	+	8		+		x			×	x	×	+		
	Make 2 East	x				16	1	7		x	×		×	×	×	+		
	Make 2 West	x			+	6	1	+		x			×	×	×	+		
	Line 1 East	x				6		+					1		×			
	Line 1 Central	×		-		10							1		x		electrical noise?	
	Line 1 West	x				20		+	×				1		×			
	Line 2East	×				10		,,				,			×			
	Line 2Central	x				10		· · · · · · · · · · · · · · · · · · ·				· · · · · · · · · · · · · · · · · · ·			×		electrical noise?	
	Line 2 West	×				20		· · · · · ·	×			,			×			
ļ	Line 3 East	×				12		· · · · · ·				· · · · · · · · · · · · · · · · · · ·			×		Expecting bugg tomp extrem	
· /	Line 3 Central	×				12		· · · · · ·				,			×		electrical no Expecting huge temp extrem	nes
I	Line 3 West	×				20		''	×			· · · · · · · · · · · · · · · · · · ·			×		in dock areas	
	Control Room North	x				20		1			×	ring 2			×	×		
J	Control Room South	×				20	3	21			×	ring 2			×	×		
	Receiving West	×				12		''				· · · · · · · · · · · · · · · · · · ·				×	temp extremes	
	Receiving NorthEast	×				12	3	21				· · · · · · · · · · · · · · · · · · ·				×	temp extremes	
	Receiving SouthEast	x				12		''				· [· · · · · · · · · · · · · · · · · · ·	×	temp extremes	
	Shipping North	×				10										×	temp extremes	
	Shipping South	×				10	2	8				,				×	temp extremes	

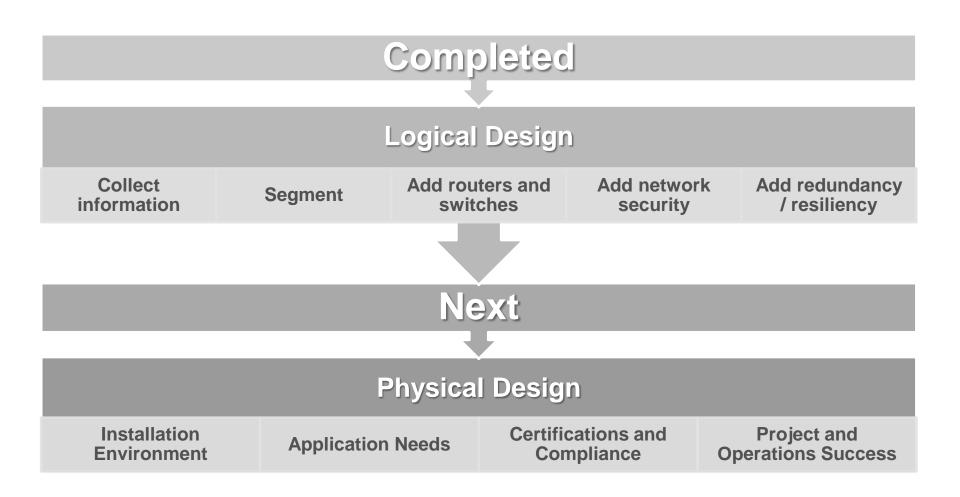


Choose Products and Record Your Choices

Use	Location /Name	L2	L3	10G ports	1G ports	10/100 ports	PoE ports	PoE Watts	1588	IP-67	2x power	Redun nets	USB memory	special requirements	Model	Catalog Number	Accessories	Accessor Catalog Numbers
Backbo	Di Control Room / Ship / R	eceive	x	3							x	ring 1	Х					
	Make Area		х	3							Х	ring 1	Х					
	Packaging Area		x	3							Х	ring 1	Х					
Firewal	Sontrol Room FW		?								х	ring 2	X					
	Shipping FW		?									g _						
	Receiving FW		?															
	Make Area 1 FW		?								-							_
	Make Area 2 FW		?															
	Line 1 FW		?							Com	att0 am							
	Line 2 FW		?							Jarr Garr	ELLCOM							
	Line 3 FW		?															
	Enterprise Edge FW		x							Prod	uct Selectic	n Guide			б нг			
	NorthEast Edge FW		x												ABEL	DEN BRAND		
	SouthEast Edge FW		x					P										
								(h) HIRS	CHMANN			-	TA					
2	Make 1 East	х												Product, Feature and Approv			1	
	Make 1 West	х											1.500				1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
	Make 2 East	х						Lead	ing Networ	king Soluti	ons for							
	Make 2 West	х						Indus	strial & Miss	sion Critical	Applicatio	ns en	COLOR C Gerriller	E pi			NUCL OF COMPANY	
	Line 1 East	х										1 AP 0	American		114 MAR	MALE COM		
	Line 1 Central	х							REFE			and the second second	Part -	WILL OF ANY		10.01 10.020		
	Line 1 West	х					sites these		HHA			1. in the		STEER 0 0 0 0 100 5 0	00	0 000		
	Line 2East	x													000	• •		
	Line 2Central	x					Sec.			H-1			In and A		0 0 0 0 0			
	Line 2 West	x				Ex.				Real II +	14		1016	1540 0 0 0 6 8 152 0 0 0 100 5	0 0000	0 0 000	0000000	
	Line 3 East	х					-			The local dates and the lo		autoradatora	0		0 000 0	00 000		
	Line 3 Central	х								arrest of stress				ME20 0 0 0 100 24 ME20 0 0 0 0 5 25	0 000 0	0 0 000		
	Line 3 West	x								Statutes and States	Sal o	timate Produ	ct Selection	WEA128 0 0 0 6 28 OCTOPUS 0 0 6 24 0	0 0000 0	000 000		
	Control Room North	x					Contraction of the		1		Mu	laged Switch	naged and es, Routers,		0000000			
	Control Room South	x					555		In	and the	Sellen	Devices, Med ach More.	lia Converters,	BACHAGE C C C 0 10 2 2	0 00	e e 000		
	Receiving West	x					Dan Tabl			24	D7/			O.O. Hollow markers indicate that	a non-standard/accorro	ry mounting option is available	0.	
	Receiving NorthEast	x					- Arts		-					All DIN rail mount switches can be mo in their housings to enable panel mount fances for rang are gwilishe for with	united in a 19" rack by using the sting. The RSR has an adaptor p d support.	Fack Mount Adapter (accessory). The date and the MACHs can have their to	o. o Spidor, Spidor II and RS2-51X sories have holes nt rack mount flanges terned 90° (additional	
	Receiving SouthEast	x								24				* All approvals for the RSP are pandle				
	Shipping North	x																
	Shipping South	x				Editi	on B			Hirschmann	" Networking							
	11 3	-								Throughput	Simplifies							
										Total Cost o	f Ownership			74		717.217.2299	www.bolden.com/hirschmann	
																		_
																		_
						_												

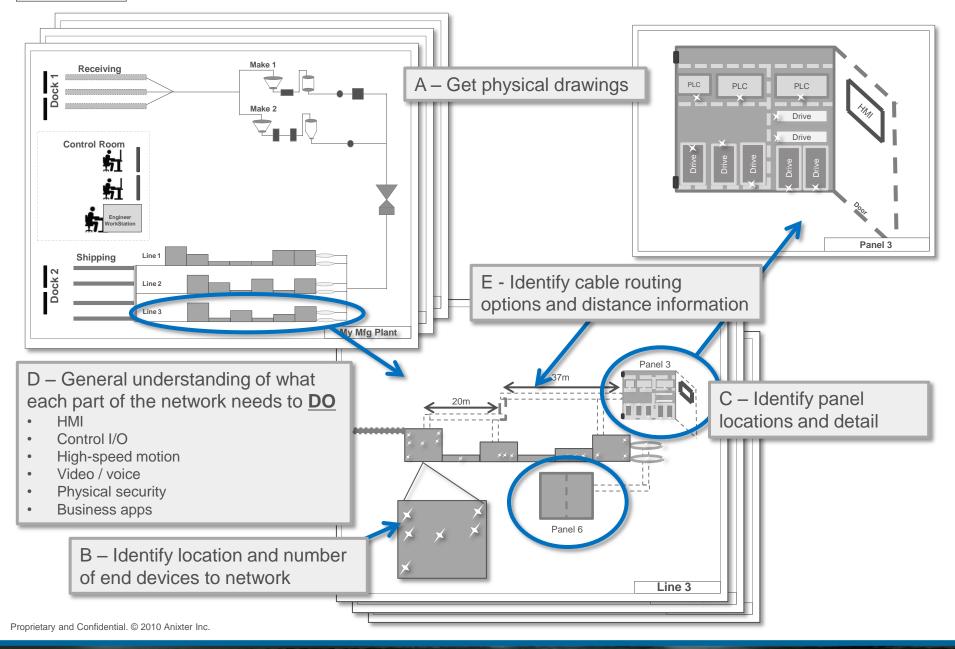


Summary – Logical Design





Step 1 – Collect Information (from Part 1)





And your spreadsheet of Switch/Router Choices...

				Swi	tch /	Route	er Lis	t - Ne	twor	k Des	sign										
Project	My Factory																				
Project Engineer																					
Project Engineer	Duviu Auurris																				
														(corrosive,							
														moisture)							
Use	Location /Name	L2	L3	10G	1G	10/100		PoE	1500	10.67	2x power	Redun nets	USB memory	Conformal			special	Model	Catalog Number	Accessories	Accessory Catalog Numbers
Use	Location / Name	LZ	13	ports	ports	ports	ports	walls	12999	IP-67	power	nets	memory	Coating	Net/IP	net	requirements	wouer	Catalog Number	Accessories	Numbers
Backbone	Control Room / Ship / Receive		×	3	3						x	ring 1	×								
	Make Area		x	3							×	ring 1	×								
	Packaging Area		x	3							×	ring 1	×								
Firewalls	Control Room FW		?								×	ring 2	×								
	Shipping FW		?																		
	Receiving FW		?																		
	Make Area 1 FW		?																		
	Make Area 2 FW		?																		
	Line 1 FW		?																		
	Line 2 FW		?																		
	Line 3 FW		?																		
	Enterprise Edge FW		×																		
	NorthEast Edge FW		×																		
	SouthEast Edge FW		×																		
L2	Make 1 East Make 1 West	×				8				x	×		×	×	×						
	Make 1 West Make 2 East	×				8	-	7		x			×	×	×						
	Make 2 East Make 2 West	×				6	1	/		x	×		×	×	×						
	Line 1 East	x				6				x			×	×	x						
	Line 1 Central	×				10									×		electrical noise?				
	Line 1 West	x				20			×						×		electrical holder				
	Line 2 East	x				10			^						x						
	Line 2Central	x				10									x		electrical noise?				
	Line 2 West	×				20			×						x						
	Line 3 East	×				12									x						
	Line 3 Central	x				12							1		x		electrical noise?				
	Line 3 West	x				20			×						×						
	Control Room North	×				20					×	ring 2	×		×	×					
	Control Room South	x				20	3	21			×	ring 2			x	×					
	Receiving West	×				12						_				x	temp extremes				
	Receiving NorthEast	×				12	3	21								x	temp extremes				
	Receiving SouthEast	x				12										×	temp extremes				
	Shipping North	×				10										×	temp extremes				
	Shipping South	×				10	2	8								×	temp extremes				



Step 2 - Specify Ethernet Cables and Connectors

Why?

- Failures can occur at Ethernet switch, connectors or cabling
- Which of these is most difficult to replace?
 - Switches have backup configurations
 - Connectors are usually easy to access
 - Cables are the most difficult to replace.
- So, make good Ethernet cable design decisions.
- Specify what is critical now!



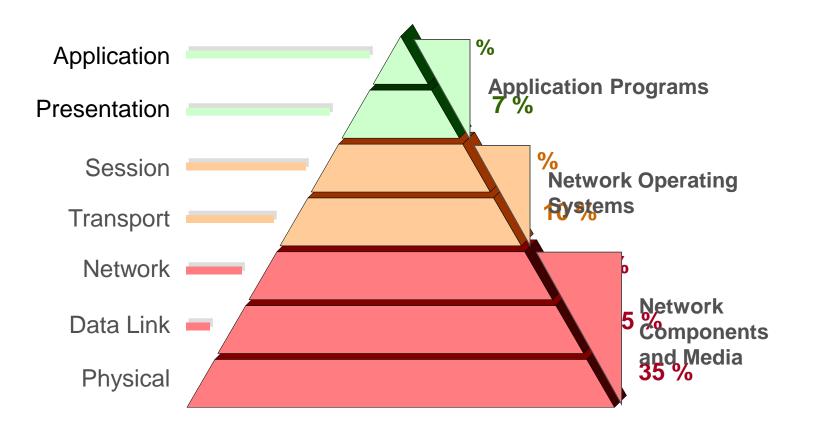






Network Reliability

What causes network faults?



Source: Datacom, Network Management Special



Choices, Choices, Choices...

Factors to consider

- distance
- performance
- environment
- application
- regulations & specifications

Choices to make

- Conductors
- Shield (or not)
- Jacket
- Connectors
- Pre-terminated or field-installable

We'll make this easy...



Specify Cable/Cordset Requirements

Factors	1. Specify ALL of these things that
< 80m	affect you or else installers will
< 100m	pick what they want.
< 5000m	pick what they want.
< 100,000m	
10/100M rate	
1G rate	
10G rate	
Power over Ethernet	
electrical noise (motors, drives, welders)	
standard bend radius (8-10x wire diameter)	
tight bend radius	
high flex	
outdoor	
UV (sun)	
washdown	
moisture	
Underground burial	
Tray installation	
Physical stress - cut-through, abrasion, crushing	
hazardous environment	
temp >20C or <0C	
chemicals	
low smoke zero halogen	
regulations & standards (many)	

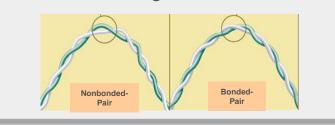


Step 7a - Specify Copper / Fiber Requirements

				С	Coppe	۶r					Fibe	er	
Factors	Stranded Alloy		Cat 5	Cat 5e / Cat 6		4 pair	Shielded	Unshielded		single- mode	e OM3/4	al ways tight buffer	always plenum
< 80m	V	V	٧	V	٧	٧	V	٧	V	٧		V	V
< 100m		V	V	V	٧	٧	V	٧	V	٧		v	V
< 5000m									V	V		v	V
< 100,000m										V		V	V
10/100M rate	V	V	V	V	V	٧	V	٧	V	V		V	V
1G rate	v	V		V		V	V	V	V	V		V	V
10G rate										V	٧	V	V
Power over Ethernet	V	V	V	٧		V	V	V					
electrical noise (motors, drives, welders)	V	٧	V	V	V	V	V		V	٧	V	V	V
standard bend radius (8-10x wire diameter)	V	٧	٧	V	V	V	V	٧	V	٧	V	V	V
tight bend radius	V												
high flex	V												

Industrial Copper, ALWAYS spec:

- Bonded Pair (see "9 tests" data)
- CAT5e or higher



drive each decision

Things shaded in orange

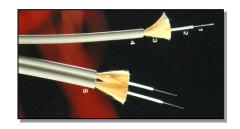
Industrial Fiber, ALWAYS spec:

- Tight buffer
- Plenum
- OM3/4



Step 7b - Specify Jacket Requirements

		-		Jac	ket			_
Factors	UV	Armor	PUR jacket	Expose Run	FEP insulation & jacket	TPE insulation & jacket	PE jacket	CPE jacket
outdoor	1	V						
UV (sun)	V							
washdown								V
moisture								
Underground burial							٧	
Tray installation				V				
Physical stress - cut-through, abrasion, crushing		V	٧					
hazardous environment		V						
temp >20C or <0C					V	٧		
chemicals						٧		
low smoke zero halogen								
regulations & standards (many)								





Step 7c - Specify Connector & Buy vs. Build Requirements

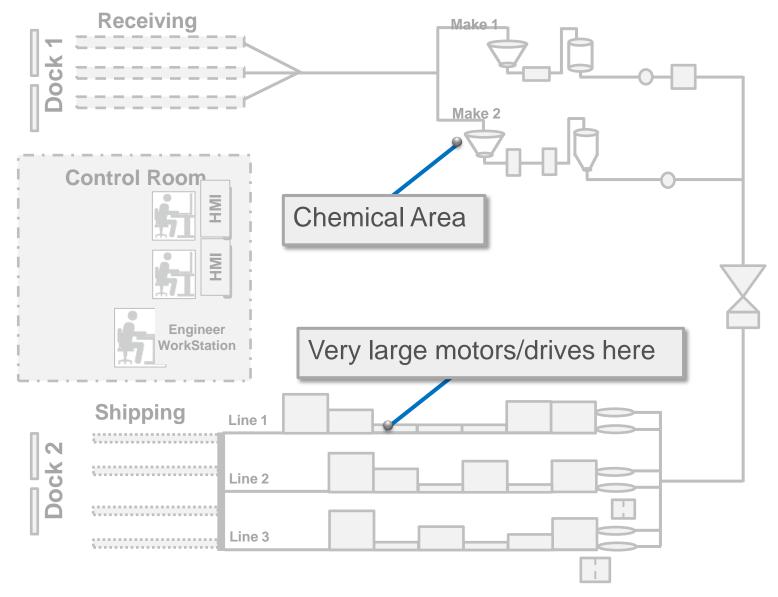
		Conne	ctor / C	ordset	
Factors	RJ-45	RJ-45 with seal overmold	M12	Field- installable connectors	premade cordset
outdoor		V	v		
washdown		V	V		
moisture		V	٧		
chemicals		V	٧		
time					٧
material cost				V	
precision length				V	





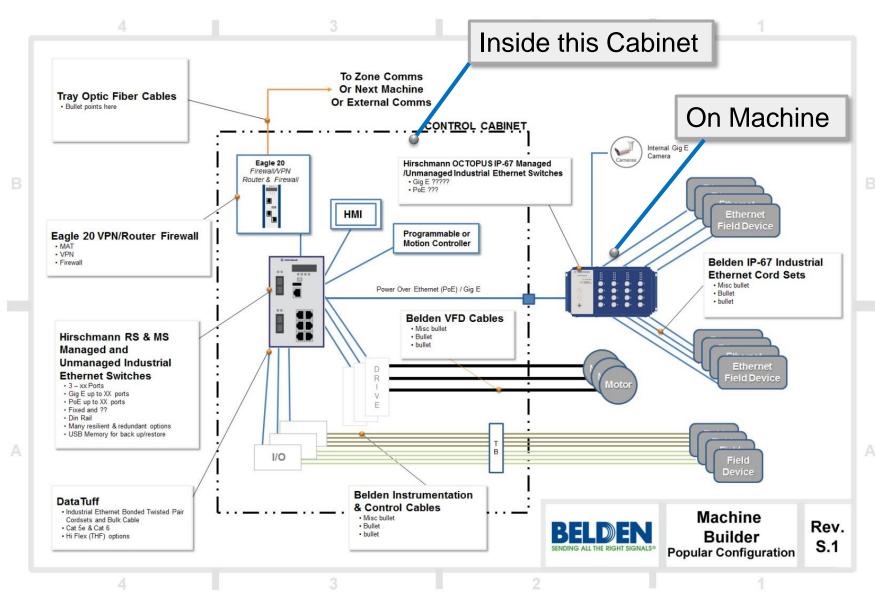


What considerations?





What considerations?





What cable choices will you use for...

				50010	/	nout		t - Net		Des	.9.1										
Project	My Factory																				
Project Engineer	David Adams																				
							_														
														(corrosive, moisture)							
Use	Location /Name	L2	L3	10G	1G ports	10/100		PoE Watts	1500	IP-67	2x	Redun	USB	Conformal Coating			special requirements	Model	Catalog Number	Accessories	Accessory Catalo Numbers
Use	Location / Name	LZ	L3	ports	ports	ports	ports	watts	1588	IP-67	power	nets	memory	Coating	Net/IP	net	requirements	wodei	Catalog Number	Accessories	Numbers
Backbone	Control Room / Ship / Receive		×	3							×	ring 1	×								
	Make Area		×	3							×	ring 1	×								
	Packaging Area		×	3							×	ring 1	×								
				_																	
Firewalls	Control Room FW		?				_				×	ring 2	×								
	Shipping FW		?																		
	Receiving FW		?																		
	Make Area 1 FW		?																		
	Make Area 2 FW		?																		
	Line 1 FW		?																		
	Line 2 FW		?																		
	Line 3 FW		?				-		L												
	Enterprise Edge FW		×				-		-												
	NorthEast Edge FW		x																		
	SouthEast Edge FW		x																		
			^																		
.2	Make 1 East	×				8				x	x		×	×	×						
	Make 1 West	×				8				x			×	x	×						
	Make 2 East	×				16	1	7		x	×		×	×	×						
	Make 2 West	×				6				x			×	x	×						
	Line 1 East	×				6									×						
	Line 1 Central	×				10									×		electrical noise?				
	Line 1 West	x				20			x						×						
	Line 2East	×				10									×						
	Line 2Central	×				10									x		electrical noise?				
	Line 2 West	×				20			×						x						
	Line 3 East	x				12									×						
	Line 3 Central	×				12									×		electrical noise?				
	Line 3 West	x				20			×						×						
	Control Room North	×				20	1				×	ring 2	×		×	x					
	Control Room South	×				20	3	21			×	ring 2			×	×					
	Receiving West	x				12						1				×	temp extremes				
	Receiving NorthEast	×				12	3	21								×	temp extremes				
	Receiving SouthEast	×				12										×	temp extremes				
	Shipping North	x				10	1									×	temp extremes				
	Shipping South	x				10	2	8								×	temp extremes				
		~		1			-	•				1					p orth orthoo				



What is Levels



- History of Category cable and Anixter involvement in defining the standards for Category cable.
- Category is based on performance and Levels is based on survivability in a particular application.
- Making it easier to identify specific cables, connectors, network switches and power supplies for the environment.
- End users and internal sales tool to make specifying cable and equipment faster and easier.

Current rating systems: Industrial Infrastructure

IEC

M3

13

C3

E3



-UL

-CE

- IEC

MICE

Individual Safety Ratings CE IEEE - IEEE -CUL**Increasing Severity** MICE Classes TIA-1005 **Mechanical** M1 M2 Ingress 11 12 - Mechanical Climate C1 C2 – Ingress - Climate E1 E2 Electromagnetic

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- Electromagnetic



Complexity of the MICE table

Climatic	C1	C2	C3
Ambient temperature	-10 to +50°C	-25 to +70°C	-40 to +70°C
Rate of change of temperature	0.1°C/minute	1°C/minute	3°C/minute
Humidity	5 to 85% (non-condensing)	5 to 95% (condensing)	5% to 95% (condensing)
Ultraviolet radiation	ffs	ffs	ffs
Solar radiation	700W/m ²	1120W/m ²	1120W/m ²
Sodium chloride	None	ffs	ffs
Sodium stearate	None	ffs	ffs
Detergent	None	ffs	ffs
Oil	None	ffs	ffs
Conductive materials in solution	None	Temporary (condensation)	Present
Gaseous pollution contaminants (ppm)	Mean /Peak	Mean /Peak	Mean /Peak
Hydrogen sulphide	0.003/0.01	0.005/0.05	10/50
Sulphur dioxide	0.01/0.03	0.1/0.3	5/10
Sulphur trioxide	0.01/0.03	0.1/0.3	5/10
Chlorine wet	0.0005/0.001	0.005/0.03	0.05/0.3
Chlorine dry	0.002/0.01	0.02/0.1	0.2/1.0
Hydrogen fluoride	0.001/0.005	0.01/0.05	0.1/1.0
Ammonia	1/5	10/50	50/250
Oxides of Nitrogen	0.05/0.1	0.5/1	5/10
Ozone	0.002/0.005	0.025/0.05	0.1/1.0

ffs: fit for service



Matching Components and Cabling to the Environment

Anixter has defined LEVELS that encompass the majority of industrial conditions (not 100%) based on economical and readily available products



Level 1: A controlled area located inside an industrial facility where cabling components are secured from physical damage and protected from harsh or industrial environments.



Level 2: Located inside an industrial facility where cabling and components are subjected to more extreme ambient temperatures, humidity and potential damage.

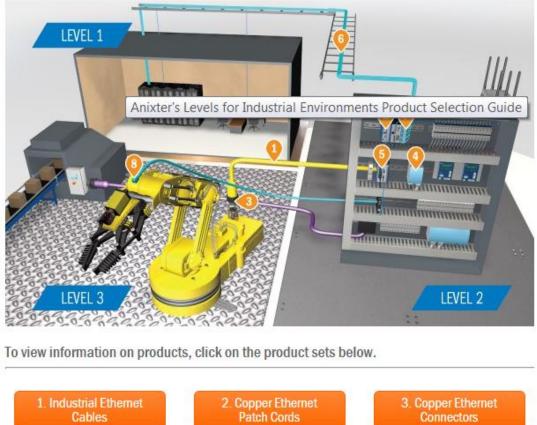


Level 3: Located in a harsh industrial area where cabling and components are exposed to oil, solvents, cleaning agents, lubricants, water, wide varying temperatures, humidity and dust.



Anixter levels – Product selection guide

Levels Homepage | Product Selection Guide Homepage | Criteria Homepage







Selection Guide for Copper Ethernet Cable

	12
	-

Cable Type	Color	Plenum or Non Plenum	Level 1	Level 2	Level 3	Solid or Stranded	Unshielded or Shielded
Cat 5e	Blue	Non Plenum	L1-5E-SOL-UTP-06		+	Solid	Unshielded
10/100		Plenum	L1-5E-SOL-UTP-06			Solid	Unshielded
	White	Non Plenum	L1-5E-SOL-UTP-01			Solid	Unshielded
		Plenum	L1-5E-SOL-UTP-P-01	-		Solid	Unshielded
	Black	Non Plenum	3 3	L2-5E-SOL-UTP-02	L3-5E-SOL-UTP-02	Solid	Unshielded
EMI	Blue	Non Plenum	L1-5E-S0L-SHD-06			Oalid	
EMI (Shielded)	Blue	Non Plenum	L1-5E-S0L-SHD-06		1220	Oatid	
						Solid	Unshielded
		Plenum	L1-5E-SOL-SHD-P-06		-	Solid	Unshielded Unshielded
	Black	Plenum Non Plenum	L1-5E-S0L-SHD-P-06		 L3-5E-SOL-SHLD-02		
Flexibility Stranded)	Black Black		L1-5E-SOL-SHD-P-06 			Solid	Unshielded



Anixter Levels Product Mix

Anixter's Levels for Industrial Environments uses technology and environment requirements to simplify product choices and deliver performance, scalability and reliability for mission-critical systems.

- Industrial Ethernet Cables
- ✓ Copper Ethernet Patch Cords
- Copper Ethernet Connectors
- Industrial Power Supplies
- Industrial Ethernet Switches
- Industrial Fiber Optic Cables
- ✓ Fiber Optic Patch Cords
- Fiber Optic Connectors



https://www.anixter.com/levels



Part 3 – Keys to Project and Operations Success

Industrial Networking Project Checklist			
Need		How Belden Can Help	Price
Manage	Manage my entire project	Provide a dedicated resource to work as customer staff	Quote
Design	Review my design & highlight areas of risk	Fax & phone consultation	FREE
	Assist with my design in a few key areas	Fax & phone consultation	FREE
	Assess my situation & create my design	Onsite meeting & comprehensive network design	Quote
Install	Preconfigure switches / routers		Variable
	Provide industrial installation guidelines		FREE
	Create custom installation instructions & drawings	Recommend experienced Belden System Integrator or partner	via SI
	Peform the installation	Recommend experienced Belden System Integrator or partner	via SI
	Peform security vulnerability testing	Onsite testing and assesment	Quote
	Peform network validation	Onsite testing and assesment	Quote
Startup	Perform startup	Recommend experienced Belden System Integrator or partner	via SI
	Provide troubleshooting	Onsite troubleshooting	
Operate	Dedicated onsite engineering service		Quote
Maintain	Stock spares	We review your application & needs & provide recommendations	FREE
	Stock preconfigured spares		Quote
	Firmware	Keep your hardware current	Variable
	Switch warranty	Lifetime Warranty	FREE
	Industrial HiVision Service Contract	Keep your software current	Variable
	Advanced replacement for faulty devices		FREE
	Remote troubleshooting		Quote
	Dedicated technical support contact	Get help from someone that knows you and your application	Quote
	On-site troubleshooting		Quote
	Troubleshooting procedures		FREE
	Troubleshooting tools		Variable
	Training for maintenance team		Variable
Upgrade	Assess planned network changes & highlight areas of risk	Fax & phone consultation	Variable
	Onsite visit if needed		Variable



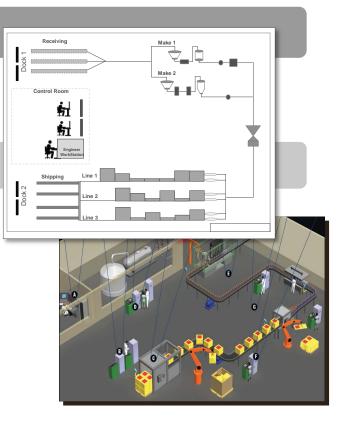
Seminar Summary

Objectives

- Complete the steps to design Industrial Ethernet networks
- Specify and select active and passive network components
- Identify and plan project and operational success factors

Agenda:

- Logical Design
 - Collect information
 - Segment
 - Add routers and switches
 - Add network security
 - Add redundancy / resiliency
- Physical Design
 - Determine critical factors
 - Conductors, shield, jacket,
- Project and Operations Success





Questions?

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