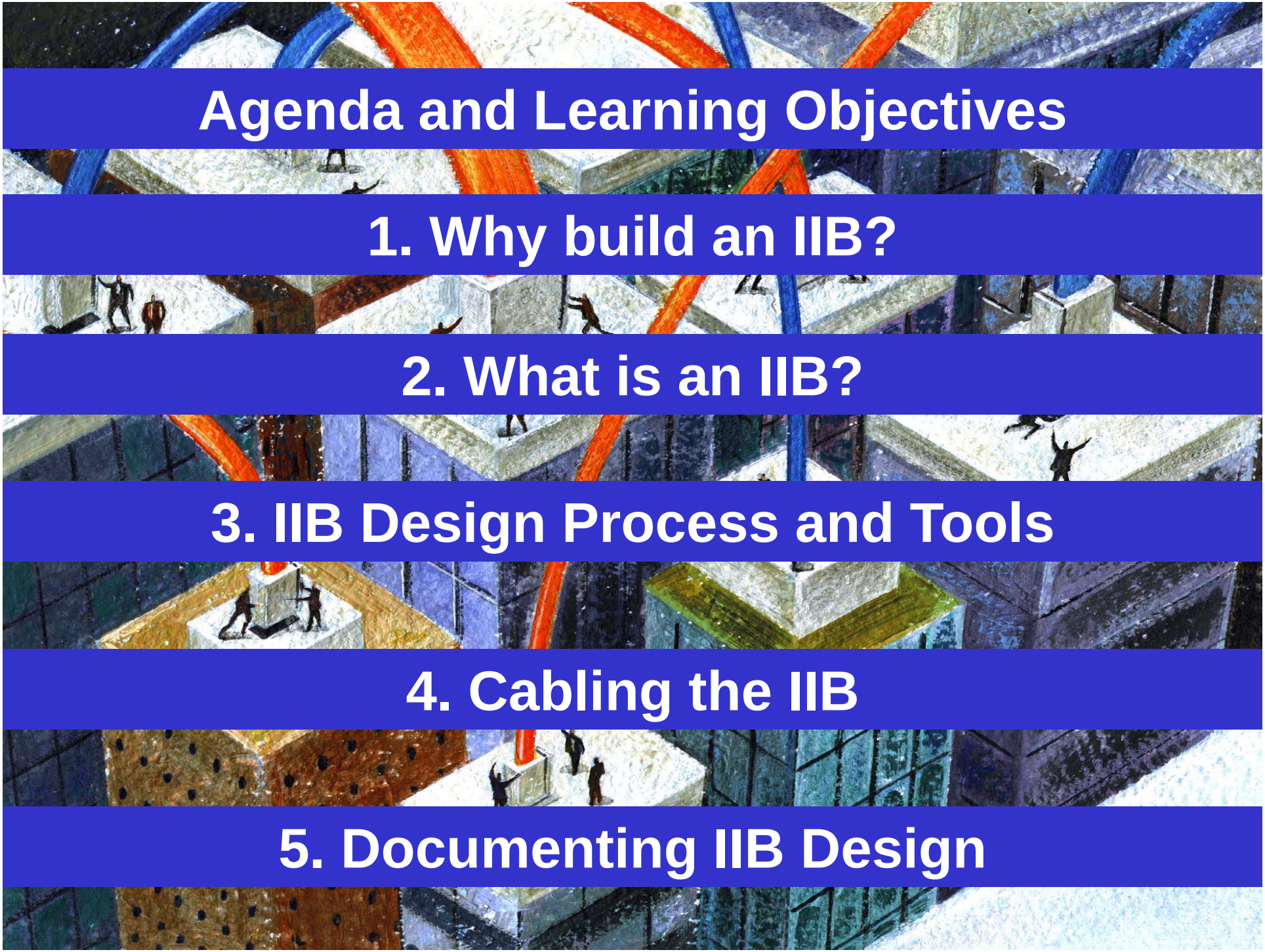
Designing, Cabling and Documenting the Integrated Intelligent Building (IIB)

Ernest Schirmer, Senior Associate

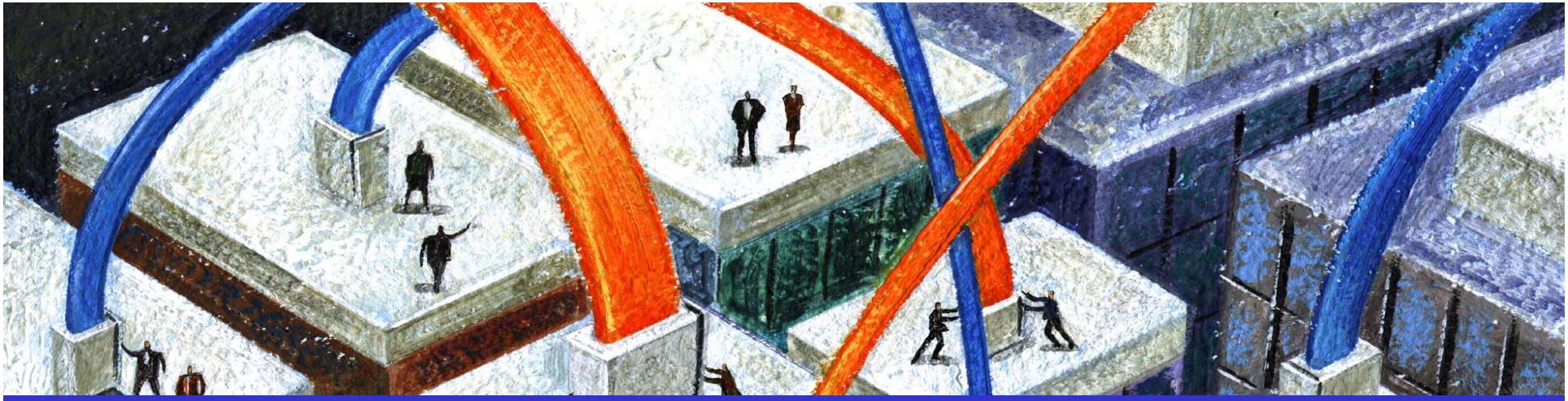
WSP | Parsons Brinckerhoff

2017
BICSI CANADIAN
CONFERENCE & EXHIBITION
MAY 8-11 • VANCOUVER, BRITISH COLUMBIA, CANADA



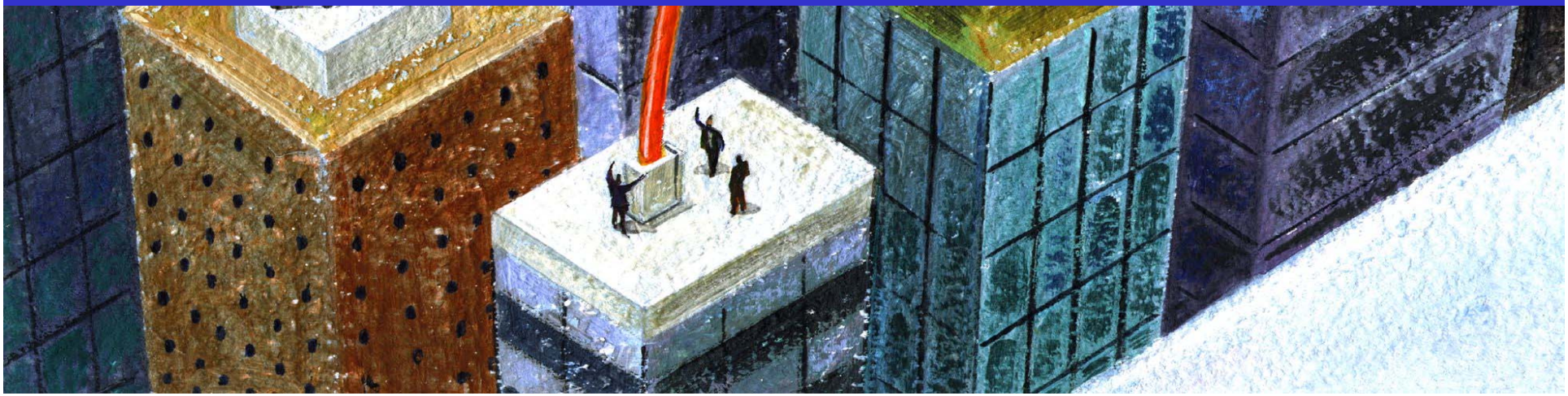
Agenda and Learning Objectives

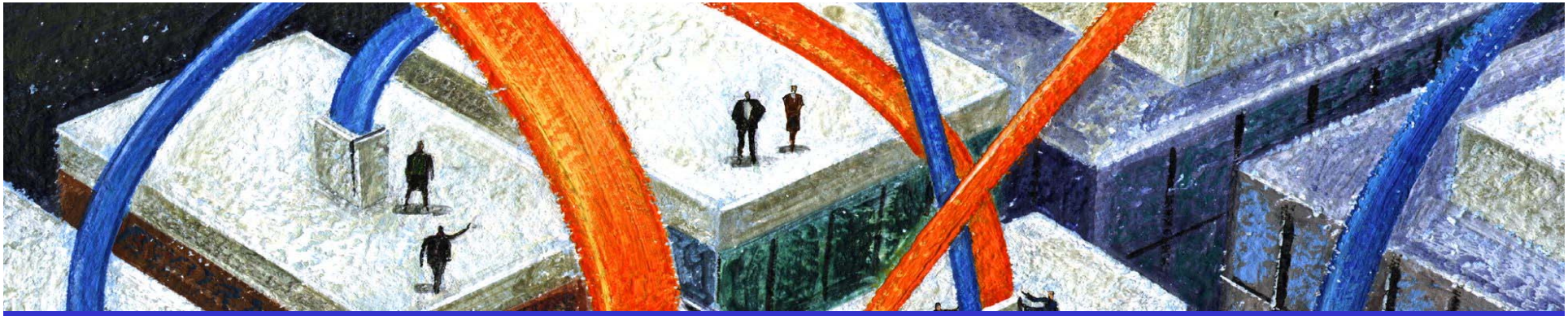
1. Why build an IIB?
2. What is an IIB?
3. IIB Design Process and Tools
4. Cabling the IIB
5. Documenting IIB Design



Managing Expectations

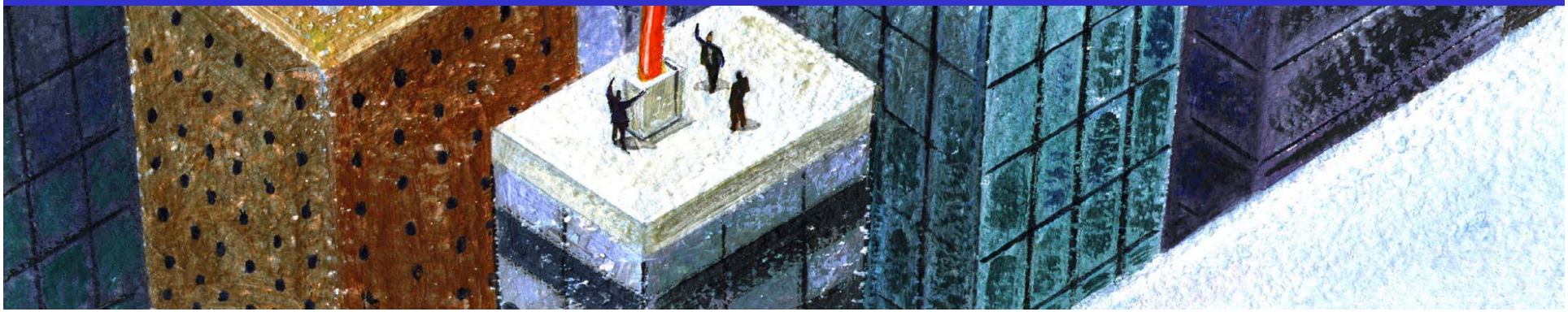
This will be a 40,000 foot overview of a complex topic.



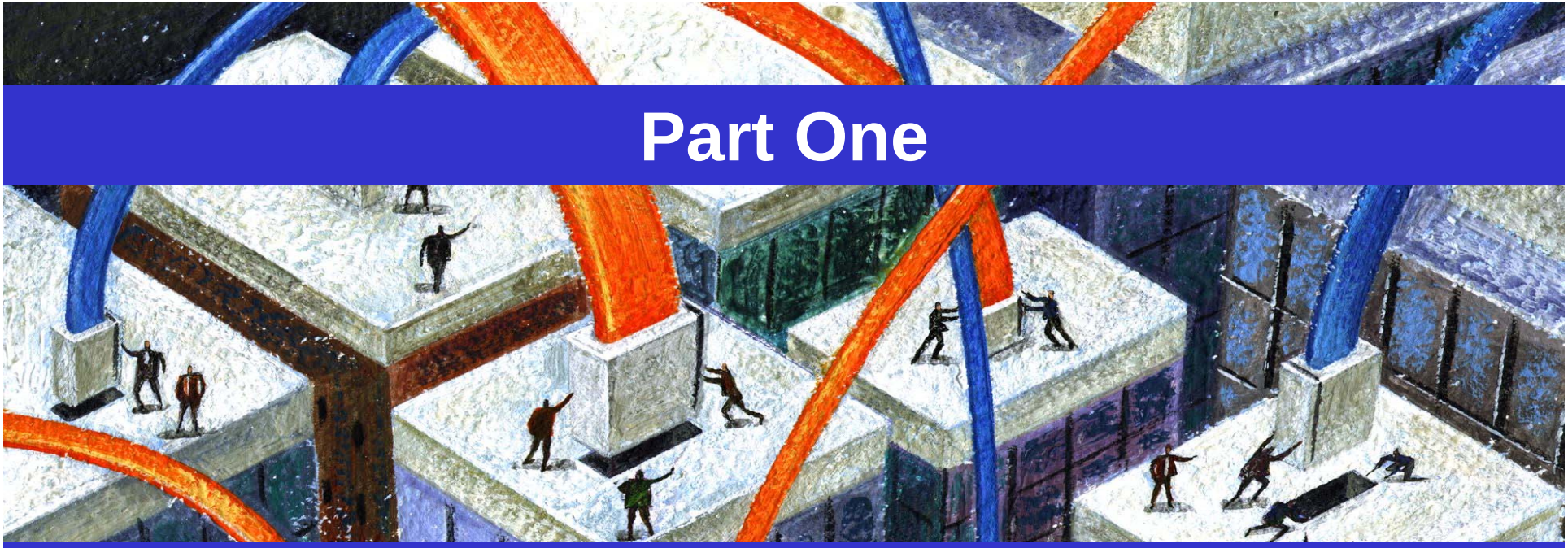


Some Questions

Is this topic of interest to you?
What type of projects are you doing?
Do you design? Install?
What do you design?



Part One



1. Why build an IIB?

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Before we begin, let's take a step back in time to review a little history.

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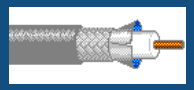
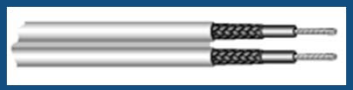
1984 “smart” building “future-proof” cabling:

- Type 9880 coaxial cable for Ethernet backbone
- Type 9907 coaxial cable for Ethernet to the Desktop
- Type 9296 coaxial cable for IBM dumb terminals



- Dual type 9555 coaxial cable for Wang word processor



- 4, 65, 12, 25-pair telephone cable

- IBM Type-1 Token Ring shielded, twisted-pair cable

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By 1989 Unshielded Twisted-Pair (UTP) cable did it all.

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And now, Back to the Future

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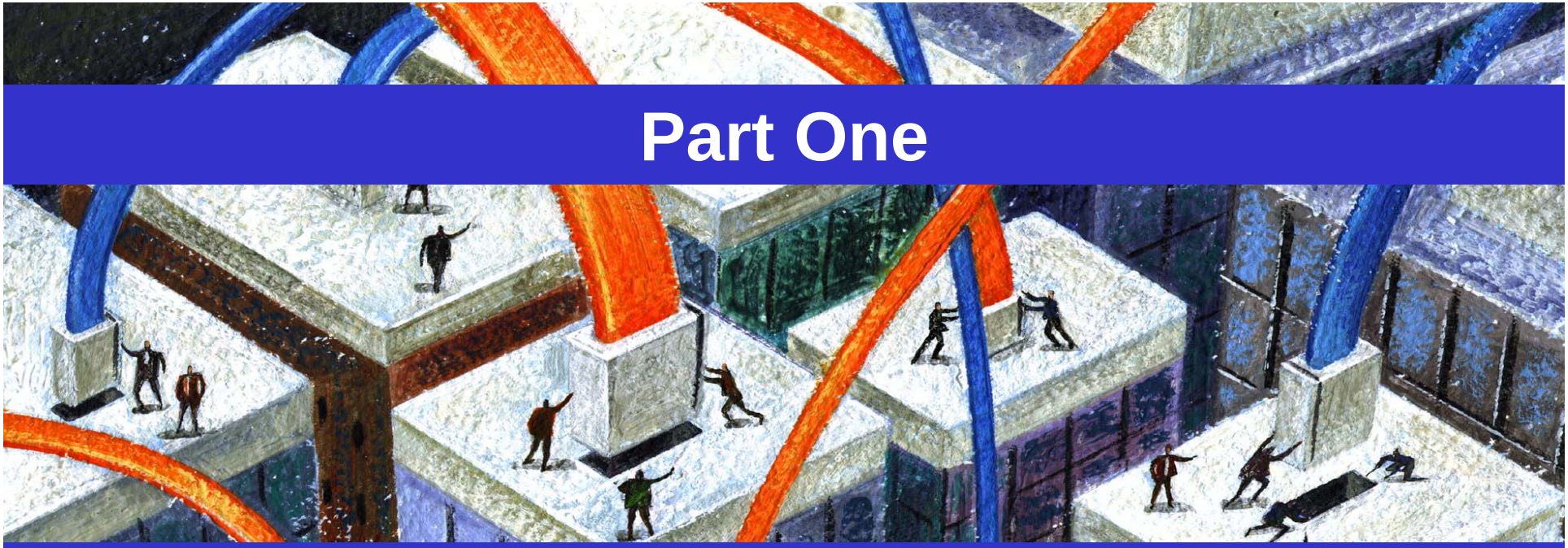
What have we learned from the past?

We can't create a future-proof design, but we can design for the *strategic accommodation of change*.

That is, creating a design that will allow the building and its infrastructure be economically modified over time. *This concept is often in conflict with project and construction budgets based on today's needs.*

Sometimes the best investment is empty conduit.

Part One



2. What is an IIB?

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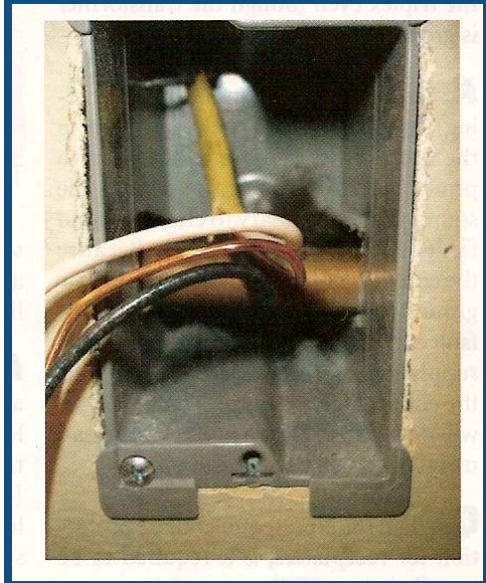
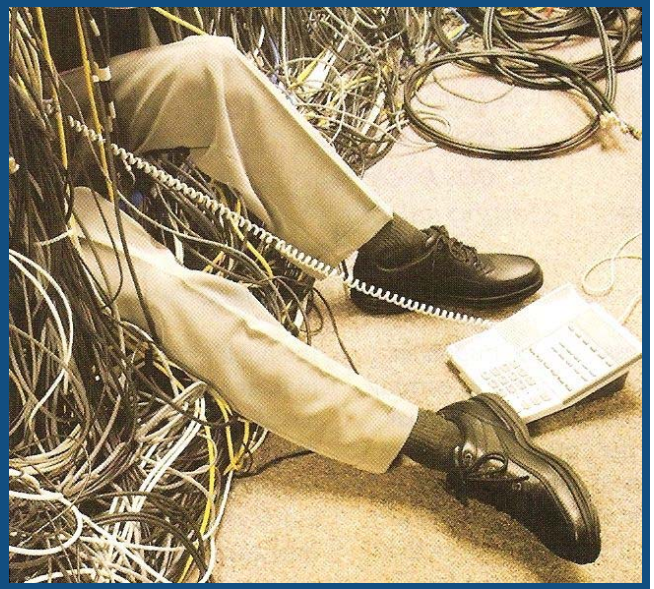
What is an IIB?
or
What problems does an IIB solve?





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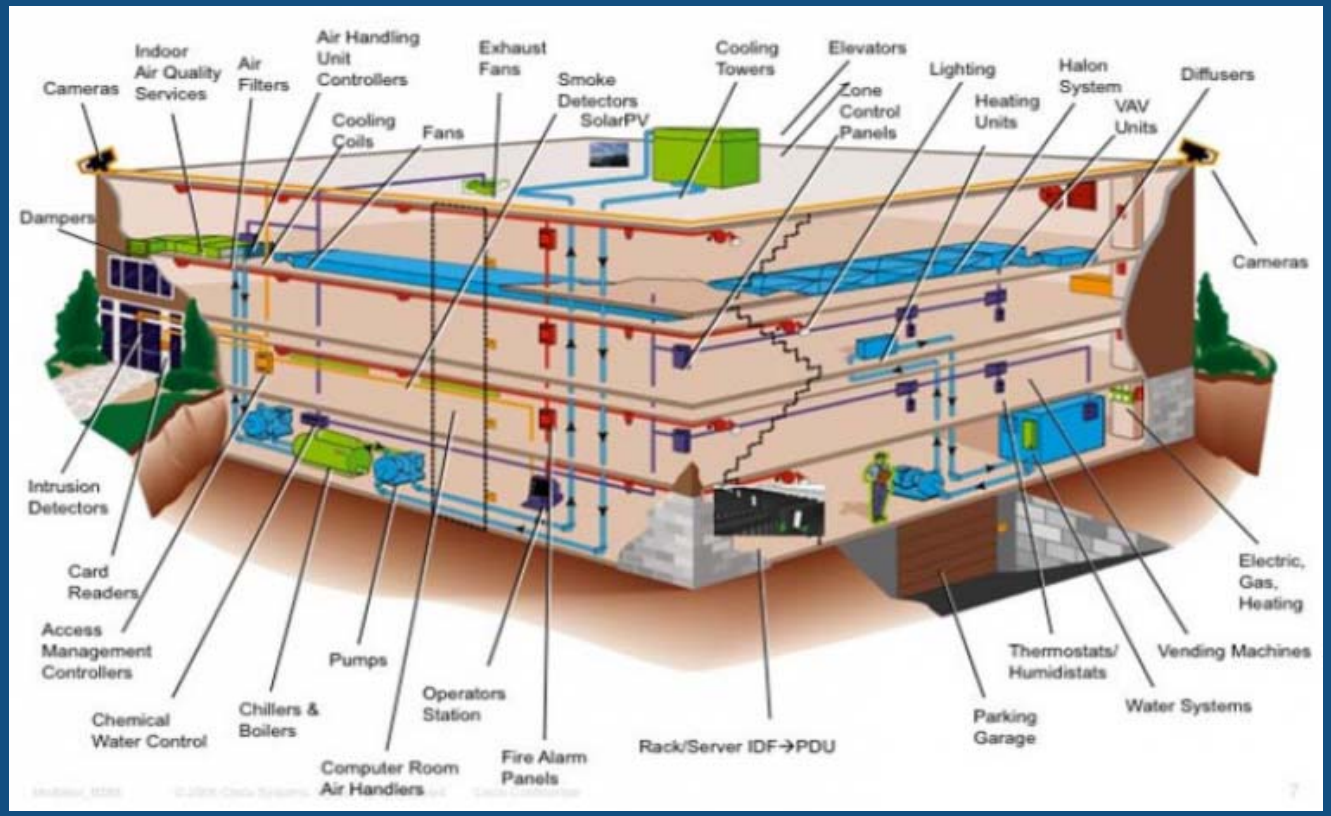
Today, almost all buildings are “smart”.



What makes them intelligent?

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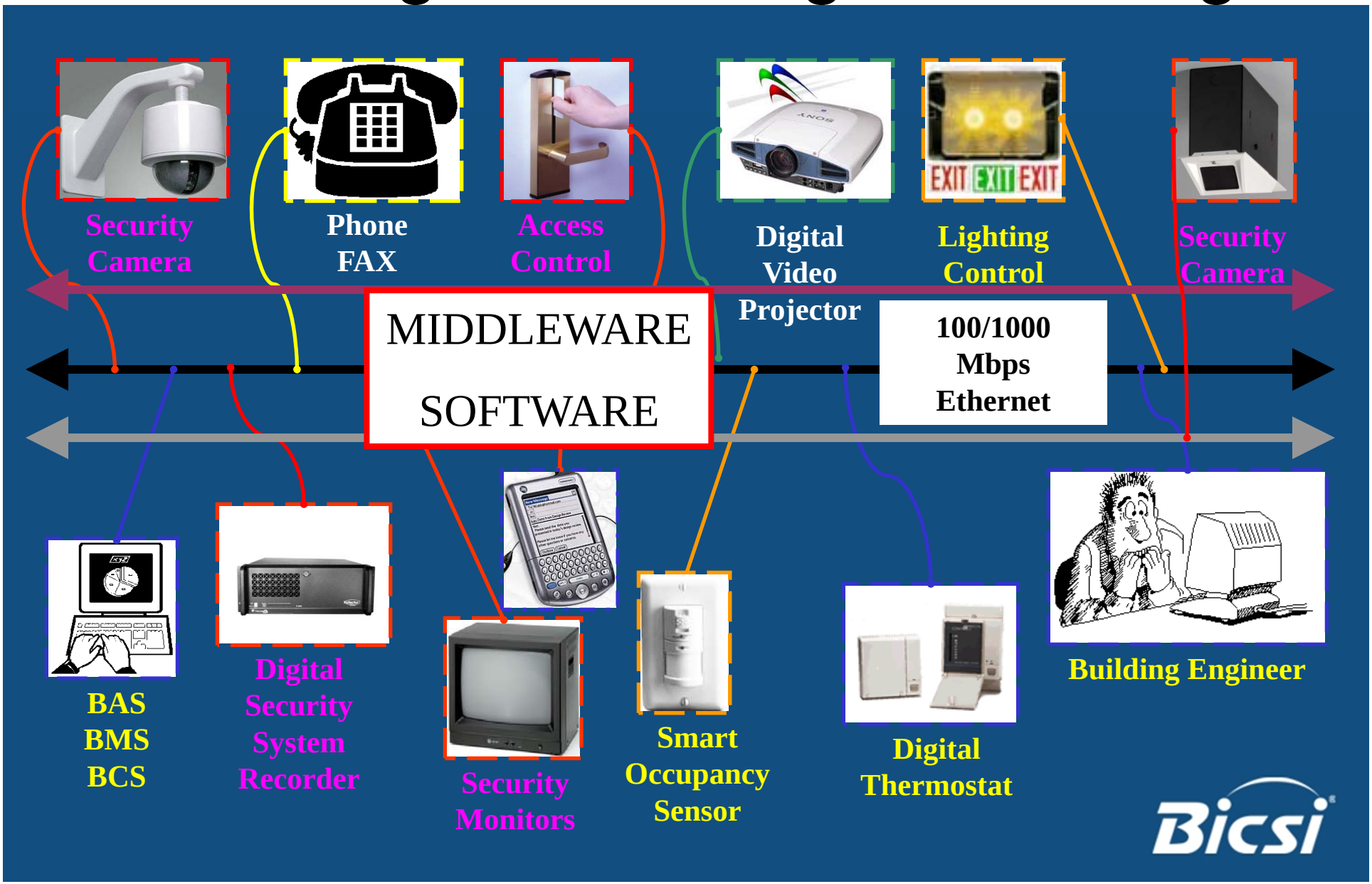

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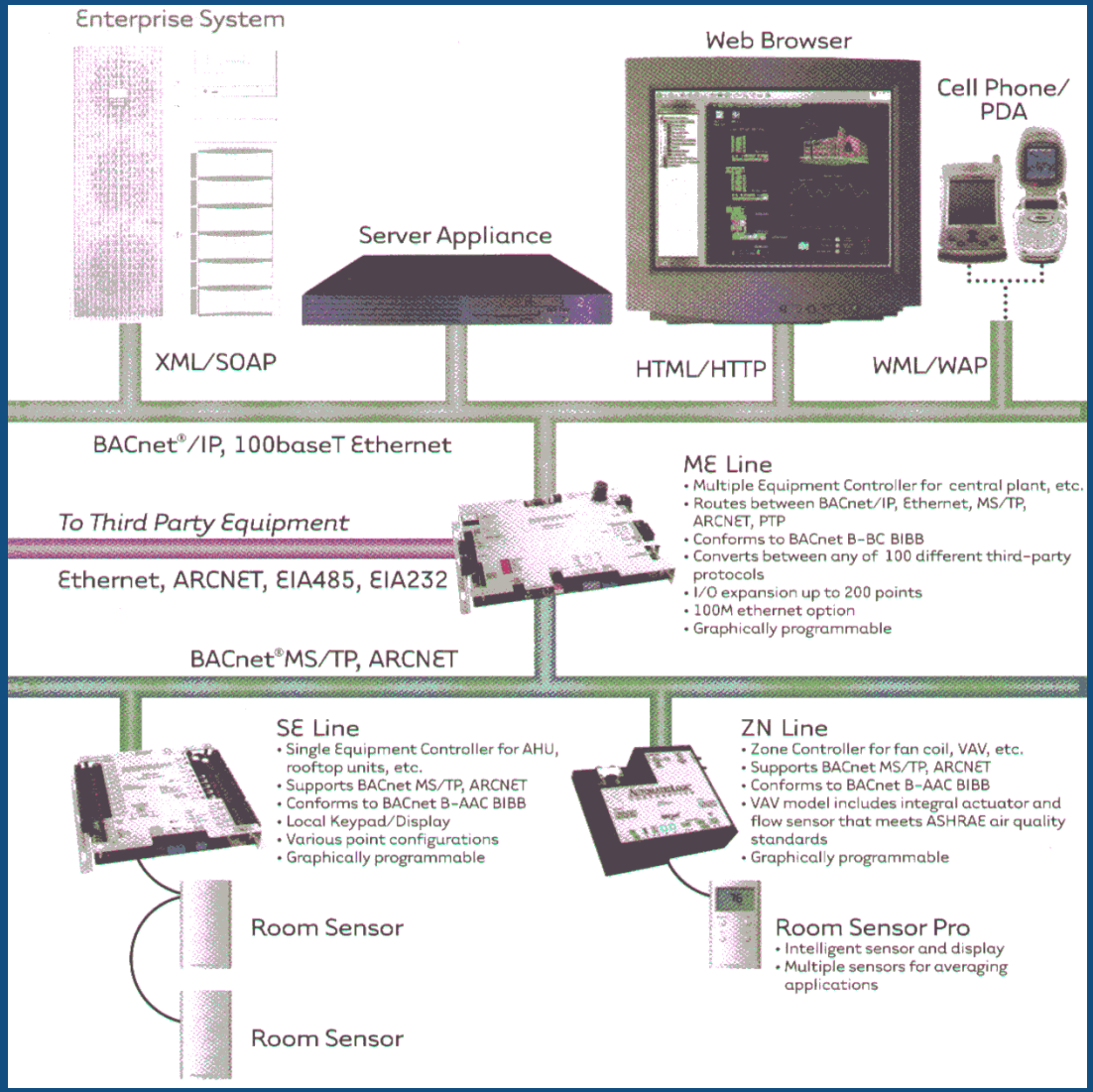

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Self-Powered Sensors Communicate Building Defects

Monday, 23 March 2015

Michigan State University researchers have developed a technology that allows sensing, communication, and diagnostic computing — all within the building material of a structure.

Using energy harvested from the structure itself, the "substrate computing" system features sensors that continuously monitor and report on the building's integrity.

"Adoption of such monitoring has previously been limited because of the frequency of battery replacement for battery-powered sensors," said Subir Biswas, professor of electrical and computer engineering, "as well as the need for a separate communication subsystem usually involving radio frequency sensor networks."

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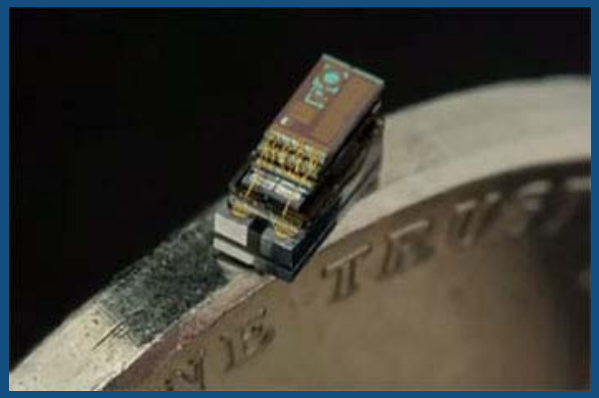
- **Is this the future of an IIB?**
- **Every light bulb, light switch, power outlet, VAV box, valve, lockset, and thermostat connected to the a network?**
- **IPv6 offers 2^{128} or 3.4 x 10^{38} IP addresses**

340,282,366,920,938,463,463,374,607,431,768,211,456



World's tiniest computer:
Michigan Micro Mote (M^3)

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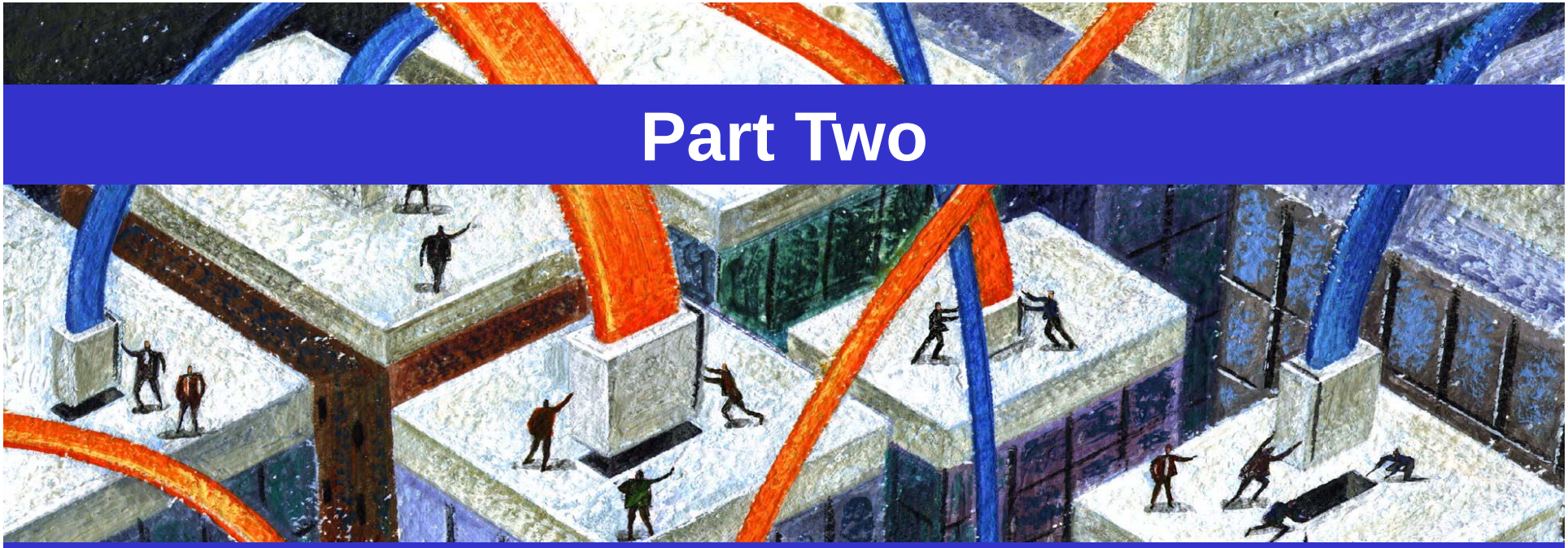
That's Equal To

- 40,000 IP addresses for every atom on the surface of the surface of the earth

- 655,570,793,348,866,943,898,599 IP addresses for every square meter on the surface of the earth

Part Two



3. IIB Design Process and Tools

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Designing the IIB

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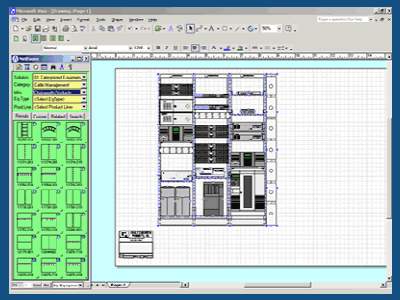
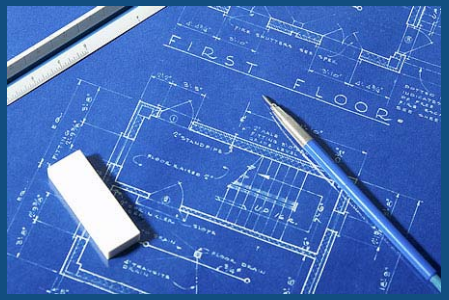
The Evolution of Design Tools

Specialty Design Tools



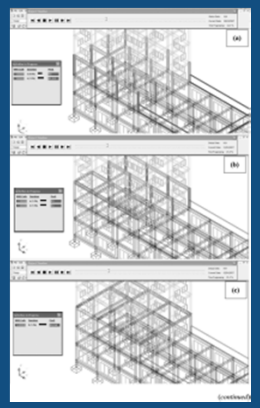
2D Manual Drafting



Building Information Model

2D/3D CAD

4D/5D Modeling



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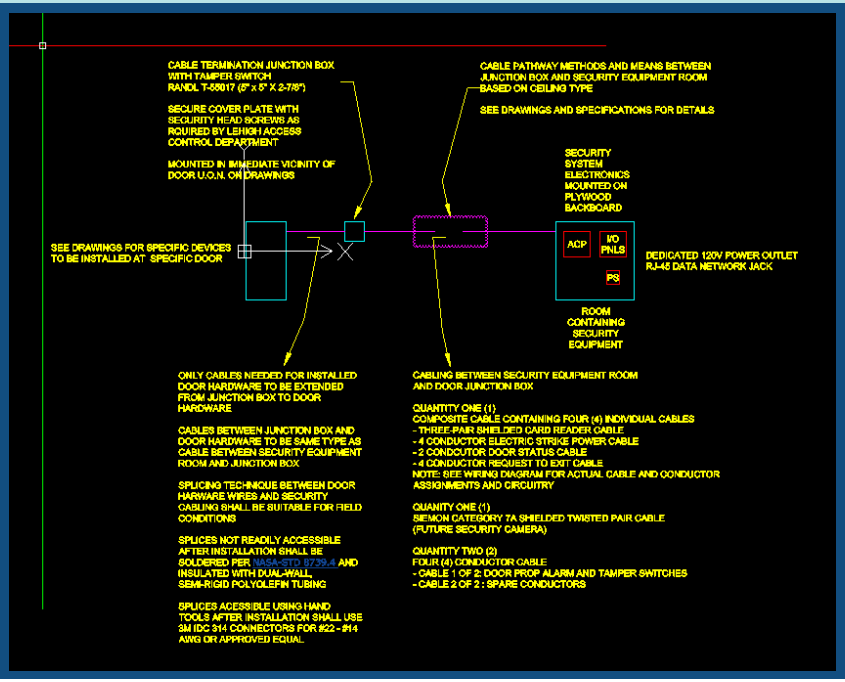
Bonus Slide
Free full-function equivalent of AutoCAD For Windows, Mac and Linux

www.3ds.com/products-services/draftsight/overview/



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The Building Information Model

3D Design

- Architect designs central model
- Design team members copy model
  - Structural, electrical, plumbing …
- What to model? (e.g., conduits > 2”)
  - Level of object detail
- Models updated and synchronized
- Collisions detected
- Subs prefabricate assemblies

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Bonus Slide
How to get a free Revit viewer

1. Download 30 day trial version of Revit
2. After 30 days, Revit will stop working
3. Revit viewer will continue to work

http://www.smarterarchitect.com/revit-viewer/

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The Building Information Model

BIM Design and Database

- **Family of objects**
  - **Walls, piping, equipment**
  - **Levels of detail**
  - **Standardization of field names**
  - **Format of data**

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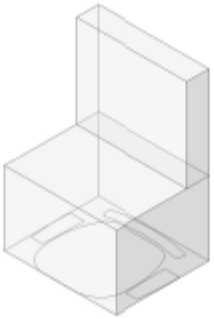
The Building Information Model

LEVEL of DEVELOPMENT

LOD 100	LOD 200	LOD 300	LOD 400	LOD 500
				
Concept (Presentation)	Design Development	Documentation	Construction	Facilities Management
DESCRIPTION: **Office Chair** Arms, Wheels WIDTH: DEPTH: HEIGHT: MANUFACTURER: Herman Miller, Inc. MODEL: Mirra LOD: **100**	DESCRIPTION: **Office Chair** Arms, Wheels WIDTH: **700** DEPTH: **450** HEIGHT: **1100** MANUFACTURER: Herman Miller, Inc. MODEL: Mirra LOD: **200**	DESCRIPTION: **Office Chair** **Arms, Wheels** WIDTH: **700** DEPTH: **450** HEIGHT: **1100** MANUFACTURER: Herman Miller, Inc. MODEL: Mirra LOD: **300**	DESCRIPTION: **Office Chair** **Arms, Wheels** WIDTH: **685** DEPTH: **430** HEIGHT: **1085** MANUFACTURER: **Herman Miller, Inc** MODEL: **Mirra** LOD: **400**	DESCRIPTION: **Office Chair** **Arms, Wheels** WIDTH: **685** DEPTH: **430** HEIGHT: **1085** MANUFACTURER: **Herman Miller, Inc** MODEL: **Mirra** PURCHASE DATE: **01/02/2013**

(Only data in **red** is useable)

practicalBIM.net © 2013

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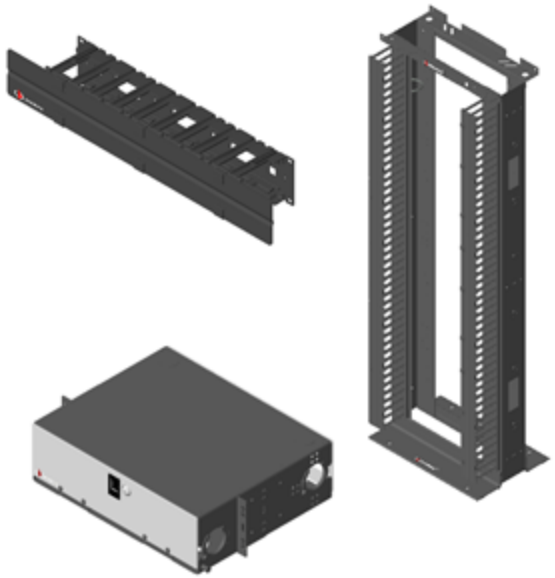
The Building Information Model

BIM (Building Information Modeling) Download Center for Network Infrastructure Hardware Models

Network Racks, Cabinets, Enclosures, Patch Panels and more in Revit, DWF, AutoCAD 3-D and ACIS 3-D formats

Building Information Modeling (BIM) uses multi-dimensional, spatial models that incorporate detailed product information for the building components. BIM offers many benefits such as improved integration of the design process and identification and avoidance of potential spatial interferences.



To support our partners using BIM initiatives, Siemon provides a growing library BIM models of our network racks, cabinets, cable management and other network infrastucture products. These models are provided in multiple formats (Revit, DWF, AutoCAD 3-D, ACIS 3-D) for optimal compatibility with today's leading BIM software programs including Autodesk® Revit® and Bentley® MicroStation.

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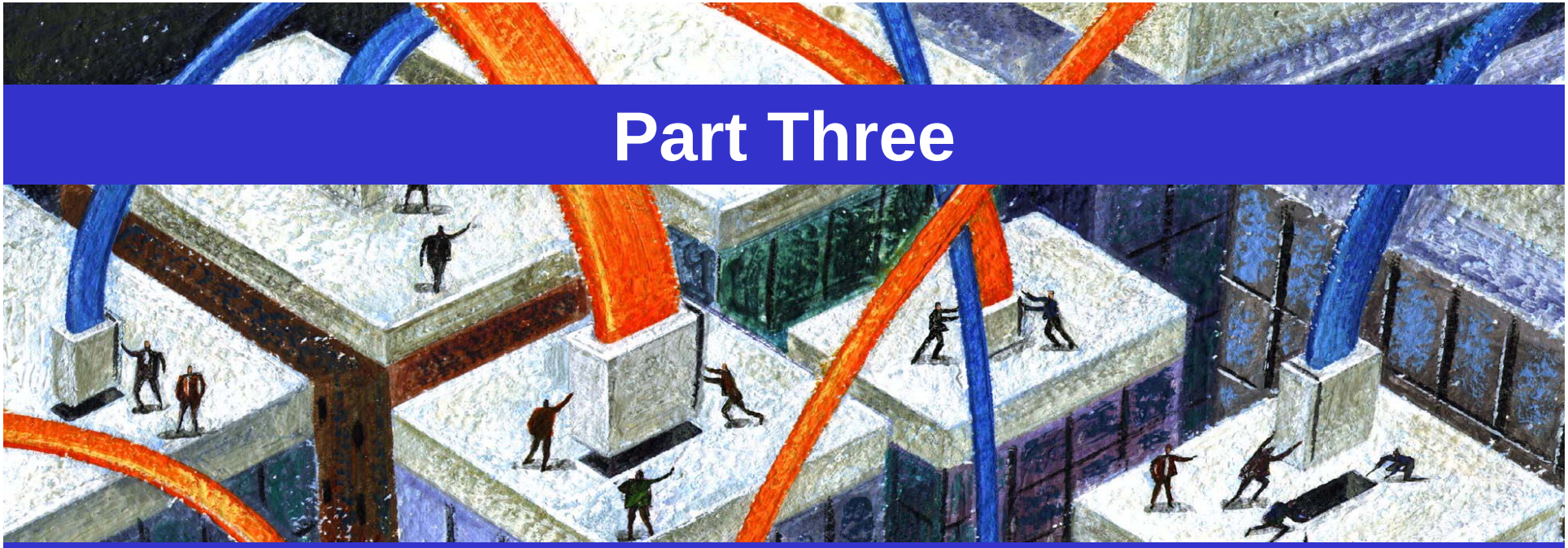
Part Three



4. Cabling the IIB

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A high-performance copper, fiber optic and wireless communications network is considered the enabling technology for an Integrated Intelligent Building

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One cable system capable of supporting:

- Legacy Voice, Video, Data
- BACnet, LonWorks, ARCnet, PROFINET
- MODBUS
- Ethernet IEEE 802.3
- Digital serial data transmission
  - (RS 232, 422, 423, 485)
- Analog data transmission
  - 0-20 and 4-20 milliamp process control
  - 0-10 volt process control

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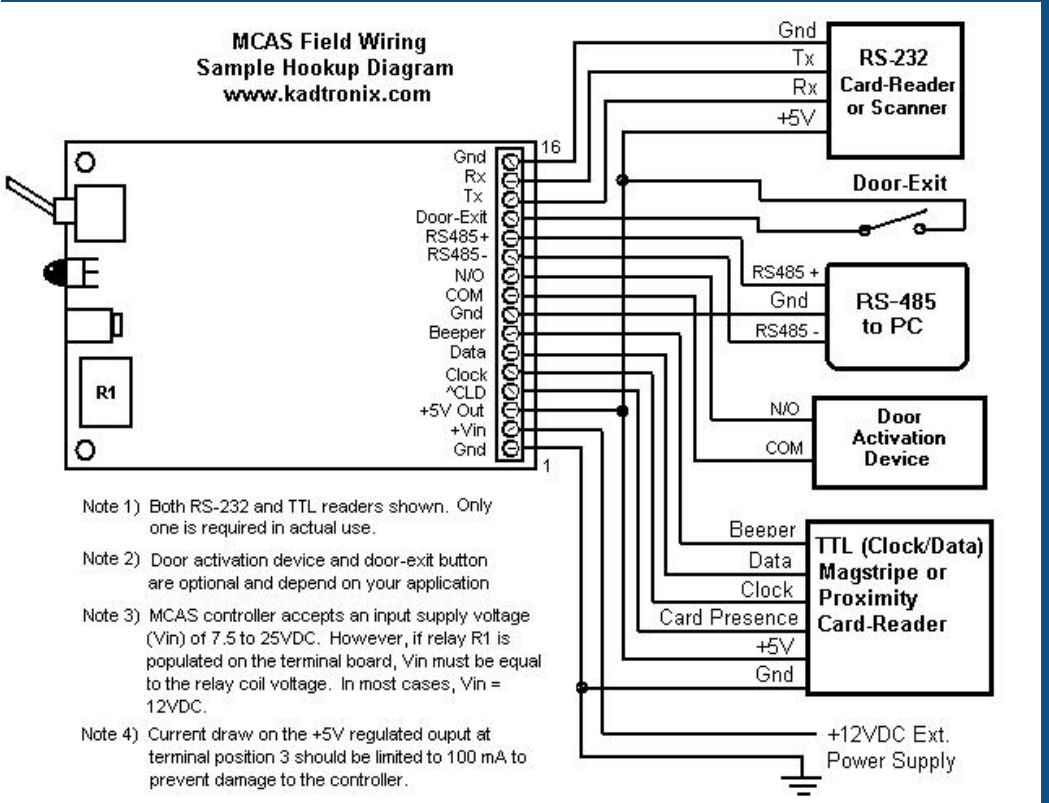

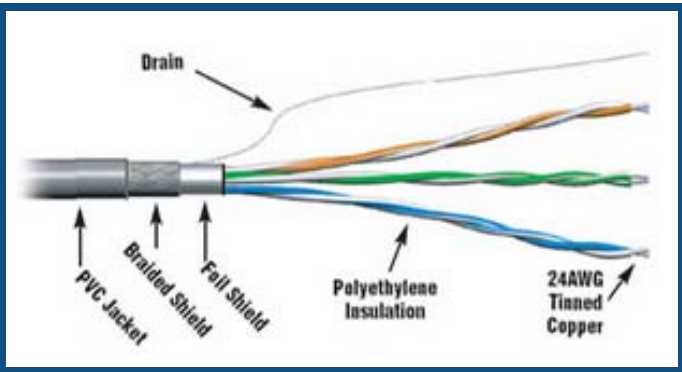

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Industrial (aka hardened) Ethernet switches are designed to operate over an extended temperature in unconditioned environments (e.g., -40ºC to -75ºC) without cooling fans

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How will this effect me?

New equipment, new terminology

New cable types

New methods and means, new temperature extremes

Multiple stakeholder coordination

More documentation

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Intelligent Building Cabling Standard

- **ANSI/TIA Standard 862-A**

Building Automation Systems Cabling Standard for Commercial Buildings

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ANSI/TIA Standard 862-B is still in committee

- **Technical issues to be resolved**
- **Nomenclature changes**

Proposed name change from
“Building Automation Systems Cabling Standard for Commercial Buildings”
To
“Intelligent Building Systems Cabling Standard”

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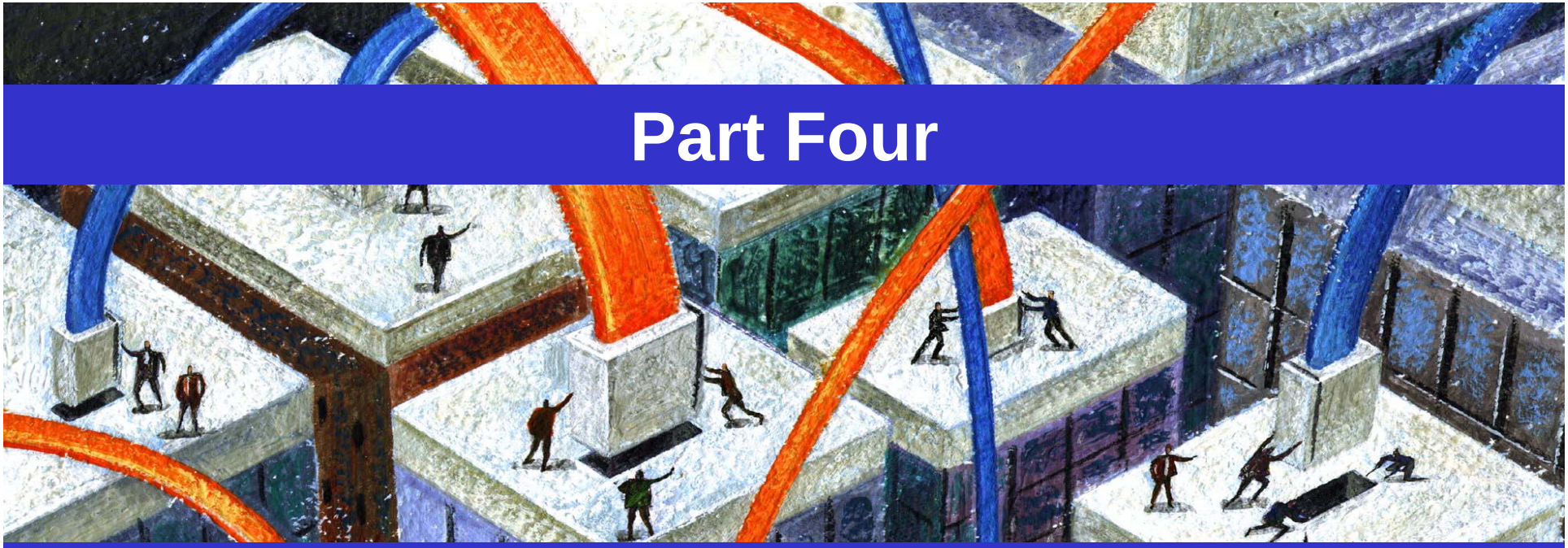
Pros and Cons of integrated cabling:

Pros: Vendor, application and protocol independent; avoids redundant design efforts; decreases construction costs (13% to 30% most frequently quoted numbers for BAS, BCS, BMS cabling); reduces life-cycle operational costs; and creates optimal ratio of active-to-spare cables.

Cons: Requires more coordination, knowledge of multiple systems and willingness of vendors to support cable plant.

Part Four



5. Documenting IIB Design

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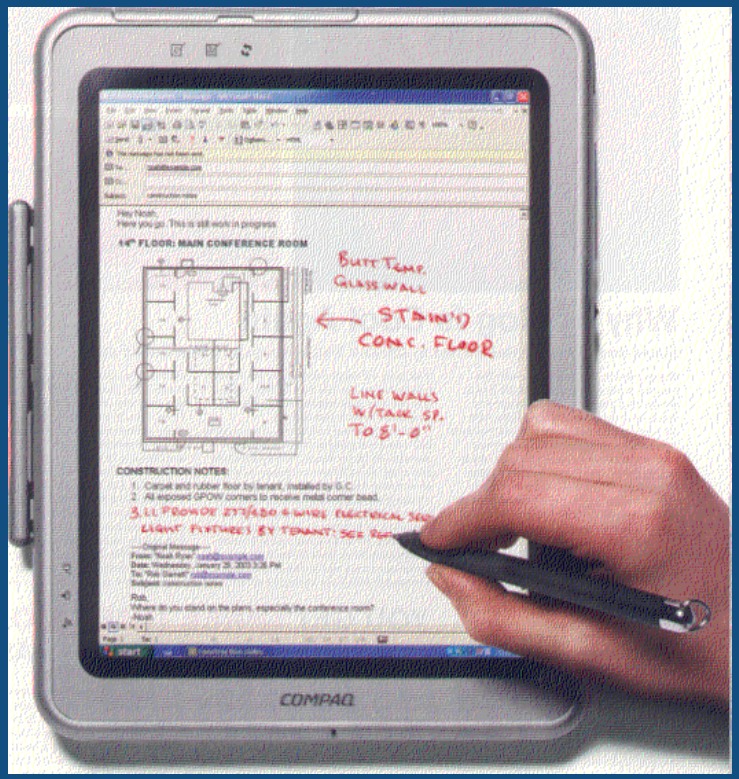
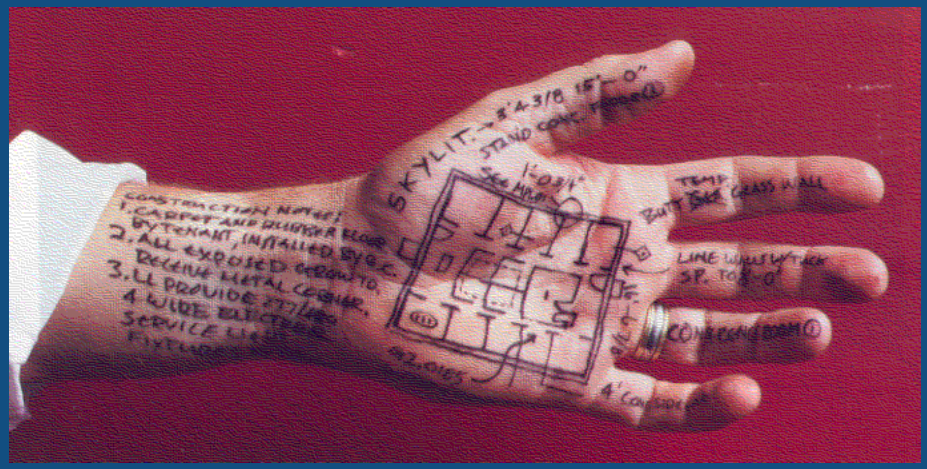
How do we document an IIB?





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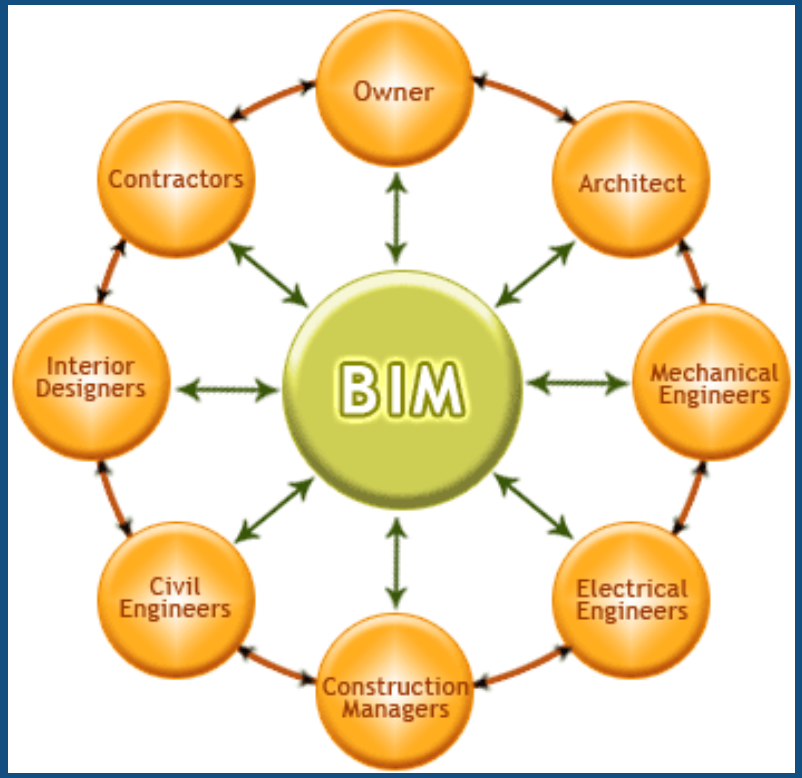
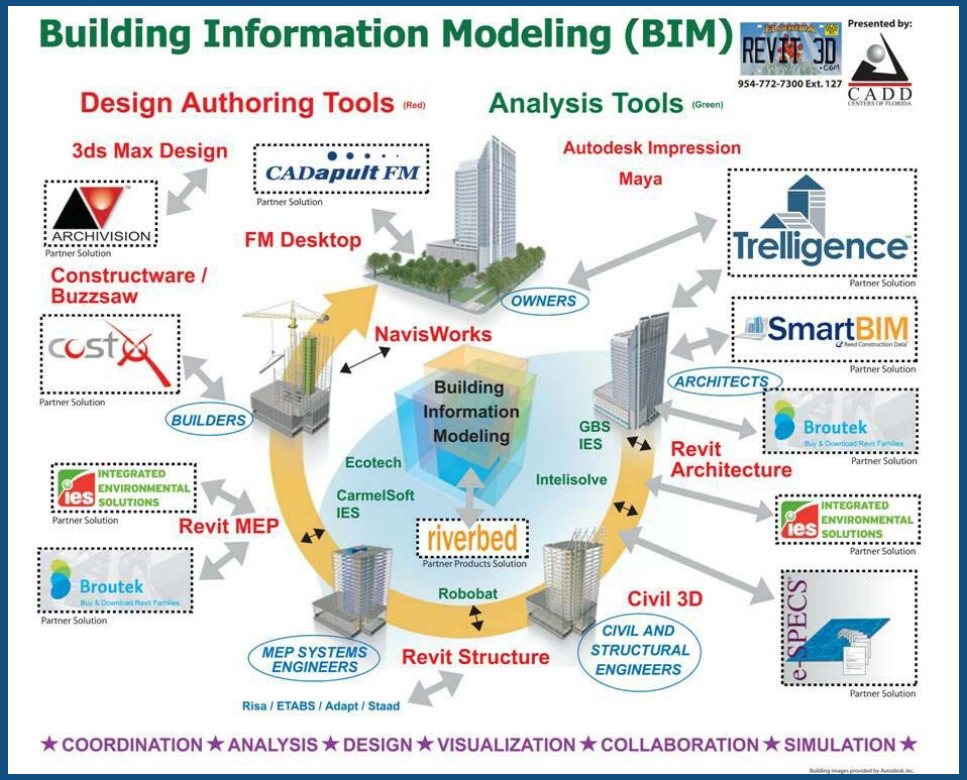
The Design Database





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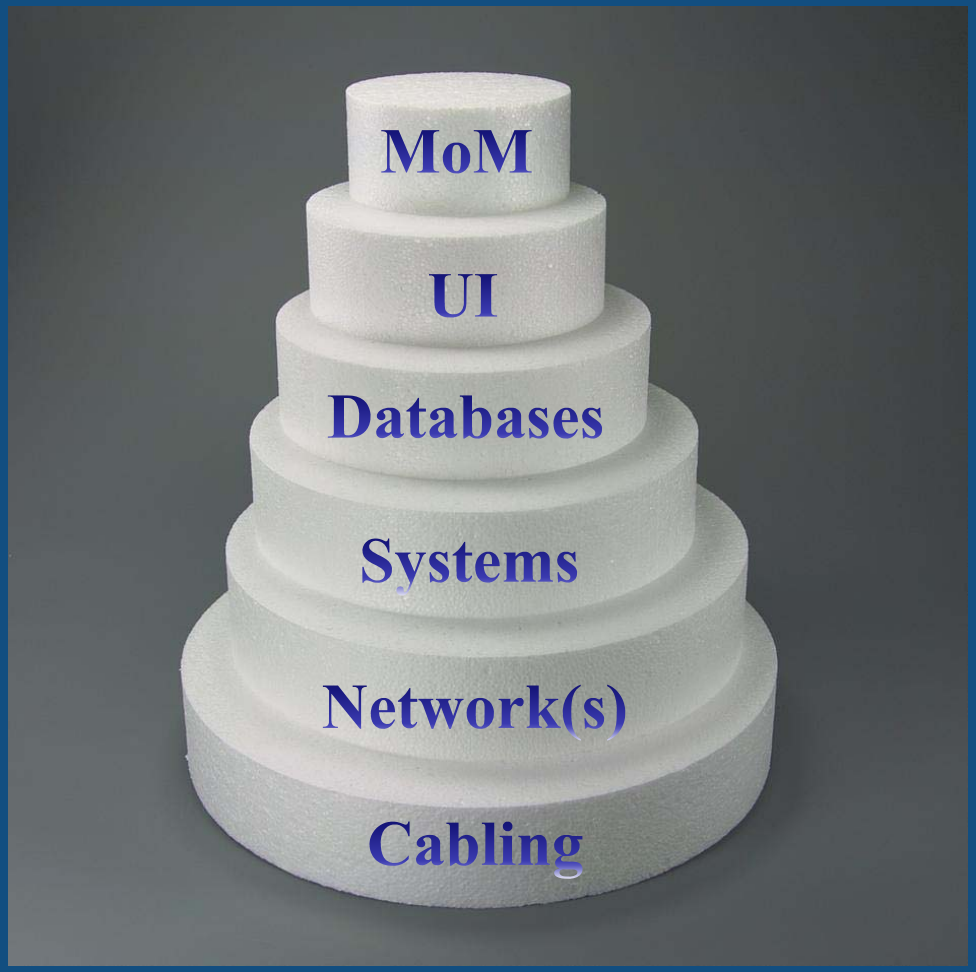
IIB Layer Model

MoM: Manager of Managers

UI: User Interface



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Data Exchange

Spreadsheet
Database
Comma Separated File
AutoCAD block attributes
BIM file (shared data)

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BIM: How Will As-Builts Be Delivered?

Who delivers the BIM model?

- Architect?
- Each trade?

Who is responsible for the accuracy?

Does it need to interface to a facilities or property management system?

Emerging Technologies

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High-density Wireless Access Point
16 radios each with its own antenna
1,000 users
1 GB Ethernet

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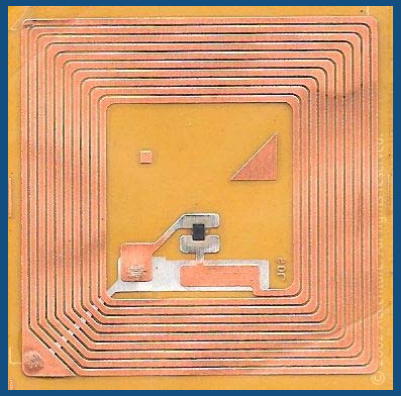
900 MHz Wireless Modem

RFID Tags



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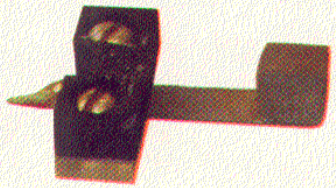
Powering the IIB - No Batteries Required

VIBRATIONAL PARASITES

The typical building never stops shaking. Air conditioners, heaters and even computer fans vibrate the walls, floors and ceilings. University of California, Berkeley, researchers are working on tiny wireless devices that scavenge this continual buzz as a source of power. The devices attach to surfaces throughout a building to monitor conditions such as airflow and temperature, and contain transceivers that send data to a central computer that can adjust the climate.

Better than batteries because it doesn't run down, and more practical than wall wiring, the device's power scavenger uses a piezoelectric material and a weight attached to a springy cantilever *(photo)* to convert mechanical pressure into electricity. Berkeley mechanical engineering graduate student Shad Roundy has built quarter-sized scavengers that generate 70 to 80 microwatts—enough to run a sensor and transceiver—and aims to demonstrate more-powerful devices by year-end.



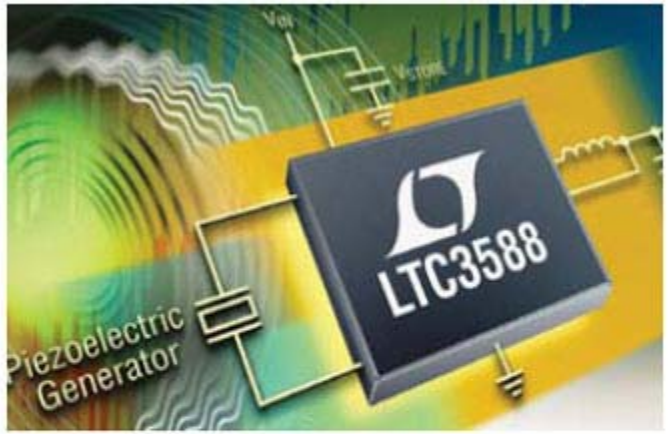


Fig. 3. The LTC3588-1 employs a high-efficiency buck converter to harvest ambient vibrational energy via piezoelectric transducers, and then convert it to a well-regulated output for use by other components.

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To Learn More

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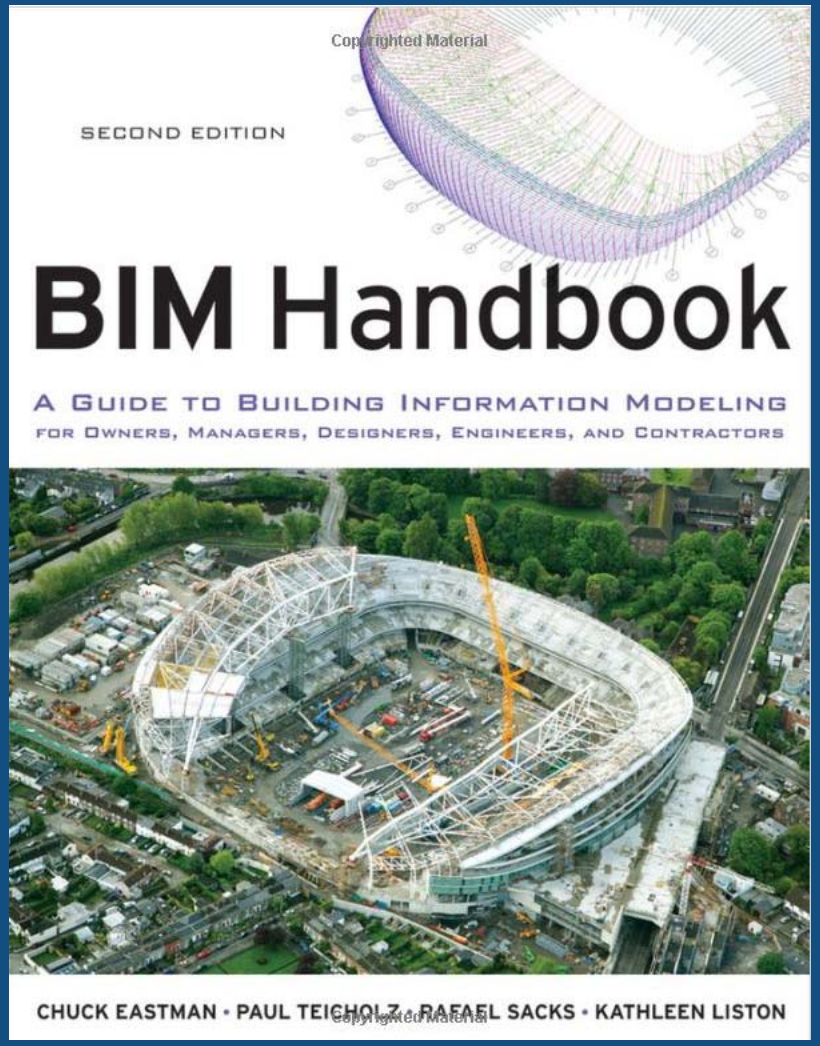

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Language: English

ISBN-10: 0470541377

ISBN-13: 978-0470541371

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Audiovisual Control and Signal Processing Equipment Manufacturers

AMX
www.amx.com

Crestron
www.crestron.com

Extron
www.extron.com

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Related Publications

Building Design + Construction Magazine
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Commercial Integrator
www.commercialintegrator.com

Sound & Video Contractor
www.svconline.com

AV Technology
www.avnetwork.com

BICSI

The Integrated Intelligent Building

Organizations

Council on Tall Buildings and Urban Habitat
www.ctbuh.org/

The Whole Building Design Guide
www.wbdg.org/

Sustainable Buildings Industry Council
www.sbicouncil.org/

BICSI

The Integrated Intelligent Building

Organizations

Continental Automated Building Association (CABA)
www.caba.org

Smart Buildings Institute
www.smartbuildingsinstitute.org

Automated Buildings On-Line Magazine
www.automatedbuildings.com/

The Integrated Intelligent Building

Questions?

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