

The Millennial RCDD

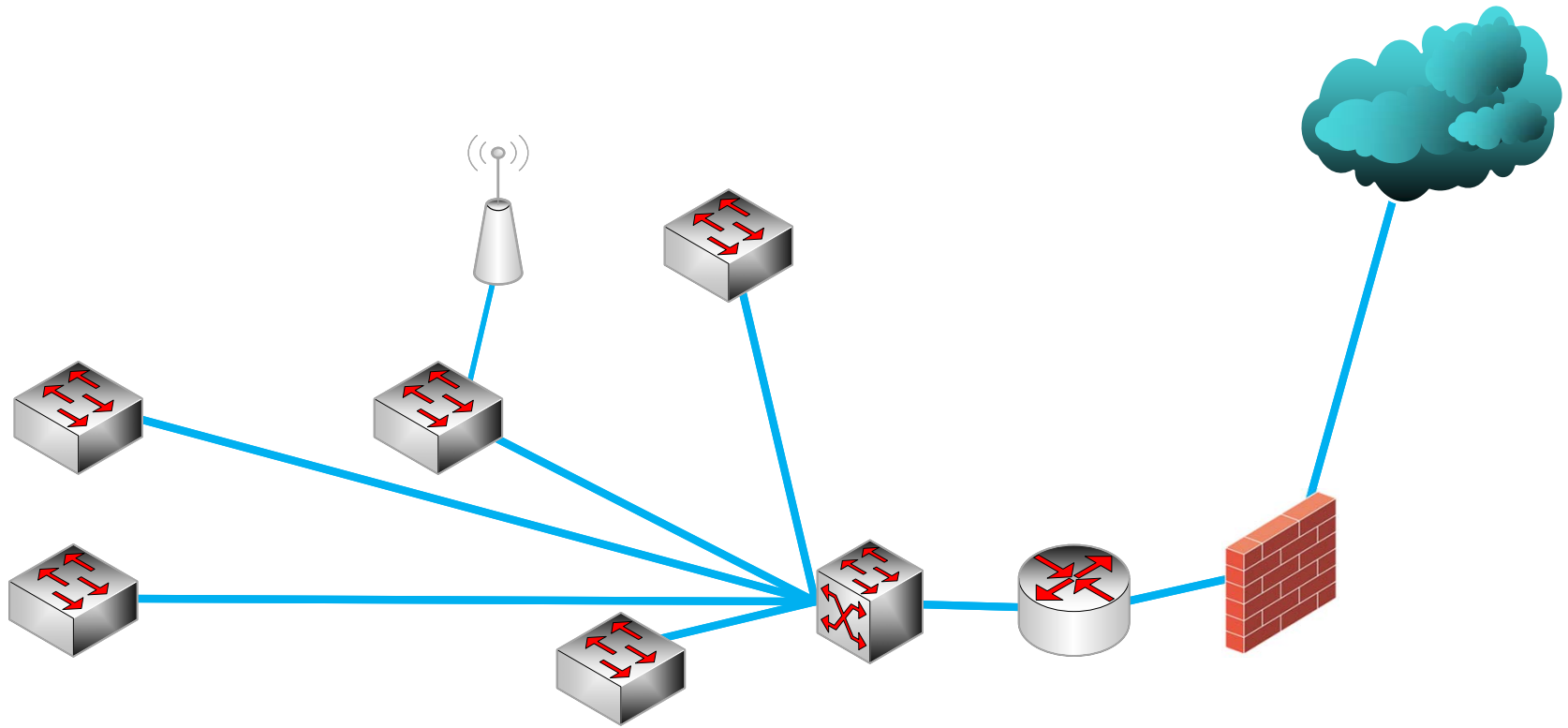
How ICT is Evolving

Chris Scharrer RCDD/NTS/OSP – CTS-D
DCS Technology Design, LLC



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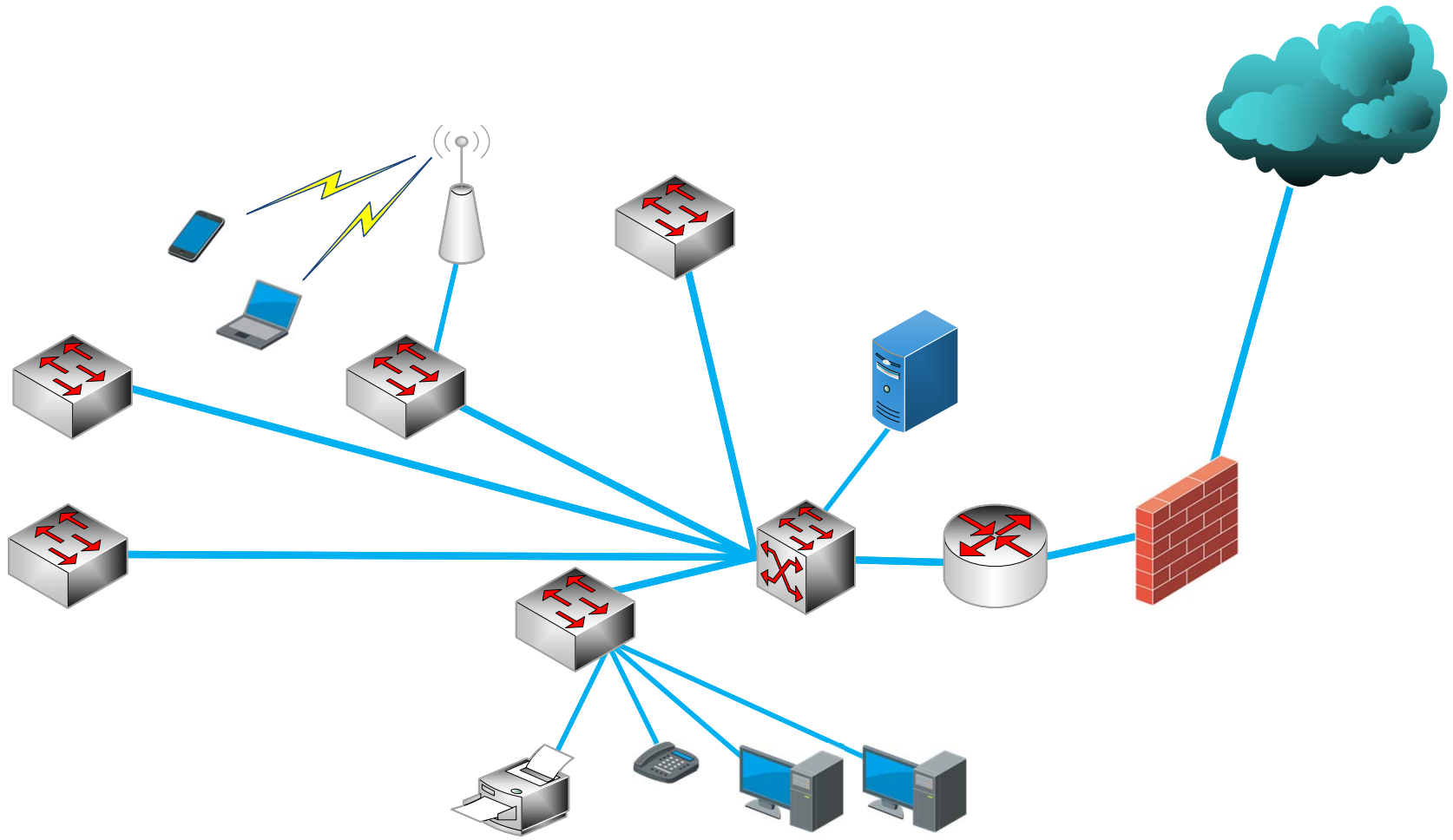




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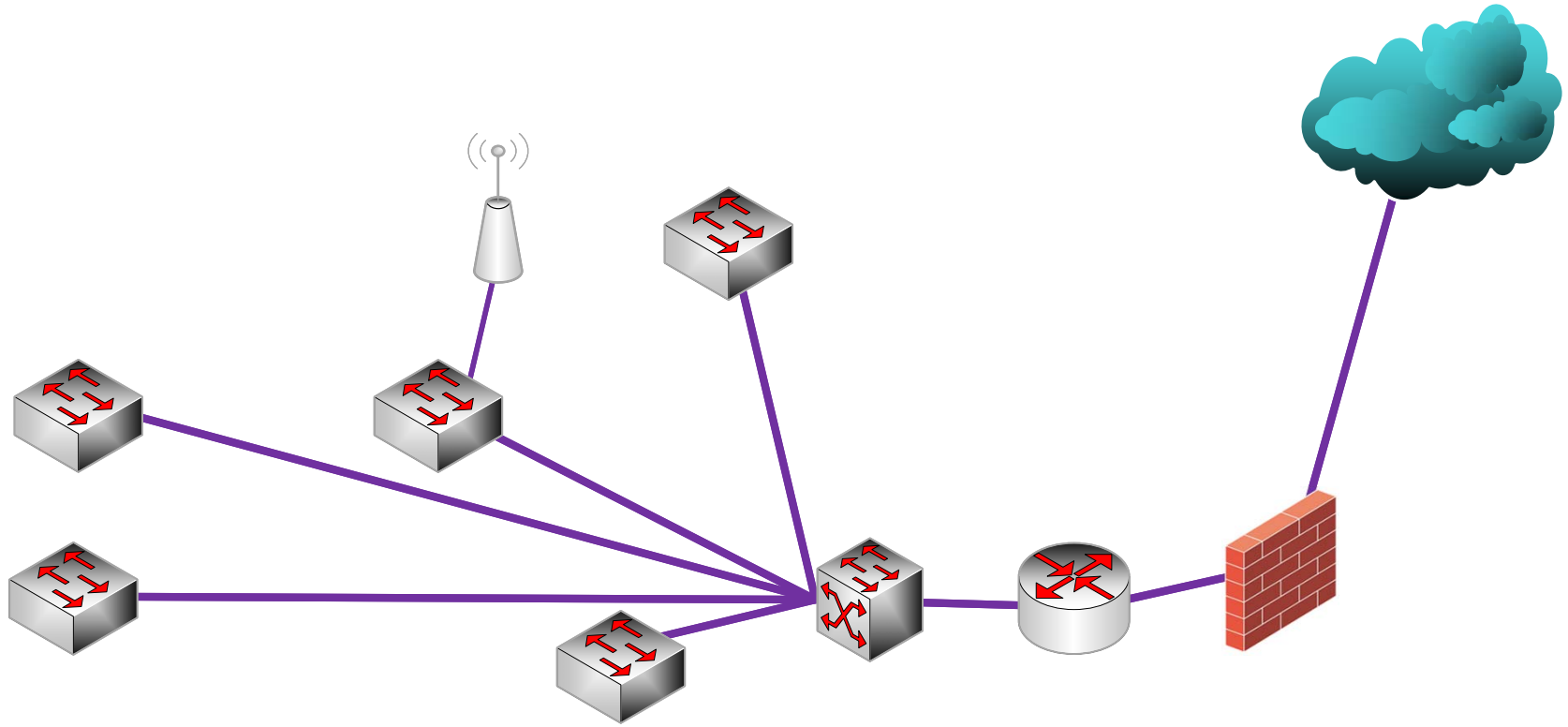
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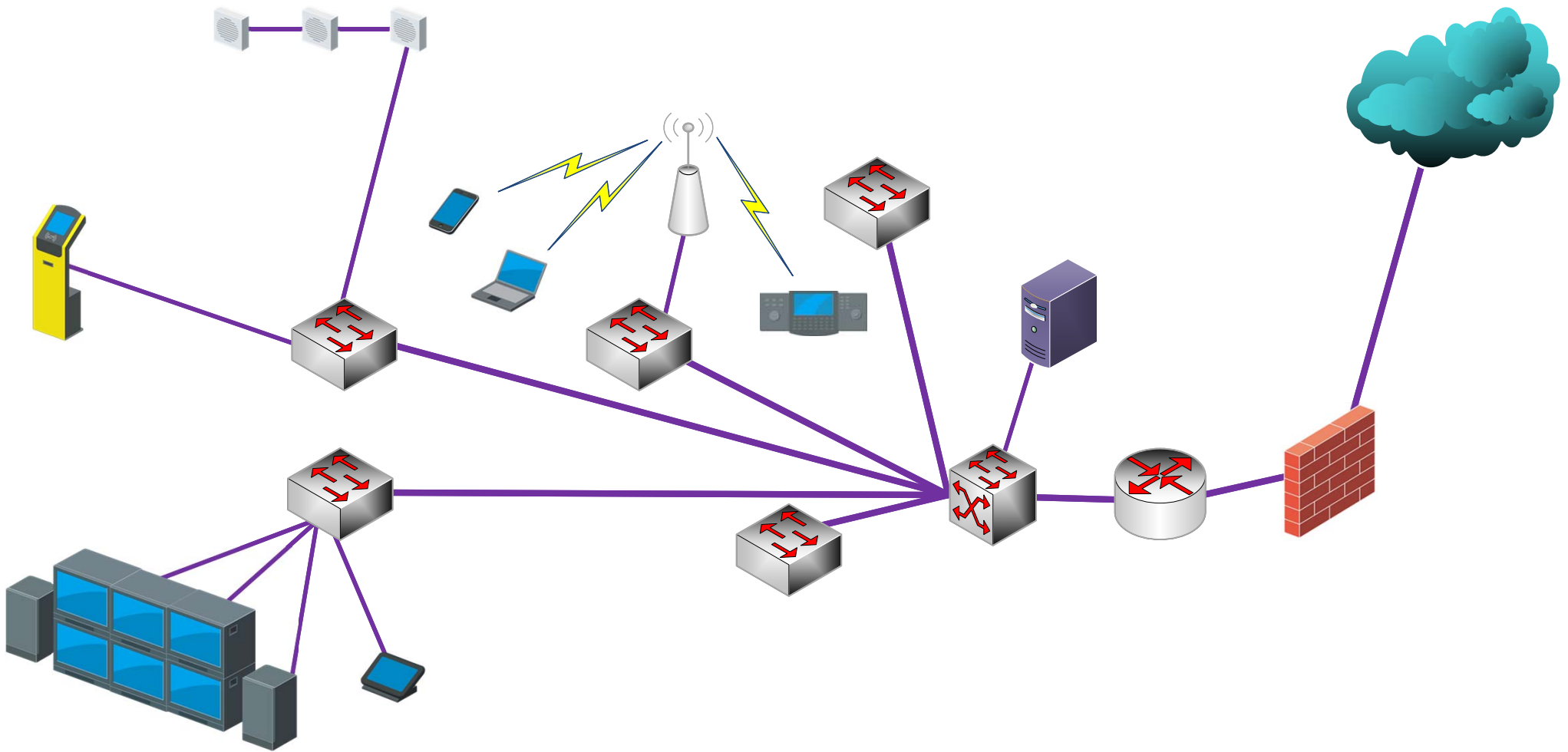




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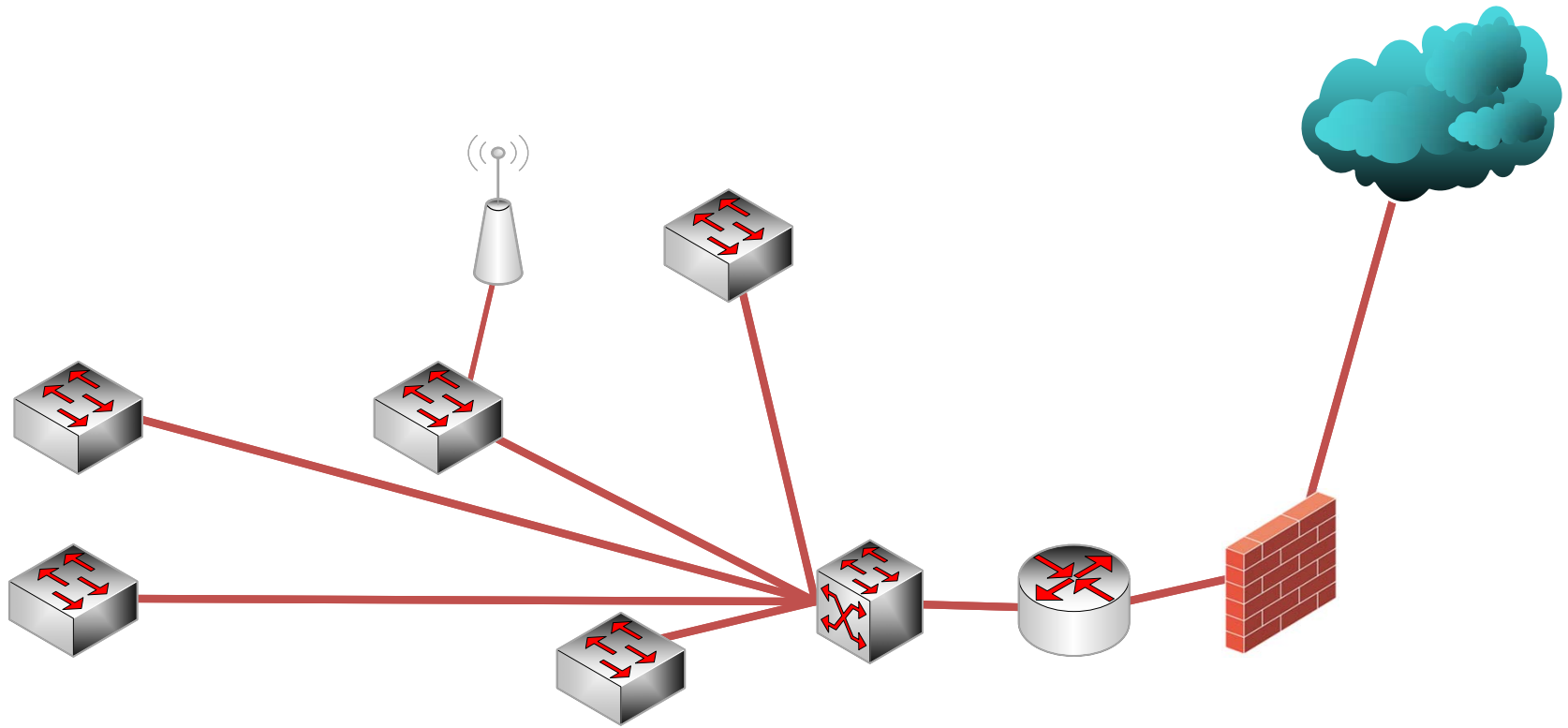




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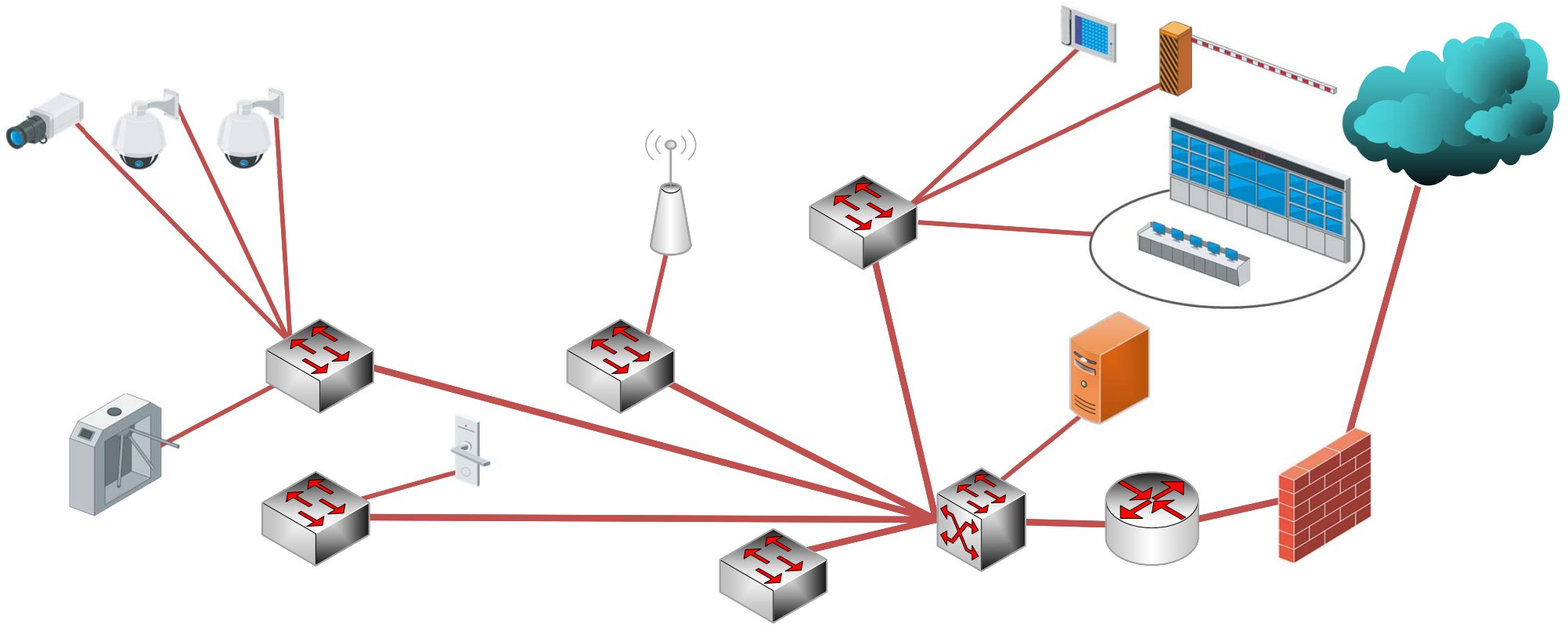




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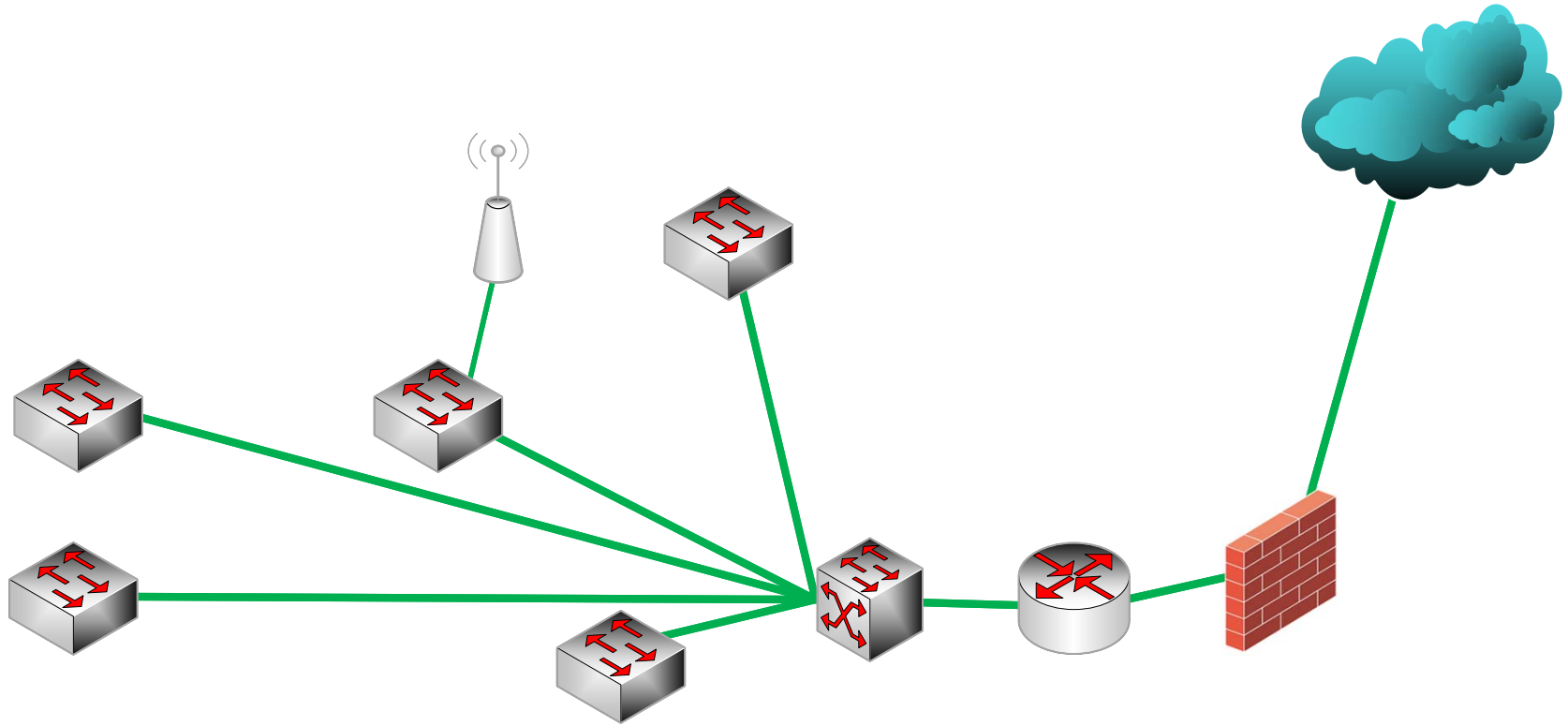




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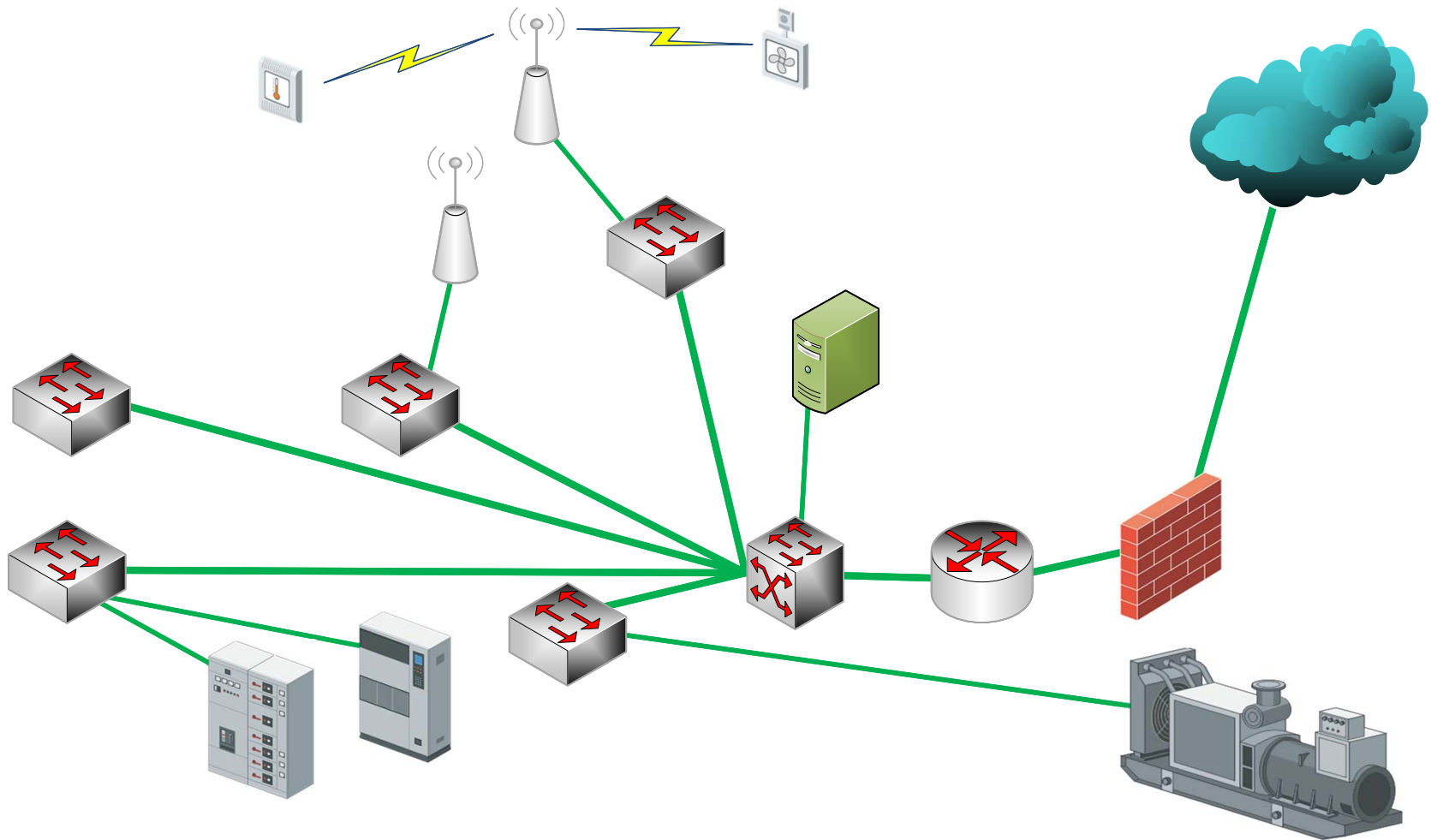




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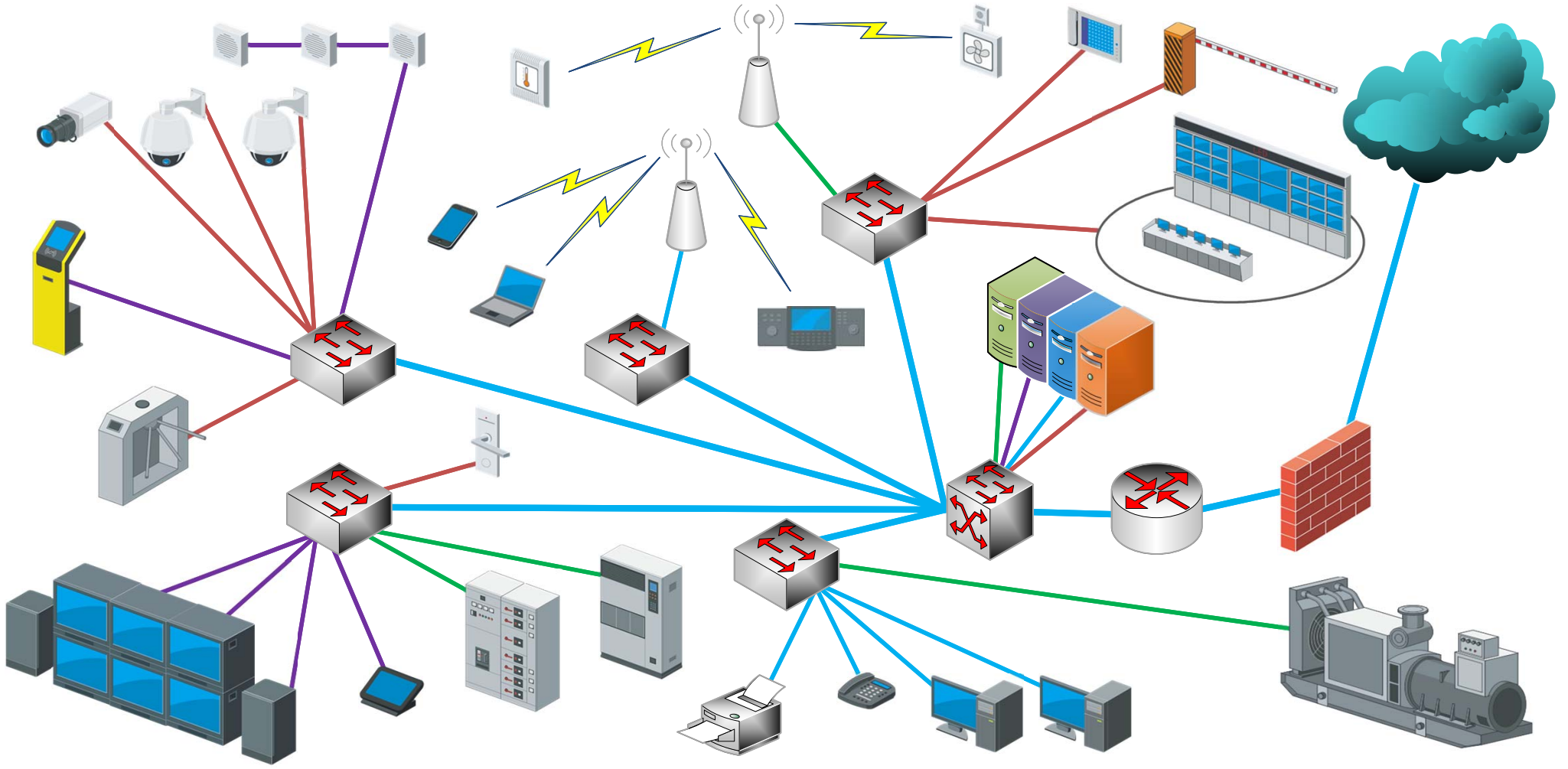




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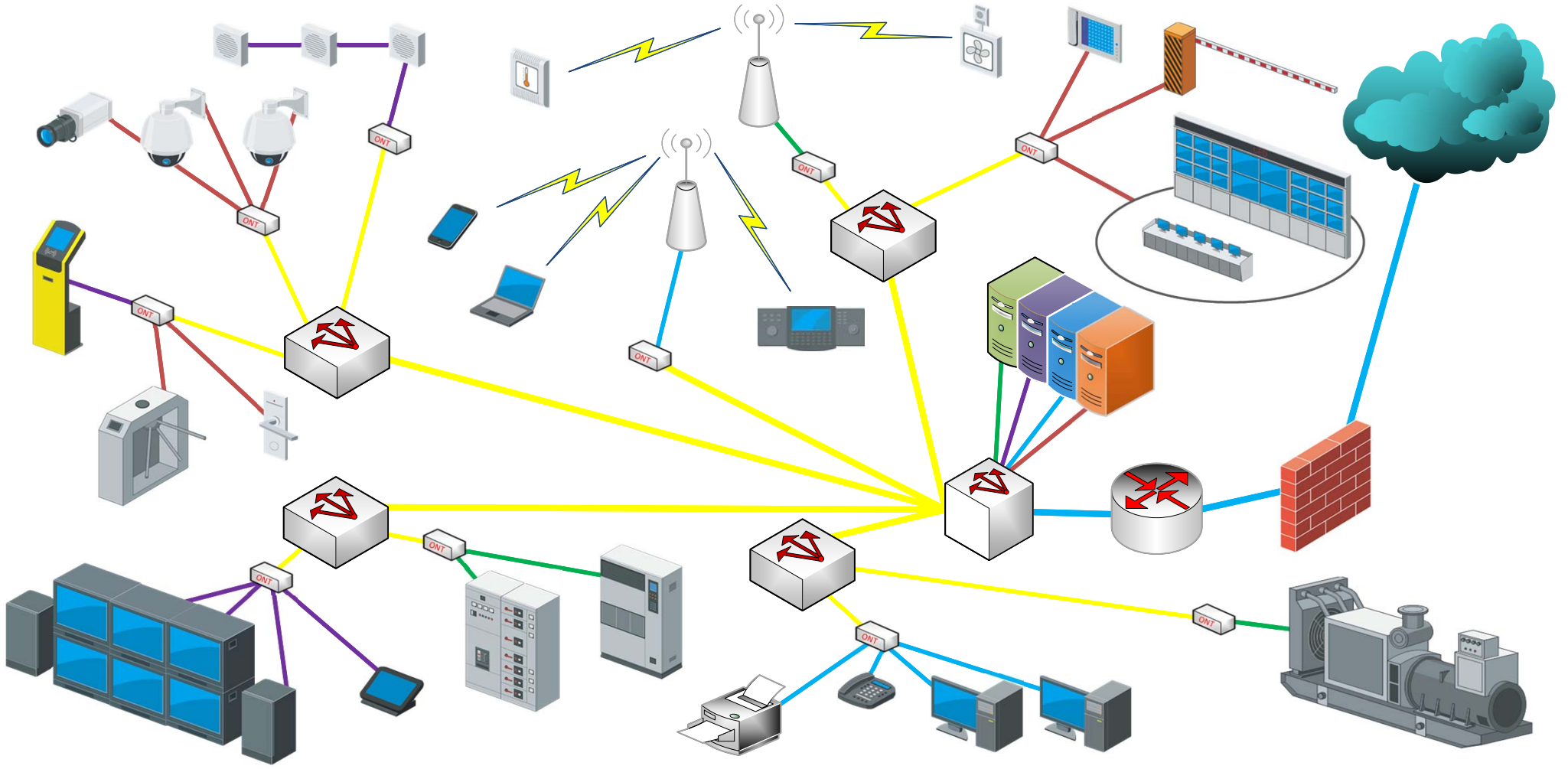
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BICSI

How We Got Here



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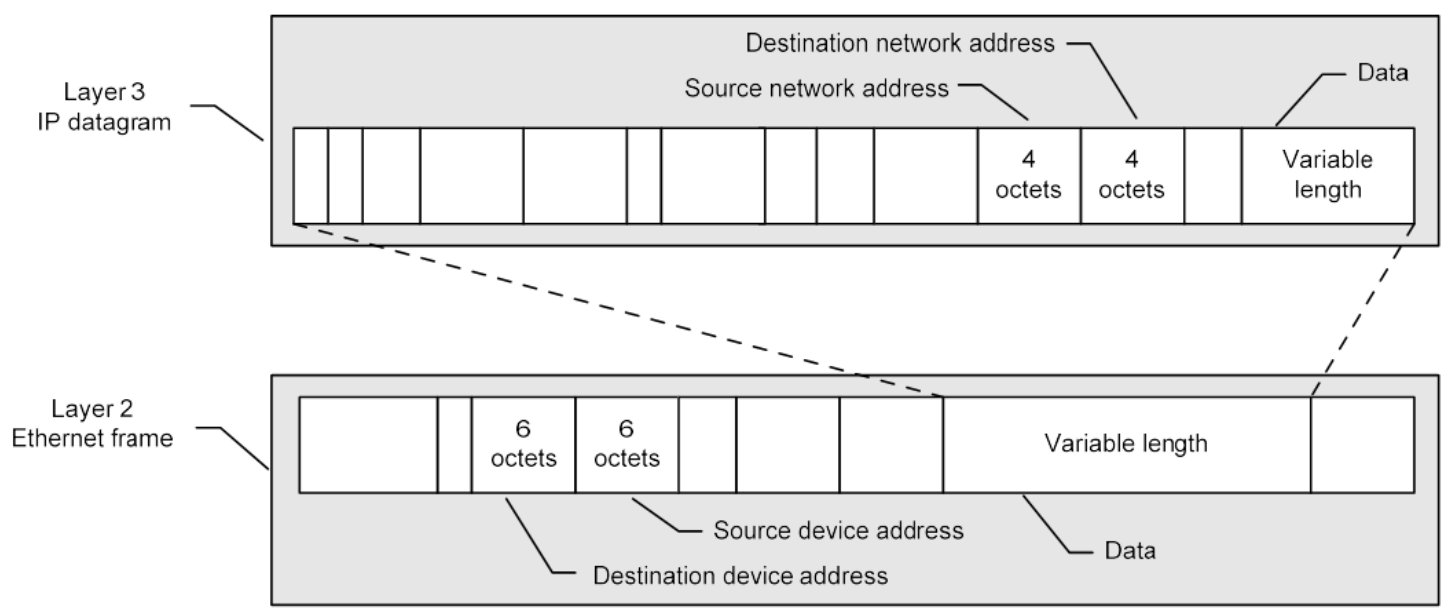
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Can anyone tell me which year the first TDMM was published?



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1985

124 Pages



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- No mention of data networking, data centers or the internet.
- Nothing about coax or category cables
- or optical fiber,
- Nothing wireless, cellular, microwave or 802.anything.



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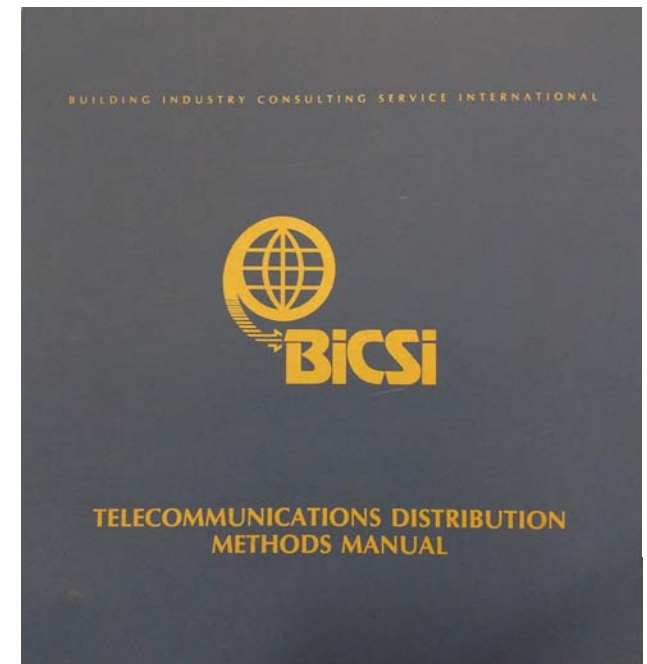
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- Added Data Networking
- Added Fiber Optic Technology



1985
1st
TDMM



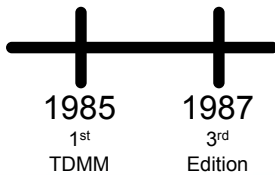
Became a 2" binder with about 300 pages

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- 1st TDMM to be used for RCDD Exam
- Added 802.3, 802.5, FDDI and EIA TR-41.8.1 (UTP, STP, etc.)



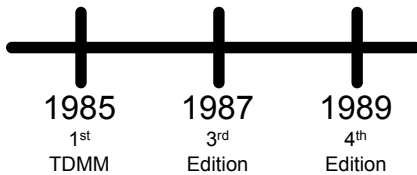
Became a 3" binder with about 500 pages



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- Recognized 802.3 as Ethernet (CSMA/CD) and 802.5 as Token Ring
- Added Microwave Radio Systems



Became two 3" binders with about 800 pages

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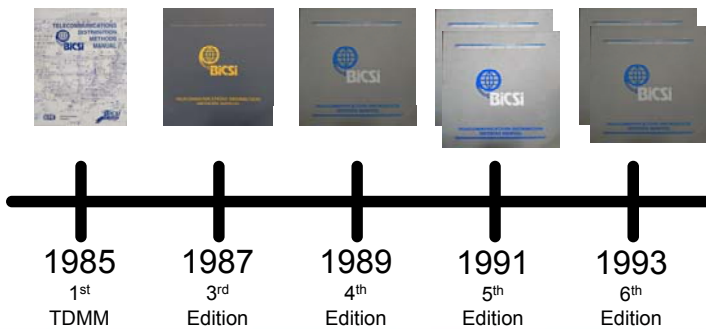


- TIA/EIA TSB36 – Categorized Cables
- SC and FC connectors added to Fiber Technologies
- Chapters on Aerial Plant and Wireless Basics were added



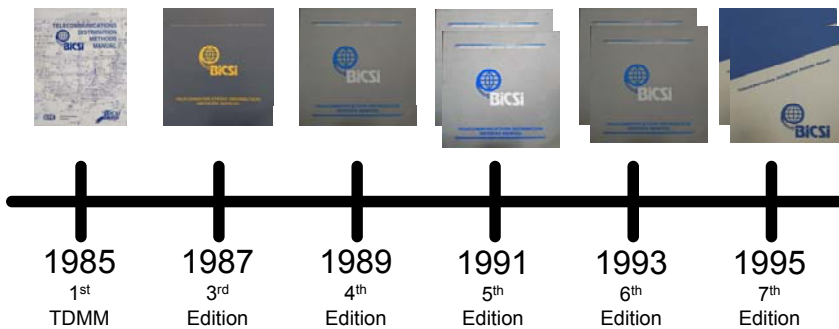
Two 3" binders with about 1000 pages

- Cable TV was added
- Telecommunications Administration (Labeling) was added
- Wireless Systems mentions 802.11 as a possible future technology
- Sound Systems were added



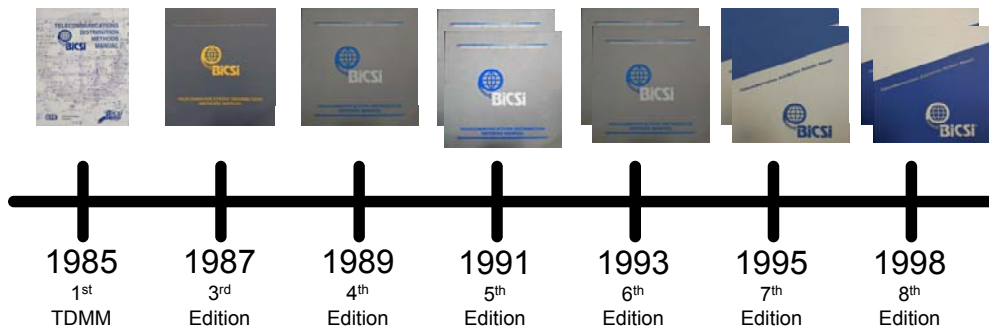
Two 3" binders with more than 1300 pages

- Field Testing was added
- Fiber was split into two chapters – Recommendations and Principles
- 802.11 was mentioned again, but still no standards
- LAN chapter increased to more than 100 pages



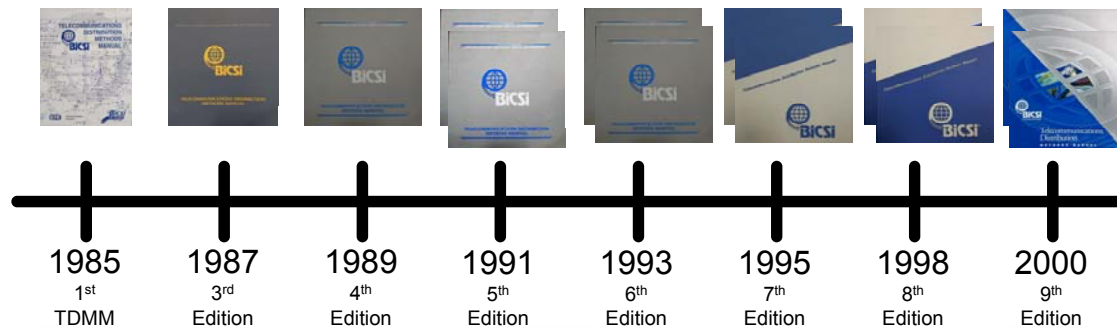
Two 3" binders with more than 1300 pages

- Building Automation (BACNet) was introduced
- Microwave and Wireless were combined, 802.11a, 802.11b, 802.15 (Bluetooth) were introduced



Two 4" binders with about 1400 pages

- Focused on Internationalization
- Restructured to place all Design relevant content in Volume 1. Field Testing chapter 12 opens Volume 2.



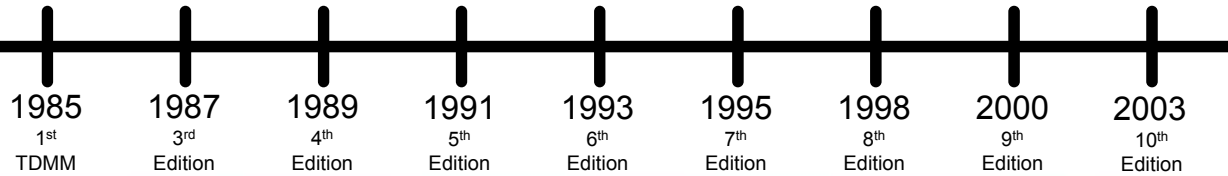
Two 4" binders with more than 1950 pages

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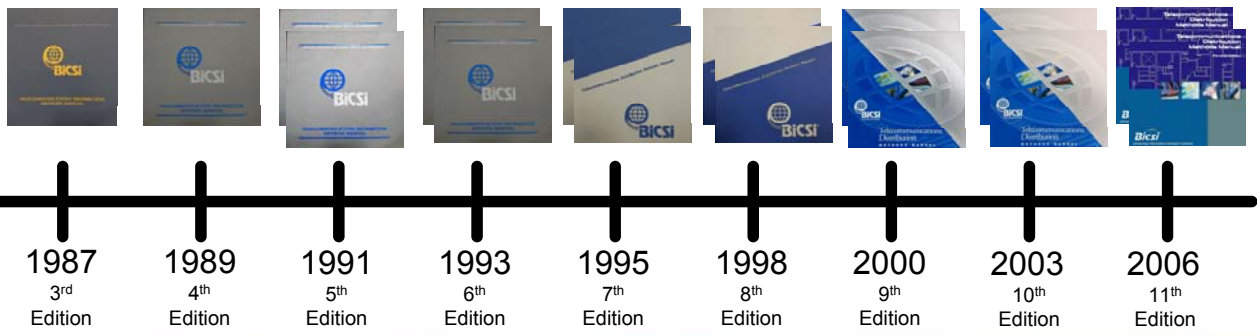


- Electronic Safety and Security was added
- Data Centers were added
- Distributed Antenna System (DAS) was added
- Videoconferencing introduced as a Networking Application



Two 4" binders with almost 2000 pages

- Health Care got it's own chapter
- ITS Cables and Connecting Hardware



Two 4" binders with more than 2100 pages

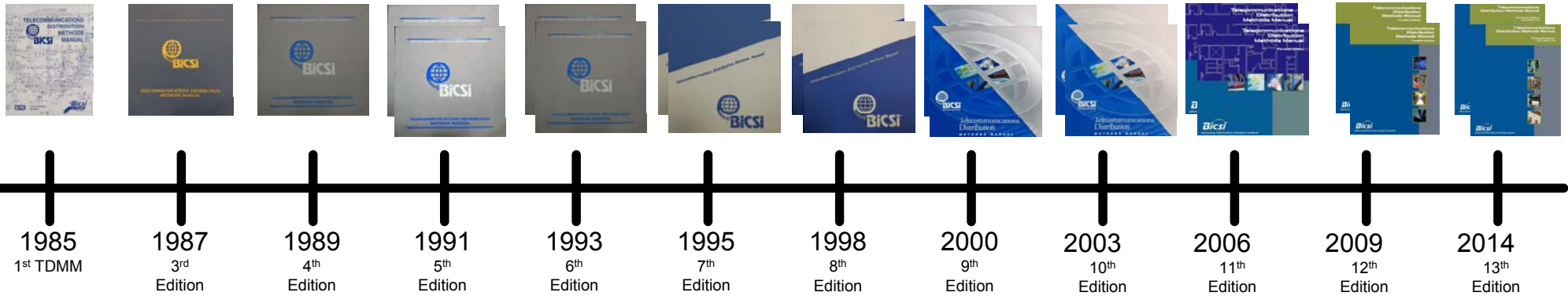
- Passive Optical Networks (PON), was added
- Section on DAS more than doubled
- Consolidated AV chapter added new technologies like Sound Masking, Digital Signage, and Video Over Balanced Twisted-Pair



Two 4" binders with almost 1950 pages



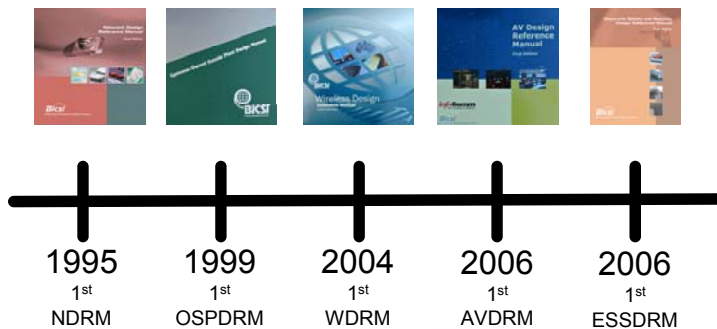
So What's Next??



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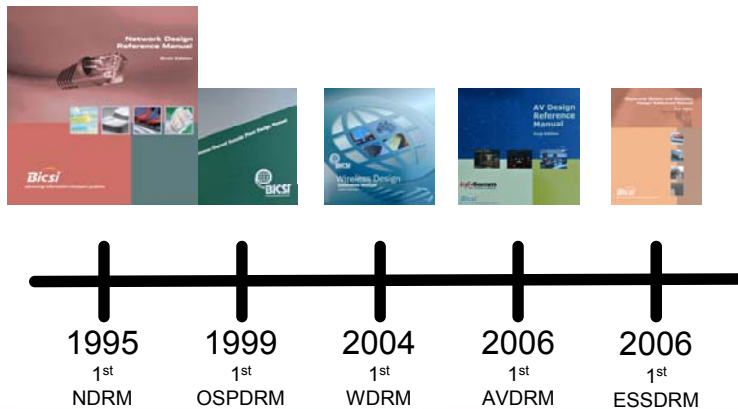


Earlier focused works that are becoming more important to the ICT World



The Significance of IP in today's ICT world

- The NDRM helped shape the DCDC program, and is the basis for Layer 3 (IP) content in several specialty areas (re)-emerging in the ICT world



The Significance of OSP in today's ICT world

- The OSPDRM is how we connect the whole world, and has just released its newest update, 6th Edition.
- You can't have FTTx, Smart Cities, or Intelligent Highways without OSP





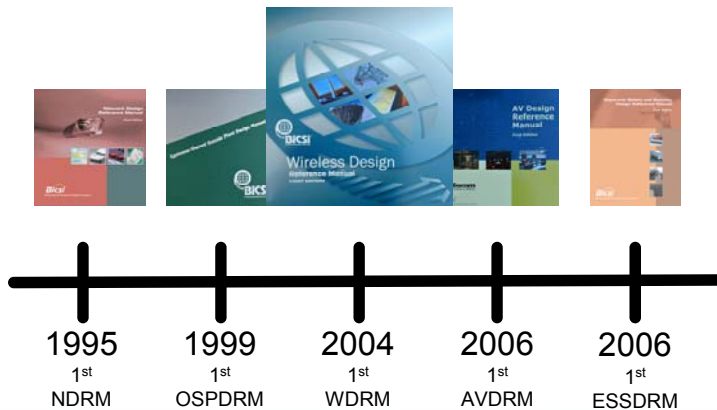
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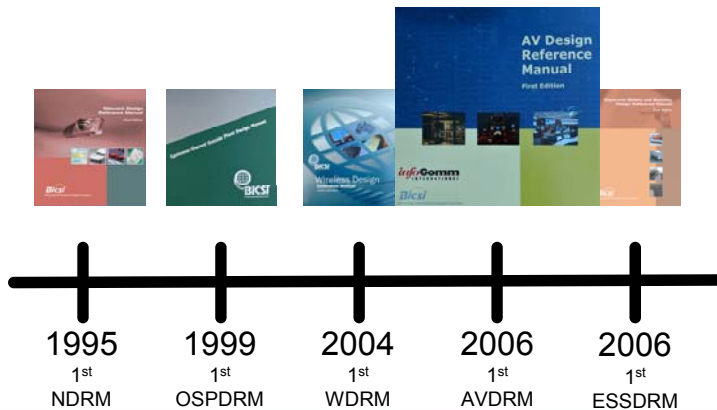
The Significance of Wireless in today's ICT world

- The WDRM covered many wireless technologies – all of which are growing exponentially.
- The content is being updated and distributed through other publications in the works.



The Significance of AV in today's ICT world

- AV is one of the fastest evolving technologies moving to IP
- Most connected devices today have some level of audio or video interface (like refrigerators?!?)
- Audio systems are all going IP



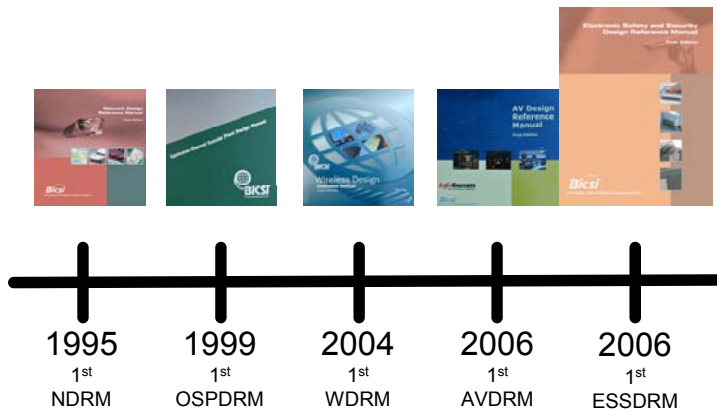
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The Significance of ESS in today's ICT world

- The technology in ESS has continued to evolve through publications like the ANSI/BICSI 005-2016
- ESS has become critical to so many industries, and virtually all new installations are based on IP and ICT methodologies

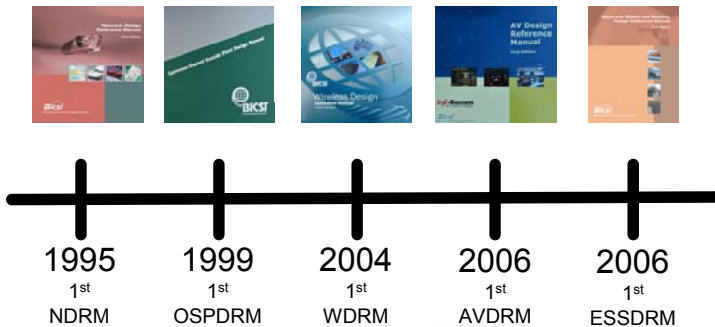


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Wireless Audiovisual and Digital Media Electronic Safety and Security



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BICSI Standards Library 2010

- ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling



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BICSI Standards Library 2019

- ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling
- NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
- ANSI/BICSI 001-2017, Information and Communication Technology Systems Design and Implementation Best Practices for Educational Institutions and Facilities
- ANSI/BICSI 002-2014, Data Center Design and Implementation Best Practices
- ANSI/BICSI 003-2014, Building Information Modeling (BIM) Practices for Information Technology Systems
- ANSI/BICSI 004-2012, Information Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
- ANSI/BICSI 005-2016, Electronic Safety and Security (ESS) System Design and Implementation Best Practices
- BICSI 006-2015 Distributed Antenna System (DAS) Design and Implementation Best Practices
- ANSI/BICSI 007-2017, Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises
- ANSI/BICSI 008-2018, Wireless Local Area Network (WLAN) Systems Design and Implementation Best Practices



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Pronounce this
number with a

“T”

By 2025

55 Billion IoT Devices

\$15,000,000,000,000 invested

Source: BI Intelligence 2018 IoT Report



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What are the technologies
fueling this?



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Wireless Technologies



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Security and Safety



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Digital Media



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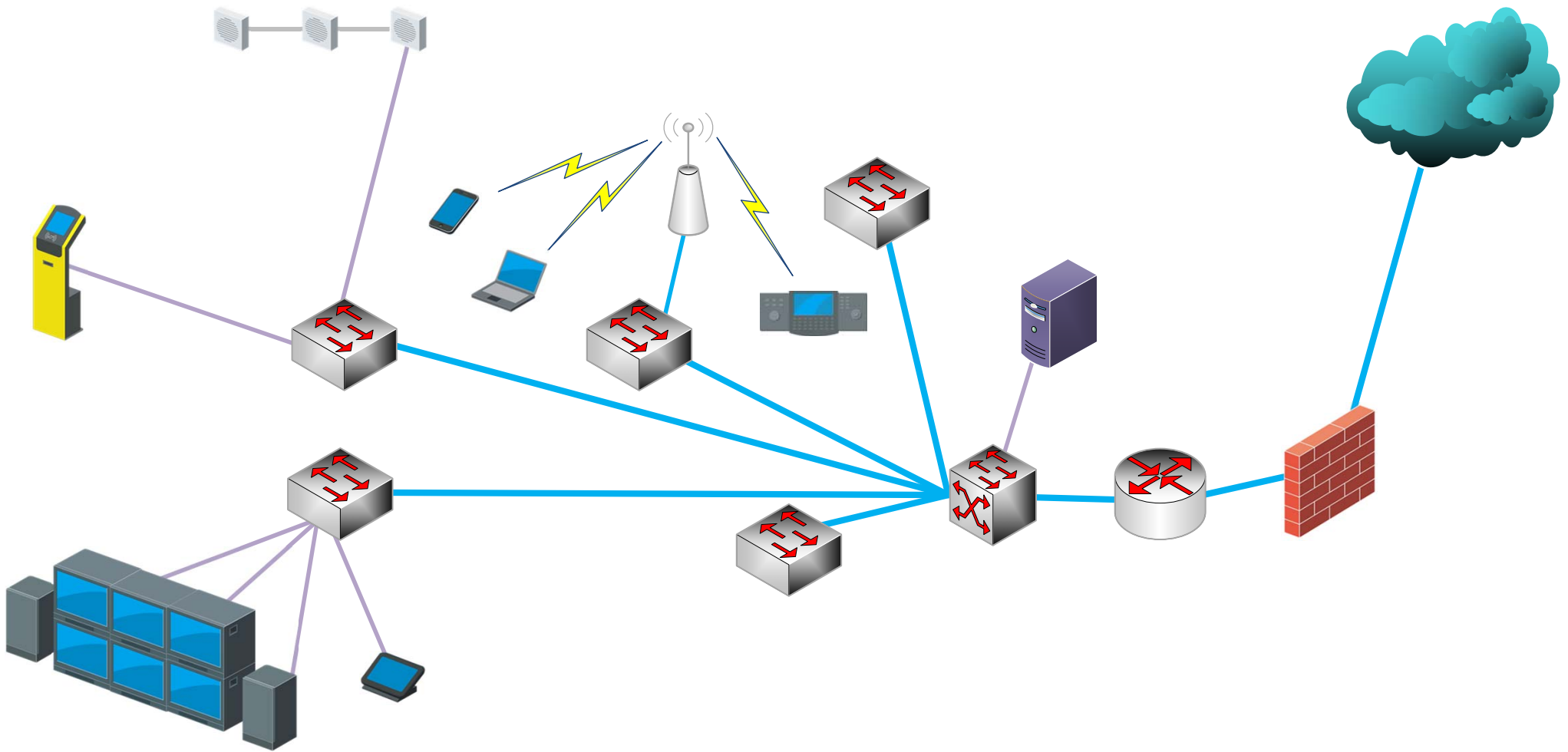
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UNITED STATES FREQUENCY ALLOCATIONS

THE RADIO SPECTRUM

RADIO SERVICES COLOR LEGEND

INTERNATIONAL AIR SERVICE	AIRTEL SATELLITE	BASEL AGENCY
INTERNATIONAL MARITIME SATELLITE	LAND MOBILE	AIRCRAFT OPERATIONS SATELLITE
INTERNATIONAL RADIOLOGICAL PROTECTION	LAND MOBILE SATELLITE	AIR SERVICES
FIXED SERVICE	MARITIME MOBILE	AIR OPERATIONS SATELLITE
FIXED SATELLITE	MARITIME MOBILE SATELLITE	AMATEUR RADIO
FIXED SATELLITE	MARITIME MOBILE SATELLITE	AMATEUR RADIO SATELLITE
FIXED SATELLITE	MARITIME MOBILE SATELLITE	AMATEUR RADIO SATELLITE
FIXED SATELLITE	MARITIME MOBILE SATELLITE	AMATEUR RADIO SATELLITE
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FIXED SATELLITE	MARITIME MOBILE SATELLITE	AMATEUR RADIO SATELLITE

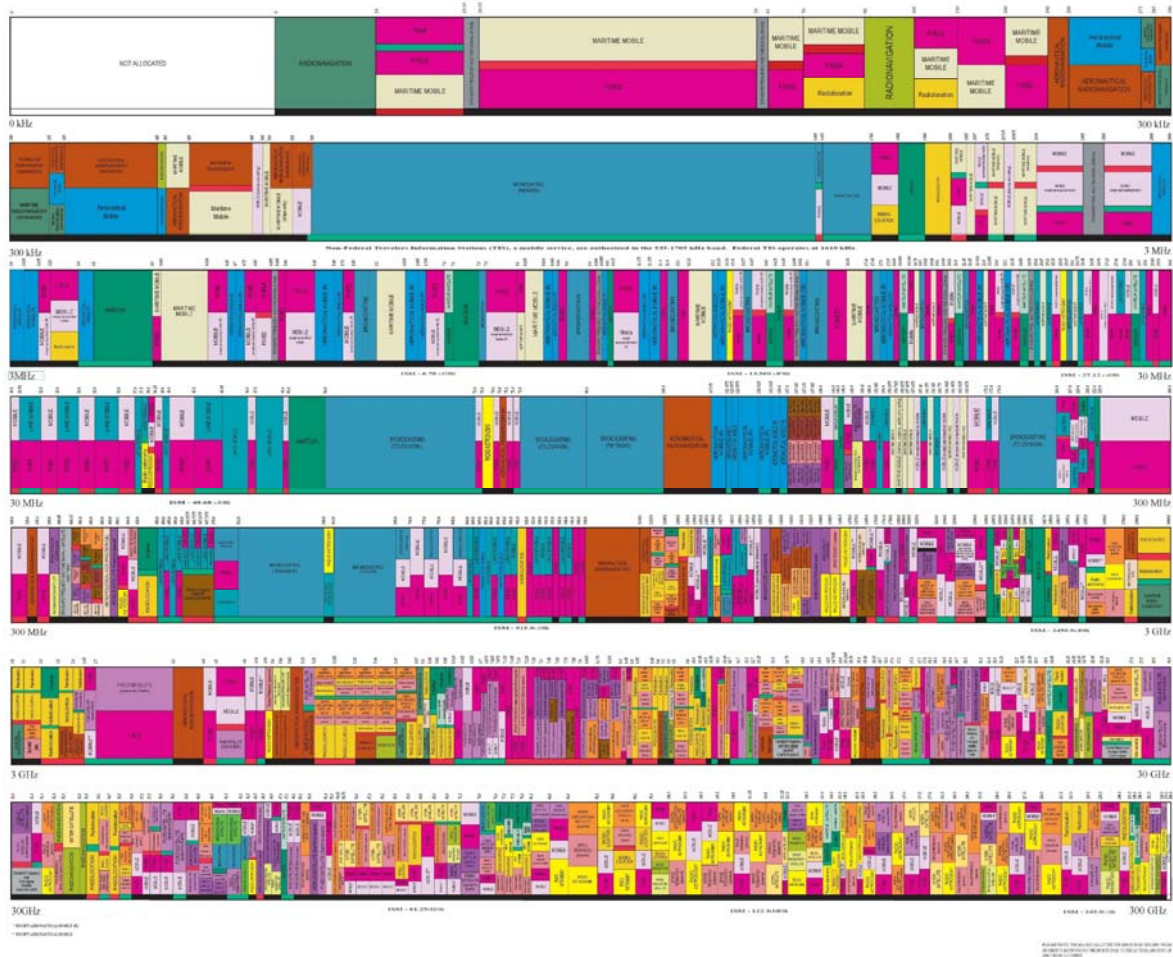
ACTIVITY CODE

FIXED SERVICE	FIXED SATELLITE
FIXED SERVICE	FIXED SATELLITE

ALLOCATION USAGE DESIGNATION

NAME	CLASS	DESIGNATION
NAME	CLASS	DESIGNATION

U.S. DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Office of Spectrum Management
JANUARY 2016



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Serial Digital Interface

- Standardized in 1989 by the Society of Motion Picture and Television Engineers (SMPTE) as SMPTE 259M
- Used 75 Ω coax and BNC connectors
- Supported standard-definition 525 line or 625 line digital video streams that were used in NTSC, PAL, and SECAM TV



HD-Serial Digital Interface

- Was introduced as SMPTE 292 in 1998 to support HDTV production up to 1080p
- Still used 75 coax and BNC connectors

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HD-Serial Digital Interface Over IP

- Was introduced as SMPTE ST 2022-6:2012 in 2012
- Transportable over IP networks with Category Cable or Fiber
- TV Production Studios and Editing Suites, Animation Studios, Stadiums and other large venues where TV Production is Common
- Published 2017, SMPTE ST-2110 integrates AES 67 and supports 4K, 8K, and HDR

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HD-Serial Digital Interface Over IP

Horizontal pixels × Vertical pixels × Frames per second × Color depth
× # of color channels = Bit rate (bps)

Red, Green and Blue each typically require 8 bits to define
Color Channels can be three (RGB/4:4:4) or four (+ Alpha/4:4:4:4)

1080p is $1920 \times 1080 \times 60 \times 8 \times 3 = 2,985,984,000$ bps (3 Gb/s)

4K is $4096 \times 2160 \times 60 \times 8 \times 4 = 16,985,931,200$ bps (17 Gb/s)

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SMPTE 2022



MPEG-2

MPEG-4

H.264



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Digital Media



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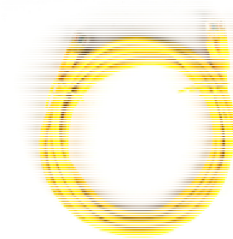


AES 67



24 Analog Audio Channels

512 Uncompressed Digital 24 bit, 48 kHz (Better than CD Quality) Audio Channels



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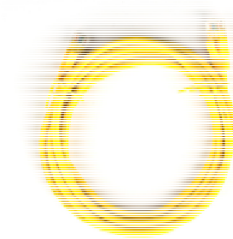


AES 67



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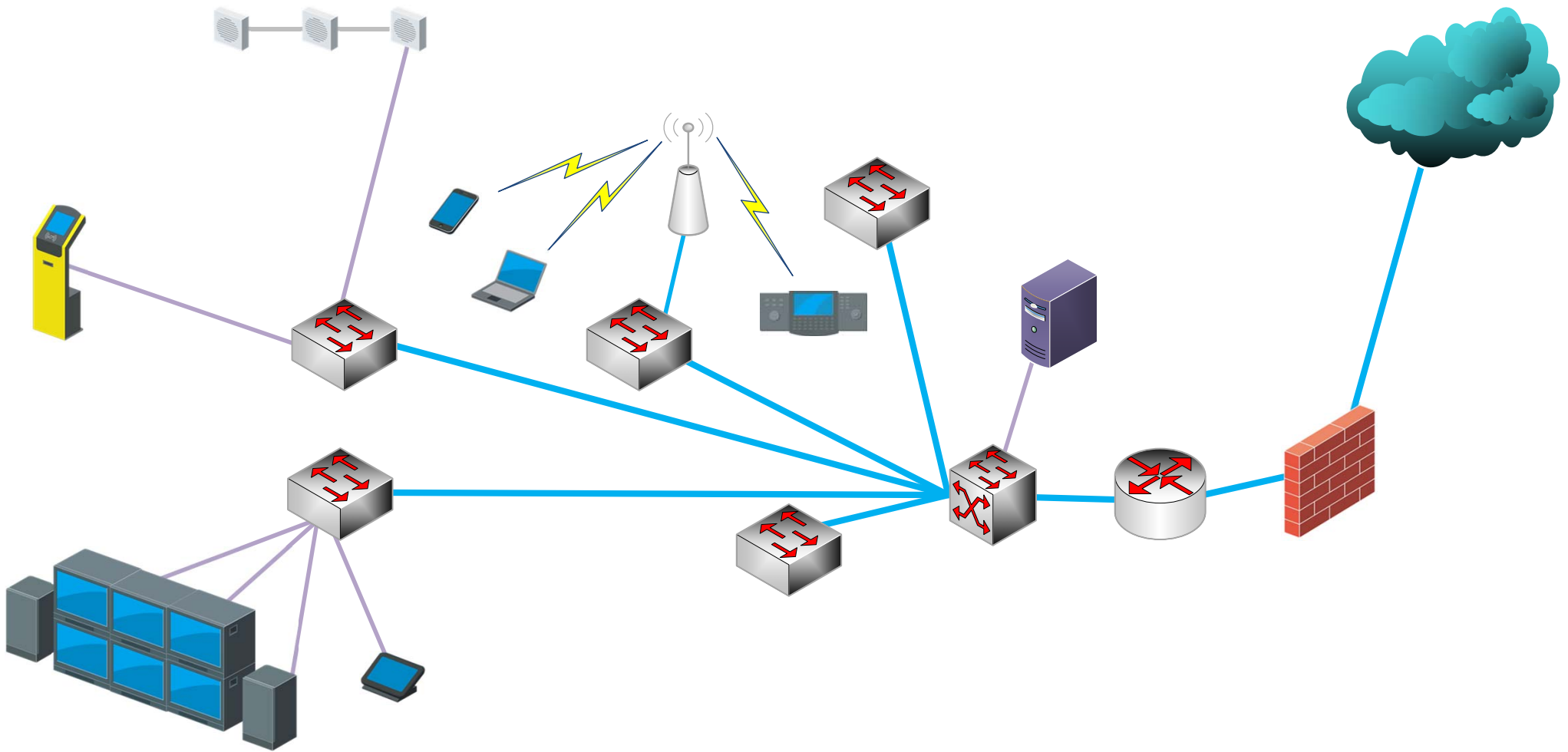




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Wireless Technologies

IEEE 802.11n and IEEE 802.11y are draft standards scheduled to be released in 2009. The 802.11n standard, which uses a new multiplexing technique called multiple input multiple output (MIMO), will operate in the 2.4 GHz and 5.0 GHz ranges and promises data rates in excess of 250 Mb/s. The IEEE 802.11y standard will operate in the 3.7 GHz range and may require licensing.



802.11 AC

SUPERSEDED



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802.11n

MIMO

Operates in 20 and 40

MHz Channels

2.4 and 5 GHz Bands

64 QAM

Up to 600 Mb/s



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802.11ac
Wave 1

MU-MIMO
Operates in 80 MHz
Channels
5 GHz Band
256 QAM
Up to 1.3 Gb/s



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802.11ac
Wave 2

MU-MIMO
Operates in 80 and 160
MHz Channels
5 GHz Band
256 QAM
Up to 6.67 Gb/s

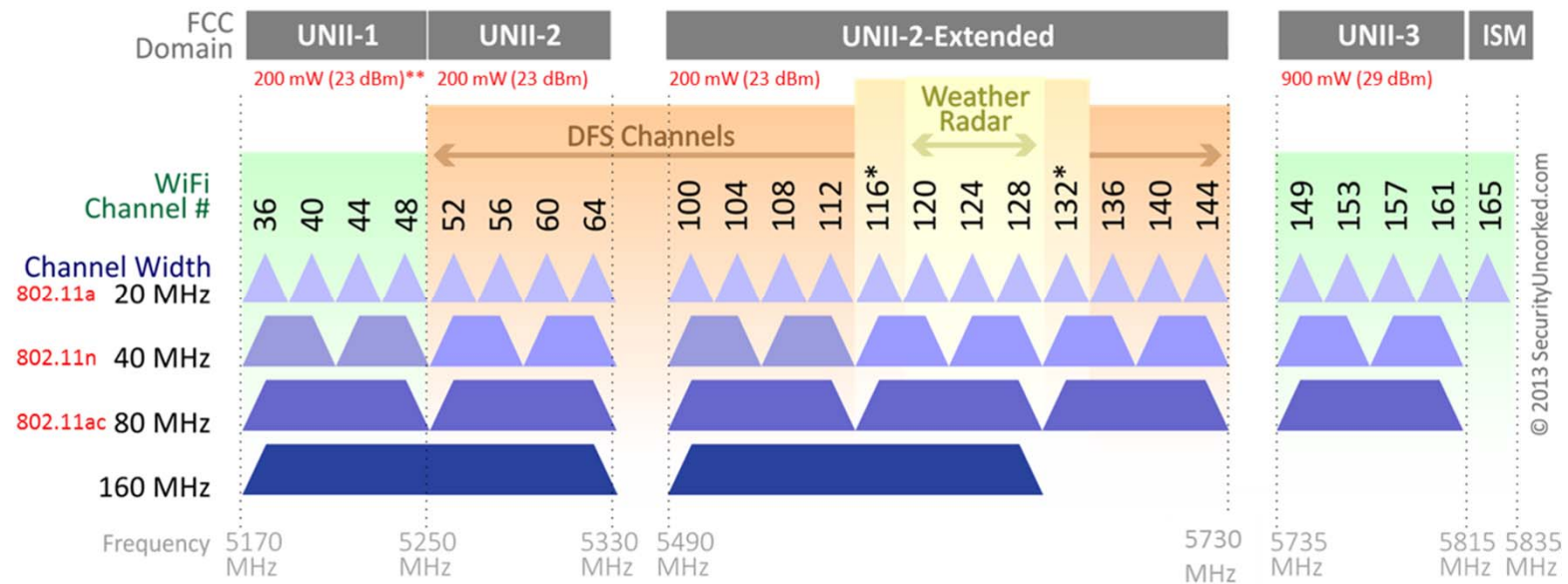


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802.11ac Channel Allocation (N America)



* Channels 116 – 144 used for Doppler radar. Channels 132 – 144 not yet available in USA
 ** Allowed Power for UNII-1 band increased by FCC from 40 mW to 200 mW in 2014

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RADIO SERVICES COLOR LEGEND

■ AERIAL NAVIGATION	■ AERIAL SATTELITE	■ BROADCASTING
■ AERIAL NAVIGATION	■ AERIAL SATTELITE	■ AERIAL SATTELITE
■ AERIAL NAVIGATION	■ AERIAL SATTELITE	■ AERIAL SATTELITE
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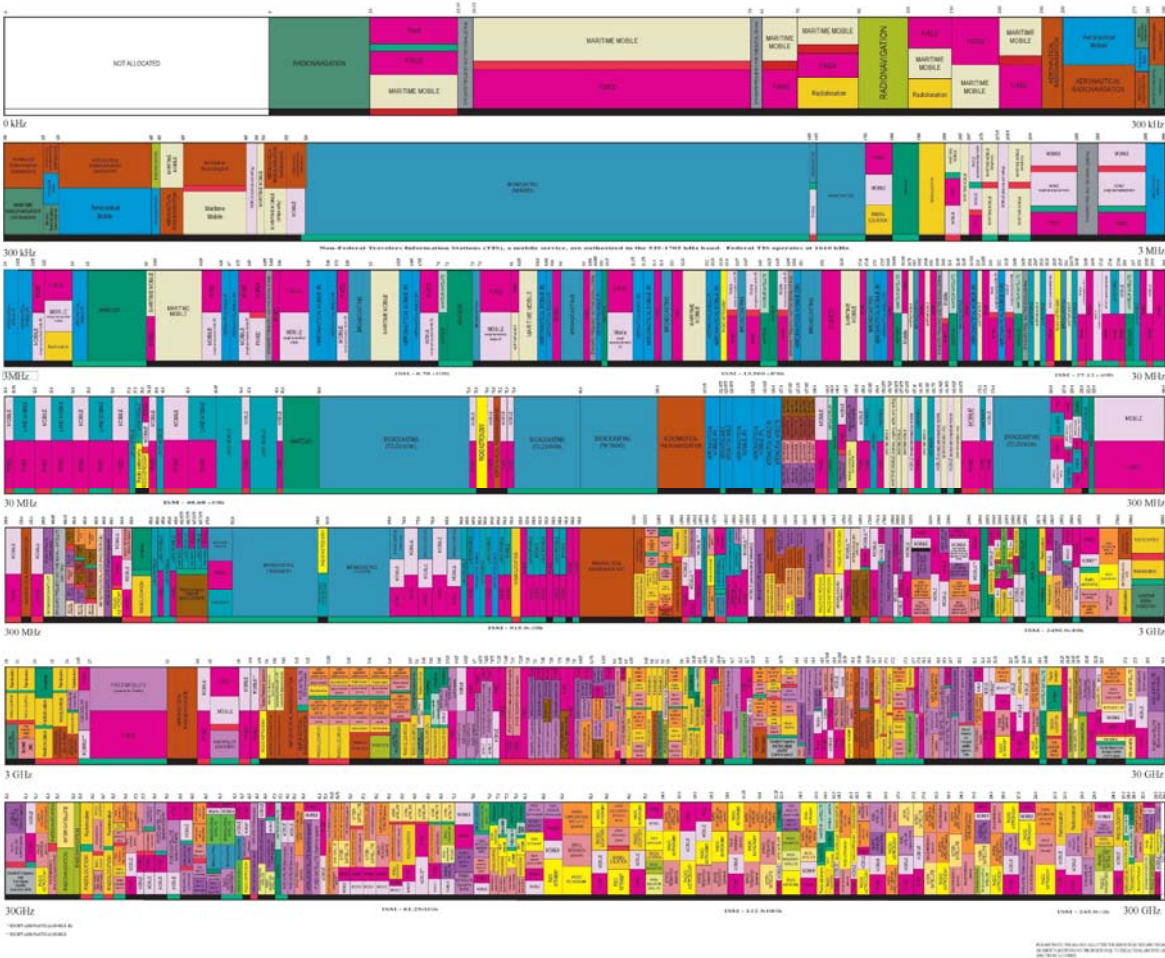
■ PUBLIC UTILITY	■ WIRELESS BROADCAST
■ COMMERCIAL/INDUSTRIAL	■ MILITARY

ALLOCATION USAGE DESIGNATION

SYMBOL	EXAMPLE	DESCRIPTION
W	1600-1700 MHz	Fixed service
M	1600-1700 MHz	Mobility service
F	1600-1700 MHz	Fixed-satellite service
M-F	1600-1700 MHz	Mobility-satellite service

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Unlicensed National Information Infrastructure (U-NII) Industrial Scientific and Medical (ISM)

900 MHz	802.11ah
2.4 GHz	802.11n, 802.11ac, 802.15, 802.11ax
5 GHz	802.11n, 802.11ac, 802.11ax
60 GHz	802.11ad



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802.11ad or WiGig

60 GHz Spectrum

Un-licensed ISM Band

Range 300 to 400 meters

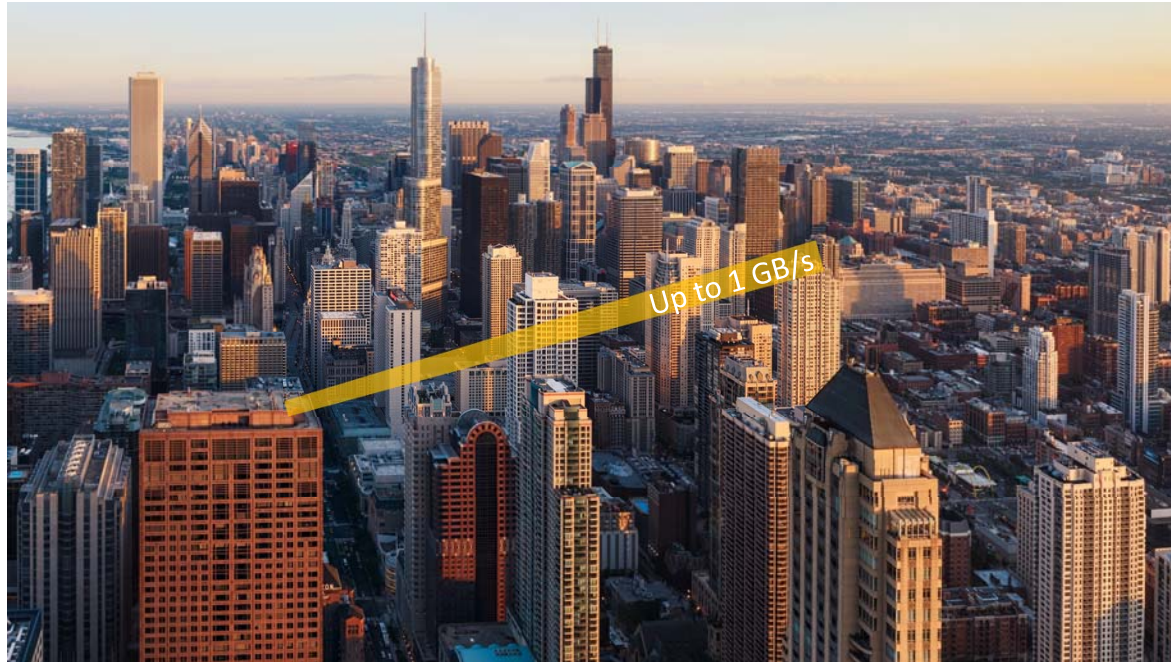
2.5 Gb/s



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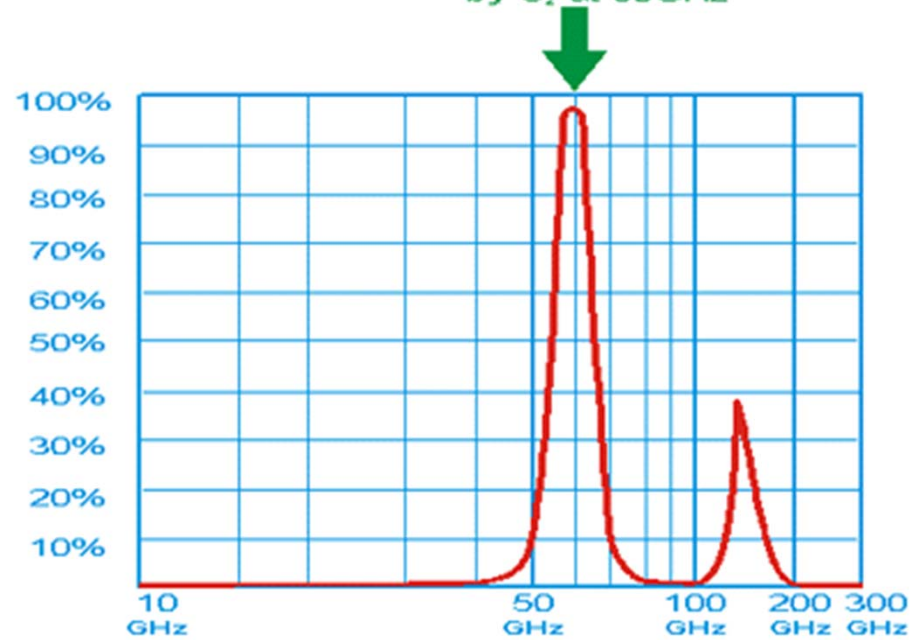




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98% of Energy Absorbed
by O₂ at 60GHz



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802.11ad or WiGig

Mostly consumer products

Wireless HDMI

Gaming and Multi-Media



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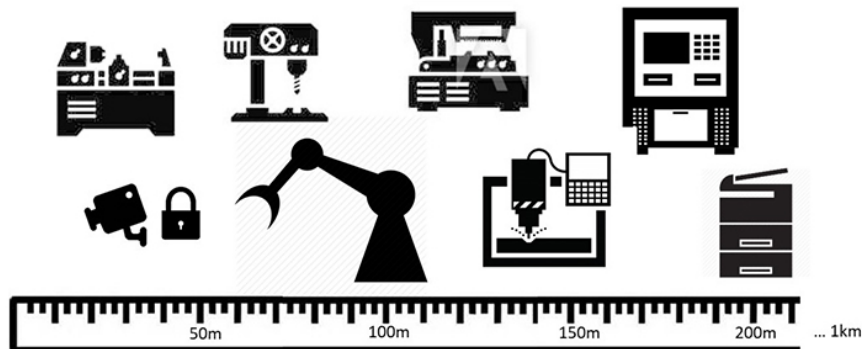
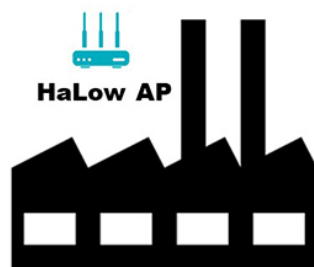
Unlicensed National Information Infrastructure (U-NII) Industrial Scientific and Medical (ISM)

900 MHz	802.11ah
2.4 GHz	802.11n, 802.11ac, 802.15, 802.11ax
5 GHz	802.11n, 802.11ac, 802.11ax
60 GHz	802.11ad



802.11ah

Uses Spatial Streams
Operates in 1 to 16
MHz Channels
902-928 MHz Band
BPSK - 256 QAM
Up to 347 Mb/s
(using 256 QAM/16
MHz and 4 streams)





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802.11ax

MU-MIMO

Operates in 1 to 16

MHz Channels

2.4 & 5 GHz Band

BPSK - 1024 QAM

Up to 12 Gb/s



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- Cellular (CELL) - 850 MHz
- Enhanced Specialized Mobile Radio (ESMR) - 800/900 MHz
- Personal Communications Service (PCS) - 1900 MHz
- Long Term Evolution (LTE) - 700 MHz / 1700 – 2150 MHz
- Advanced Wireless Services (AWS) – 1700 - 2150 MHz
- Broadband Radio Services (BRS) - 2600 MHz
- Public safety First Responder and business band Land Mobile Radio (LMR) - 700 and 800 MHz
- Some remaining in use - 450-512 MHz

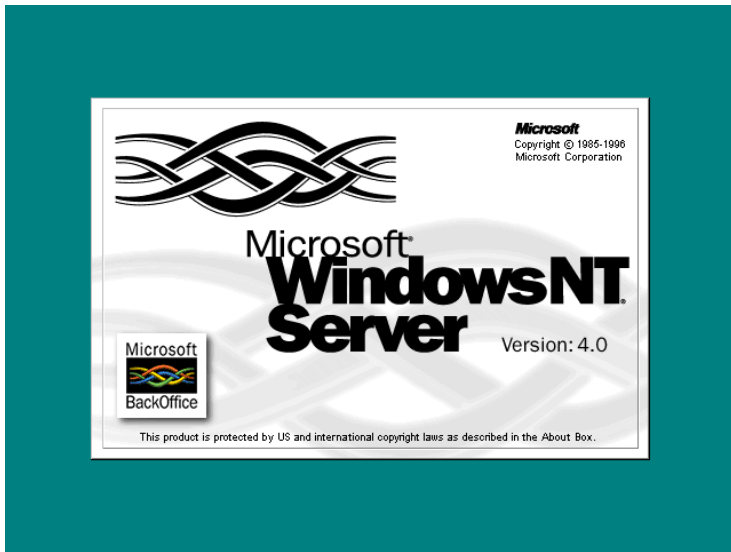




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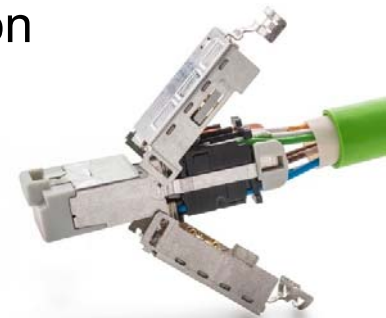
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User administered

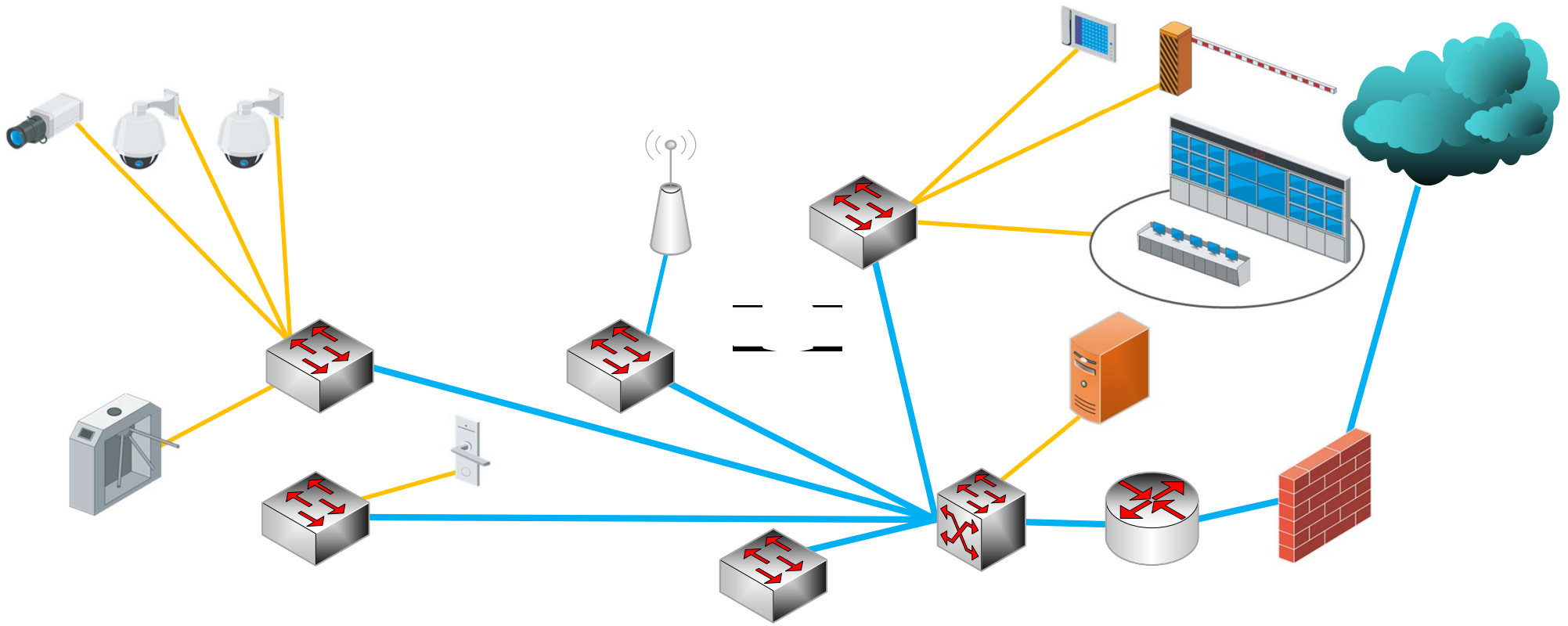
Non-user administered,
also known as a facility
connection



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The Challenge



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Thank You



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