Redefining Specification and Standards Writing

Preparing for an IoT World
Introductions & Contacts

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Agenda

• Part A – Understanding the Basics
  • Lean, Focus and Perspective, IoT Impacts, Definitions
    – Activity 1 – PB & J

• Part B – Writing for the Audience
  • Templates, Tools, Customization, Understanding the Audience
    – Activity 2 – Lego Buildings

• Part C – Understanding & Overcoming Challenges
  • Technology, History, Bias, Overwhelming Choices
Part A
Understanding the Basics

Lean, Focus and Perspective,
IoT Impacts, Definitions
This is an Expansion of Lean

How does Lean apply to specifications and standards?

Getting the right things (information),
to the right place (audience),
at the right time (process),
in the right way (documents),
with minimal wasted resources

Avoiding Waste!
Focus and Perspective

- **Requirements**: Conditions that must be met to ensure successful completion
- **Specifications**: Detailed, precise description of the desired solution
- **Codes**: Protect life, limb and property
- **Standards**: Minimum performance based thresholds (for international/generic)
- **Best Practices**: Recommendations subjectively based on perceived value
- **Manufacturer Guidelines**: Vendor requirements tied to a product line
- **Marketing**: Vendor Capabilities

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Why is this Important

- IoT – internet of things
- 5G – the next generation of cellular networks
- WiFi 6 – the next generation of Wi-Fi networks
- AI – artificial intelligence
  - Virtual Reality
  - Augmented Reality
- Smart Cities – connected and reactive systems

Industry Design Principles and Assumptions Are Outdated
Impactful Secular Trends

**INDUSTRIAL AUTOMATION**
Increasing Pressure to Automate Production

**SMART BUILDINGS**
Integrated Networks Require Connectivity

**VIDEO CONSUMPTION**
Increase in Quality and Quantity of Video Consumed

**BANDWIDTH**
Insatiable Demand for High-Speed Internet
## Industrial Automation

<table>
<thead>
<tr>
<th>Trends</th>
<th>Asset Replacement Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Labor Substitution...</strong>&lt;br&gt;SKILLS GAP &amp; WAGE INFLATION&lt;br&gt;LOWER COST OF CAPITAL</td>
<td><strong>Aging Equipment...</strong>&lt;br&gt;2016 = 7.7 years&lt;br&gt;Average age of manufacturing assets highest since 1951</td>
</tr>
<tr>
<td><strong>Flexibility...</strong>&lt;br&gt;PRODUCT CUSTOMIZATION&lt;br&gt;SHORTER LEAD-TIMES</td>
<td><strong>Capacity Utilization at Multi-Year Highs...</strong>&lt;br&gt;United States 77%&lt;br&gt;EU 84%</td>
</tr>
</tbody>
</table>

**DRIVING IP ADOPTION**

<table>
<thead>
<tr>
<th>IP Benefits</th>
<th>IP Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factory Connected to the Enterprise</td>
<td>Connect New Technologies with Legacy Systems</td>
</tr>
<tr>
<td>Remote Access</td>
<td>Collaboration Between Operational and Information Technologies</td>
</tr>
<tr>
<td>Open Standards</td>
<td>Manage Security Risks</td>
</tr>
</tbody>
</table>
Smart Buildings

Driving Investment...

High-Spec Copper Cabling
Cat 6A
+26% CAGR\(^1\)
(2015-2021)

Connectivity
LAN Connectivity Points
+3% CAGR\(^1\)
(2015-2021)

# Video Consumption

## Video Consumption is Changing

<table>
<thead>
<tr>
<th>Video Format</th>
<th>Source</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live Broadcast</td>
<td>63% of Television ad spend is allocated to live events vs. pre-produced content.</td>
<td></td>
</tr>
<tr>
<td>Video Quality</td>
<td>51% CAGR of UHD Televisions installed (2016-2021)</td>
<td></td>
</tr>
</tbody>
</table>

## Creating Challenges for Our Customers

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producing Live Events</td>
<td>Is complex and has the highest cost of failure.</td>
</tr>
<tr>
<td>UHD Content Creation</td>
<td>Requires higher bandwidth than legacy protocols can provide.</td>
</tr>
<tr>
<td>Delivering Content on Multiple Platforms</td>
<td>Challenges existing workflow.</td>
</tr>
</tbody>
</table>

Broadcasters need to adopt IP technologies to address these challenges.
Bandwidth

Today, the number of networked devices = 2X global population

By 2021, the number of networked devices = 4X global population

73% of Internet traffic today is video

Video traffic will exceed 80% in 2021

Internet traffic will grow 3X by 2021

Creating Opportunity for our Customers...

- 2014: $44.94
- 2017: $52.75
- 2020E: $60.80

MSO revenue per high-speed data user

...Driving Significant Investment

Global fixed broadband speeds will double by 2021

Sources: Cisco VNI 2017; SNL Global Market Intelligence, 2017; Sell-side Consensus Estimates as of 10/9/17; Company annual reports
Understanding the 3 / 30 / 300 Rule

- Everyone is looking to save money, to be more efficient, to get more from less
- We need to understand the difference between capital and operational costs
- Annually (operational) enterprises look at
  - $3 per sq.ft. in utilities
  - $30 per sq.ft. in rent
  - $300 per sq.ft. in employee costs
- But what about building (capital) it in the first place?
  - $200+ per sq.ft to construct a building
  - $100 per sq.ft. to provide tenant fit-up
- Traditional telecommunications infrastructure is typically about 1% in large capital projects
  - even with the growth of IoT it rarely exceeds 5%
  - but it enables and is the foundation for all systems
Increasing Reward = Increasing Complexity

“simple” closed systems that exist today

Energy → Efficiency

$3

Space → Utilization

$30

Payroll → Productivity

$300

Average value per Sq. Ft. Per year

JLL 3:30:300
Smart Building Value

... providing tangible value to key stakeholders such as Building Owners, Property Managers and Occupants...

“complex” bridging to the user(s) and 3rd party systems
But is it Real?

• In a word – YES!
• Enabled spaces are becoming more the norm around the world wherever we;
  – Work
  – Live
  – Play

The Future is Now!
Lessons Learned from Childhood

• One Size does not fit all
  – Bigger isn’t always better
  – Less can be more
  – Things don’t always get faster
  – Future ‘proofing’ may not be real

“You have brains in your head. You have feet in your shoes. You can steer yourself, in any direction you choose.”

Our Fairy Tales Had Important Messages
Just because you are right, does not mean, I am wrong. You just haven’t seen life from my side.

There is no magic bullet and anyone who says otherwise is lying.
Needs & Wants

• A need is something that is necessary to live a healthy life.
• Needs are distinguished from wants. In the case of a need, a deficiency causes a clear adverse outcome: a dysfunction or death.
• A need is something required for a safe, stable and healthy life (e.g. air, water, food, land, shelter)
• While a want is a desire, wish or aspiration.
• When needs or wants are backed by purchasing power, they have the potential to become economic demands.
Standards

- Not just BICSI/TIA/ISO/IEEE
- In essence, a **standard** is an agreed way of doing something.
- It could be about making a product, managing a process, delivering a service or supplying materials
- **Standards** can cover a huge range of activities undertaken by organizations and used by their customers.
Specifications

• Refers to a set of documented requirements to be satisfied by a material, design, product or service.
• Specification templates are a necessary reality
• Construction specifications typically follow the Master Format (sections)
  – each section is split into 3 parts General Products and Execution
Group Activity1 (15 min)

Differences Between Standards & Specifications
PB&J Sandwich Activity

• What do we need/want?
  – Create a Standard

• How do we get it?
  – Create a Specification
Part B
Writing for the Audience

Templates, Tools, Customization
Understanding the Audience
Defining the Requirements

• Why do we need a specification?
  – New build
  – Expansion
  – Renovation (and ultimately demolition)
    • Complete or phased
  – Technology Upgrade
    • Bootstrap; or bridge
• What are you trying to achieve, and how?
Understanding Industry References

• There are no document police
• Use and create what you need
• National Master Format
  – Beware ‘generic’ templates
• Industry Performance Standards
  – Performance is the only ‘value’ or requirement
Templates Are Good ‘*Generic*’

• Most common objection ... but I got it for ‘free’!
• Beware specific values not supported by standards
  – e.g. OM3 2.3dB/km@850nm 0.6dB/km@1300nm” vs 3/1 dB/km for standards
Construction Document Associations

CSI

CSC

Canadian Standard Association

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SECTION FORMAT STRUCTURE

- Part 1 GENERAL
- Part 2 PRODUCTS
- Part 3 EXECUTION
PART 1 GENERAL

• Summary
• References
• Definitions
• System description
• Submittals
• Quality assurance
• Delivery storage and handling

• Project / site conditions
• Sequencing
• Scheduling
• Warranty
• System start up
• Owners instructions
• Commissioning
• Maintenance
Definitions

• Definitions need to be;
  – Clear concise and sound
• Perspective is everything
  – Legal, technical, operational etc.
• Must be aligned and understood relative to project goals throughout all parties
  – Owner, agents, contractors, suppliers
PART 2 PRODUCTS

- Owner (by other) furnished products
- Systems, assemblies, equipment, materials
- Accessories
- Source and source quality control
‘Specific’ Examples of Problematic Documents

• Specifications that:
  – Are overly specific
  – Are selectively specific
  – Put the emPHAsis on wRonG SYLlabLE
When “equals” “alternatives” can be accepted.

• The document that defines “alternatives” should indicate when they can be submitted and how and when they can be accepted
  – Substitution requests must be submitted prior to bid and will be accepted in the form of an addendum issued to all bidders
  – “Comparable Product” submittals are due at the same time as submittals for named products during construction
Product Selection & Specification

• Not just the what ... but also why, when, where and how
  – Performance
  – Features and benefits
  – Fit, form, function
  – Availability, compatibility

• Is there multiple products that fit?
  – Then list them
  – Or use “Deemed to comply”
PART 3 - EXECUTION

• More than just supply install and test
  - Installation
  - Preparation
  - Installation
  - Protection
  - Follow up
  - System Start
  - Adjustments
  - Closeout
  - Quality Control
  - Testing
  - Examination
  - Cleaning
  - Reinstallation
  - Maintenance
  - Documentation

• IoT M2M and other smart building impacts
  - Day 2 Adjustments
  - Trade Coordination
  - Security – Physical
  - Integration
  - Systems Integration
  - Security – Cyber
  - Monitoring
  - Operations Integrity
  - Security - Process
How Standards are Structured

- TR42 – Plenary
- TR42.1 – Premises Telecommunications Infrastructure
- TR42.3 – Telecommunications Administration, Pathways, Spaces, Bonding and Grounding
- TR42.5 Terms
- TR42.7 Copper Cabling Systems
- TR42.9 Industrial
- TR42.11 Optical Systems
- TR42.12 Optical Fibers and Cables
- TR42.13 Passive Optical Devices and Fiber Metrology
Avoiding Confusion in a Complex World

• Multiple types of buildings
• Each has a different ‘core’ function
• Where possible reference the specific premises document
• Ensure you have a strong foundation
  – Universal and generic concepts
  – Codes, and AHJs
  – Media references and resources
  – Related and support documents
How To Call Out Standards – A Practical Example

- Premises Specific Documents
  - All are Mandatory
- Generic Documents
  - Generally optional
  - Few are mandatory (only if directly called out) 758 OSP
- Component Documents
  - Mandatory only if you’re calling them out specifically
- Related and Support Documents
  - Mandatory only if you’re calling them out specifically
Why Create Standards

• Industry standards should be the base for performance
• Customer standards should be made to list the changes in the standard for performance or other values;
  – Time, cost, ease, availability
  – Aide in the understanding of use-cases, purposes, client
  – Can include additions, deletions, modifications of information provided in other documents
How to Create Your Standard

• Do
  – Call out your references
  – List exceptions
  – Describe your needs and wants (expectations)
  – Focus on your core business

• Don’t
  – Cherry pick references unless it’s intentional
  – Blindly copy and paste
  – Assume the audience understands what you mean
  – Forget to include examples and use cases wherever possible
Group Activity 2

Lessons Learned
LEGO Block House

• Difference between a standard and a specification
Part C
Understanding & Overcoming Challenges
Technology, History, Bias, Overwhelming Choices
New LAN on the Rise

2000s

Connecting People
Fixed Connections
Locally Powered Devices

2020

Connecting Devices
Wireless Connections
Remotely Powered Devices

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Considerations

• Spaces
  – Location / Quantity / Size / Services

• Media
  – Data / Immunity / Power / Portability / Mobility

• Pathways
  – Size / Configuration / Contents

• Topology
  – Centralized / Distributed / Hybrid
  – Pure Star Heirarchy / Multi-Drop

• Other Considerations
  – Accessibility / Lifespan / Maintenance / Configuration
  – Legacy Systems
  – Many technologies, approaches, vendors, solutions ... choices
Digital Building Mix Traditional Cabling

Digital Building Mix %

- Traditional LAN
- IoT

User Connectivity

Infrastructure Connectivity

State of the Industry in 1-Word: Siloed

Independent *closed* and *proprietary* systems spanning *multiple networks*.

Things generating mountains of *unstructured data* without transformation into actionable results.

Without the ability to cross *boundaries* between *stakeholders*: Building Owners, Property Managers and Tenants.
Good News: All the pieces exist today!

There are many great vendors of pieces and sub-systems today.

Master integrators have an excellent opportunity to provide value, however a holistic approach is needed to scale to reduce cost and risk.
Where are the Roadblocks?

Ownership

What is critical to ops:
- Building?
- Tenant?

Who owns what:
- Building owner?
- Tenant?
- Leasehold improvement?
- Pay vs. benefit?
- Liable?

Sub-system Interoperability

Tenant system vs. Building:
- HVAC using Outlook?
- Lights and Security?

High Risk Devices:
- Non-secure devices (user controls code execution) interact with secure devices (security)?

CRE Lifecycle

IT in Build Cycle:
- Where is it?
- IT without tenant?
- Building expected life?

IT Environmental:
- Construction environment vs. IT equipment?
How is IT different for a Building Owner?

MEP (Mechanical, Electrical, Plumbing)
- 20+ Year Lifecycle
- Install and Forget

IT (Information Technology)
- 2-3 Year Lifecycle
- Constant Maintenance
Creating the Smart Facility
Understanding Point of View

**Owner:**
- Building vs. Tenant

**Risk vs. Network:**
- User code execution
- Safety of Life

**Performance:**
- 2.5/5G/10G
- 1G and Less
- Legacy Analog/Digital

**Power:**
- Metering and billing
# Single Pair Ethernet (SPEC)

<table>
<thead>
<tr>
<th>Market Segment</th>
<th>802.3 TG</th>
<th>Speed, Mbps</th>
<th># connectors</th>
<th>Distance, m</th>
<th>Name</th>
<th>Frequency Range, MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>industrial, Enterprise</td>
<td>cg</td>
<td>10 Mbps</td>
<td>10</td>
<td>1000</td>
<td>10BASE-T1L</td>
<td>0.1-20</td>
</tr>
<tr>
<td>automotive</td>
<td>cg</td>
<td>10 Mbps</td>
<td>4</td>
<td>15</td>
<td>10BASE-T1S</td>
<td>0.3-200</td>
</tr>
<tr>
<td>automotive</td>
<td>bw</td>
<td>100 Mbps</td>
<td>4</td>
<td>15</td>
<td>100BASE-T1</td>
<td>1-200</td>
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<tr>
<td>automotive</td>
<td>bp</td>
<td>1000 Mbps</td>
<td>4</td>
<td>15</td>
<td>1000BASE-T1 Type A</td>
<td>1-600</td>
</tr>
<tr>
<td>industrial</td>
<td>bp</td>
<td>1000 Mbps</td>
<td>4</td>
<td>40</td>
<td>1000BASE-T1 Type B</td>
<td>1-600</td>
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<tr>
<td>automotive</td>
<td>ch</td>
<td>2.5, 5, 10 Gbps</td>
<td>4</td>
<td>15</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

**What is Single Pair?**
- Gigabit speeds at very short distances
- Megabit speeds at very long distances
- Intended for sensors/controls and power delivery (PoDL)

**PoDL Circuit**

![PoDL Circuit Diagram](image)

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SPEC Applications

- **Automotive**
  - 1, 2.5, 5, 10 Gb
  - 15 m

- **Industrial**
  - 10Mb – 1000m
  - 1Gb – 40m

- **Enterprise**
  - 10Mb – 1000m
  - 1Gb – 100m (?)
Complexity in Wireless Systems

IoT Devices
- Multi-User (MU)
- Low/Battery Power (Device)
- Extended Range
- Excellent Propagation

General Purpose
- Multi-User (MU)
- Short Range
- Good Propagation

High Performance
- Single-User (SU) / Multi-User (MU)
- Short Range
- Line-of-Sight (Poor Propagation)
Deploying High Efficiency WiFi

Why More WAPs?

- Higher Modulation requires higher signal quality
- Higher frequency, reduced range
DAS/RAN Application Flexibility
PON Deployment Configurations
M2M – the Internet of Things
Hyperlinks

- JLL 3:30:300 https://youtu.be/VkY_a9C98DM
- Future Construction Site https://youtu.be/qFshEDbjj-8
- Decoupling Crane and Operator https://youtu.be/Q7oforWX6AU
- People Processes Data https://youtu.be/vgtTVaLj3zM
Resources

www.bicsi.org
www.tiaonline.org
www.ieee.org
www.spec.tiaonline.org
www.boma.org
www.leanconstruction.org

www.csiresources.org
www.csc-dcc.ca
www.thenbs.com (ca)
www.global.ihs.com
www.innovationnetwork.ieee.org
www.iotworldtoday.com
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