

# 综合布线系统与园区网解决方案

吴健

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中国工程标准化协会综合布线工作组副组长

# 议程

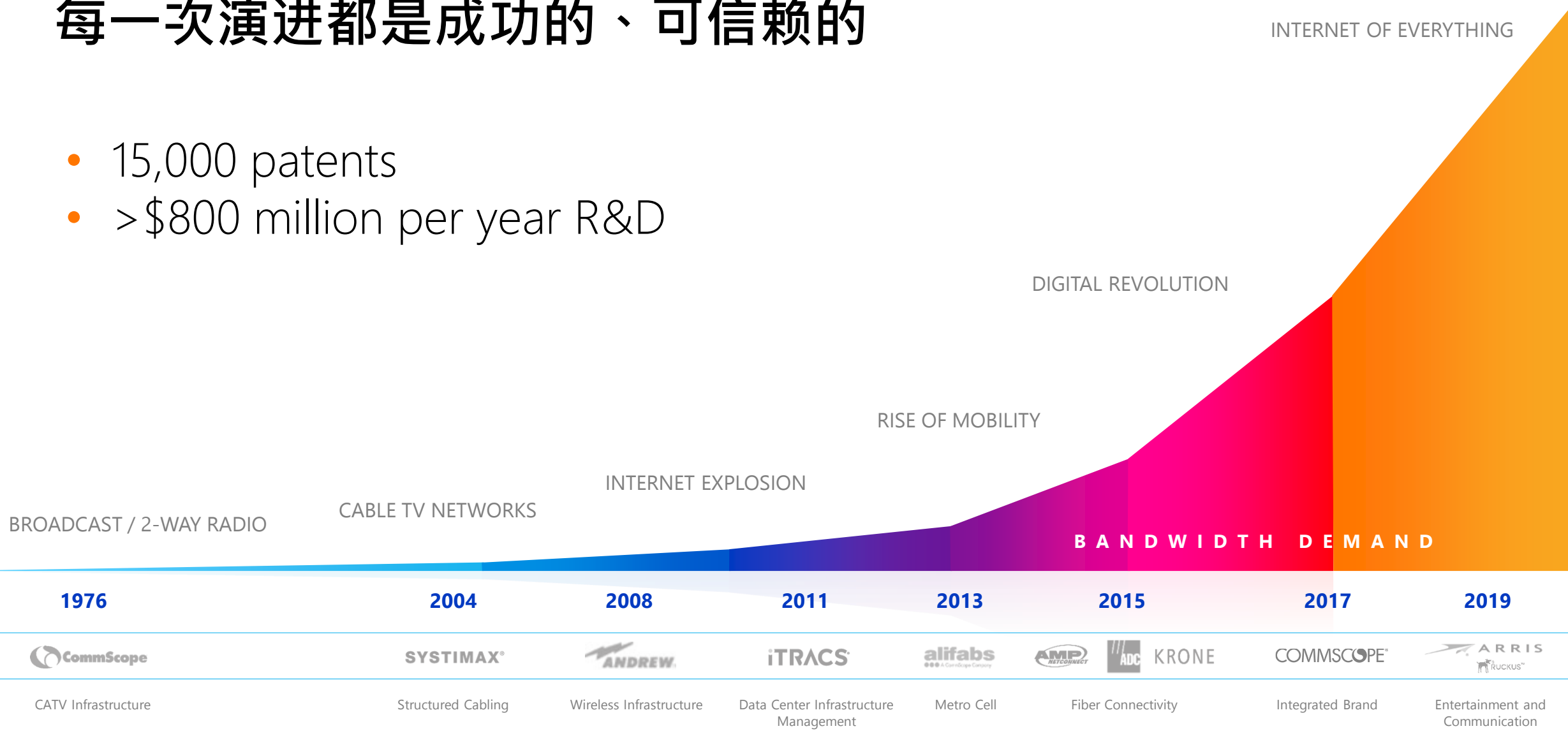


- 数据中心发展趋势及标准
- 园区网技术发展
- POE ( 铜缆 )
- 智能化管理
- 安全线缆标准

公司介绍

# 每一次演进都是成功的、可信赖的

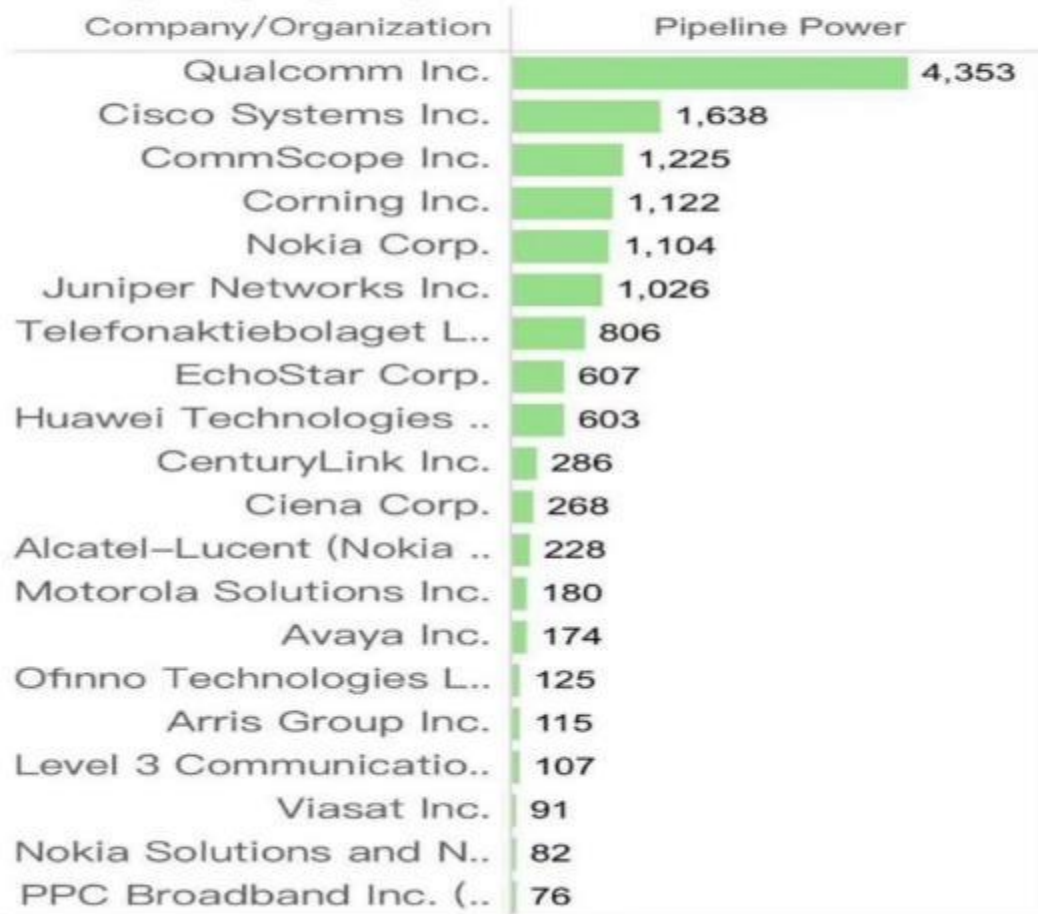
- 15,000 patents
- >\$800 million per year R&D



## Sector

Communication/Internet Equipment

## Company by Pipeline Power



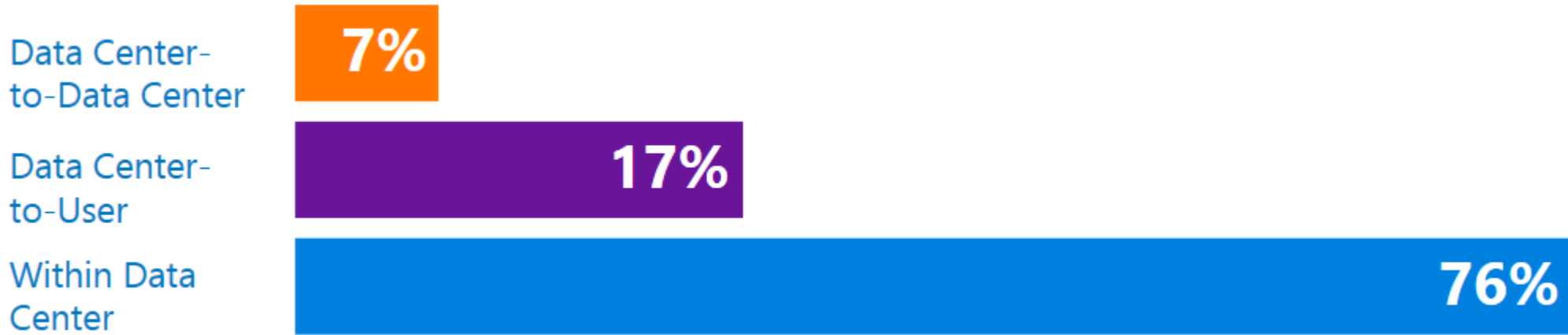
IEEE 全球科技企业创新  
能力排名

通讯类

commscope排名第三

# 网络的发展

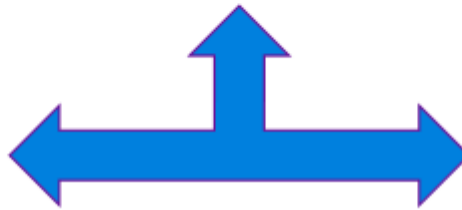
# 全球数据流量分布



**Data Center-to-Data Center**  
Replication,  
inter-database links



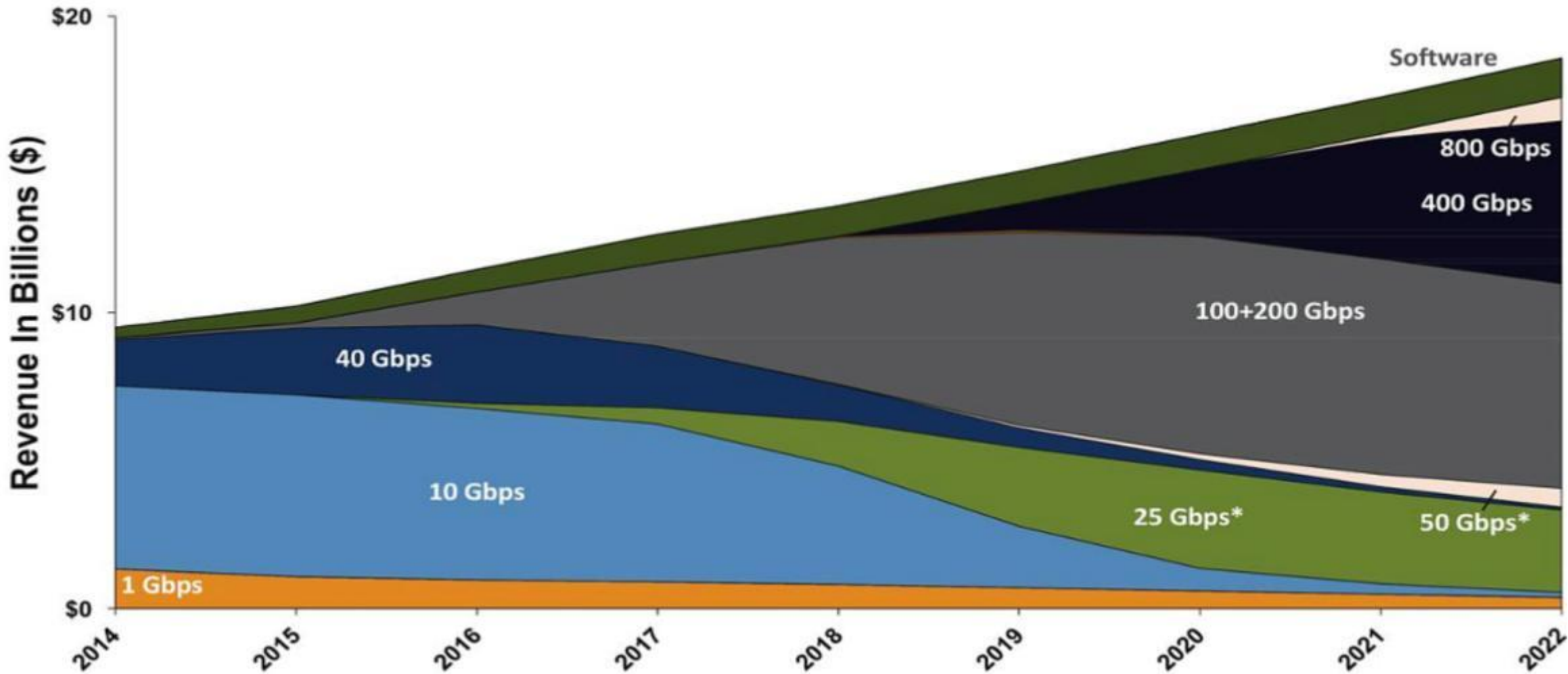
**Data Center-to-User**  
Web, email, internal  
VoD, WebEx, et al.



**Within Data Center**  
Storage, production  
and development  
data, authentication



# 以太网交换机市场趋势

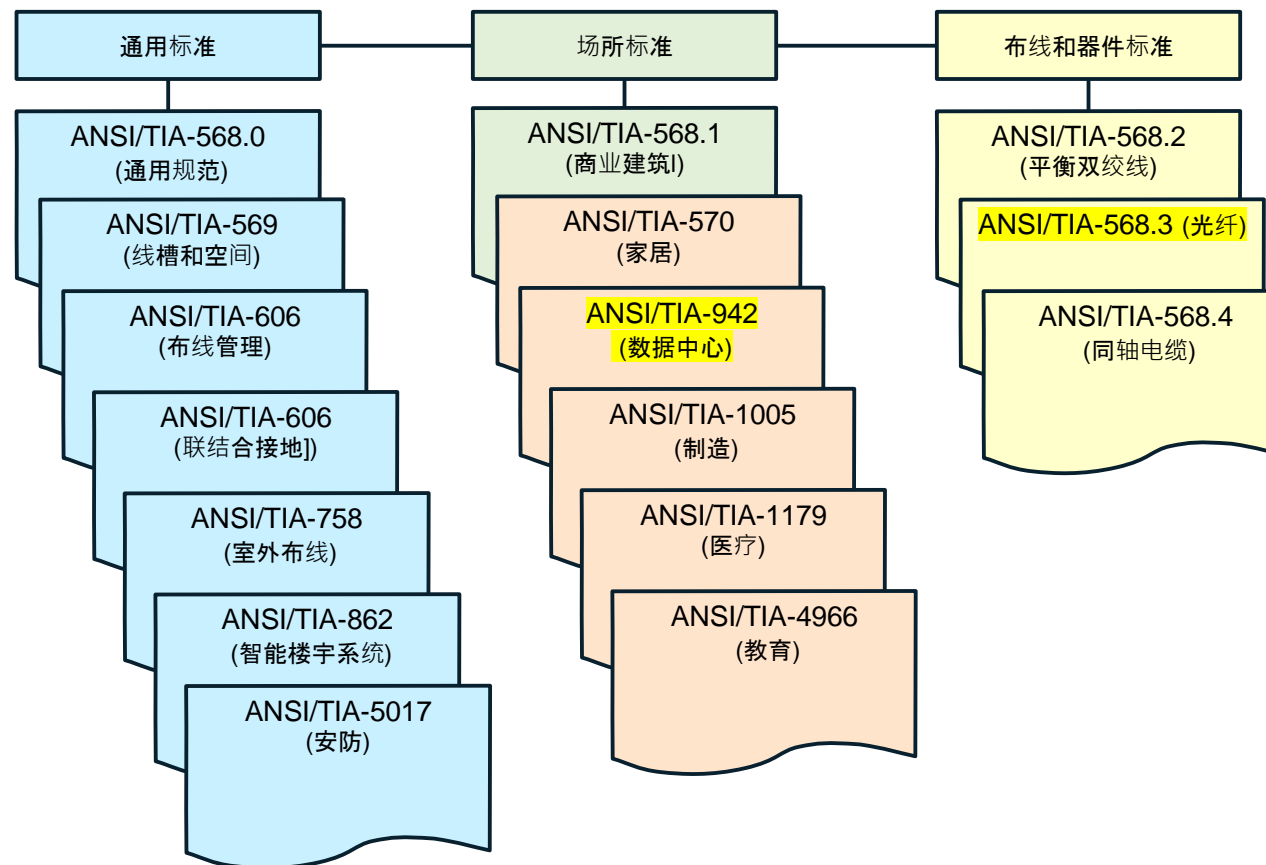


Source :650 Group , Dec.2017



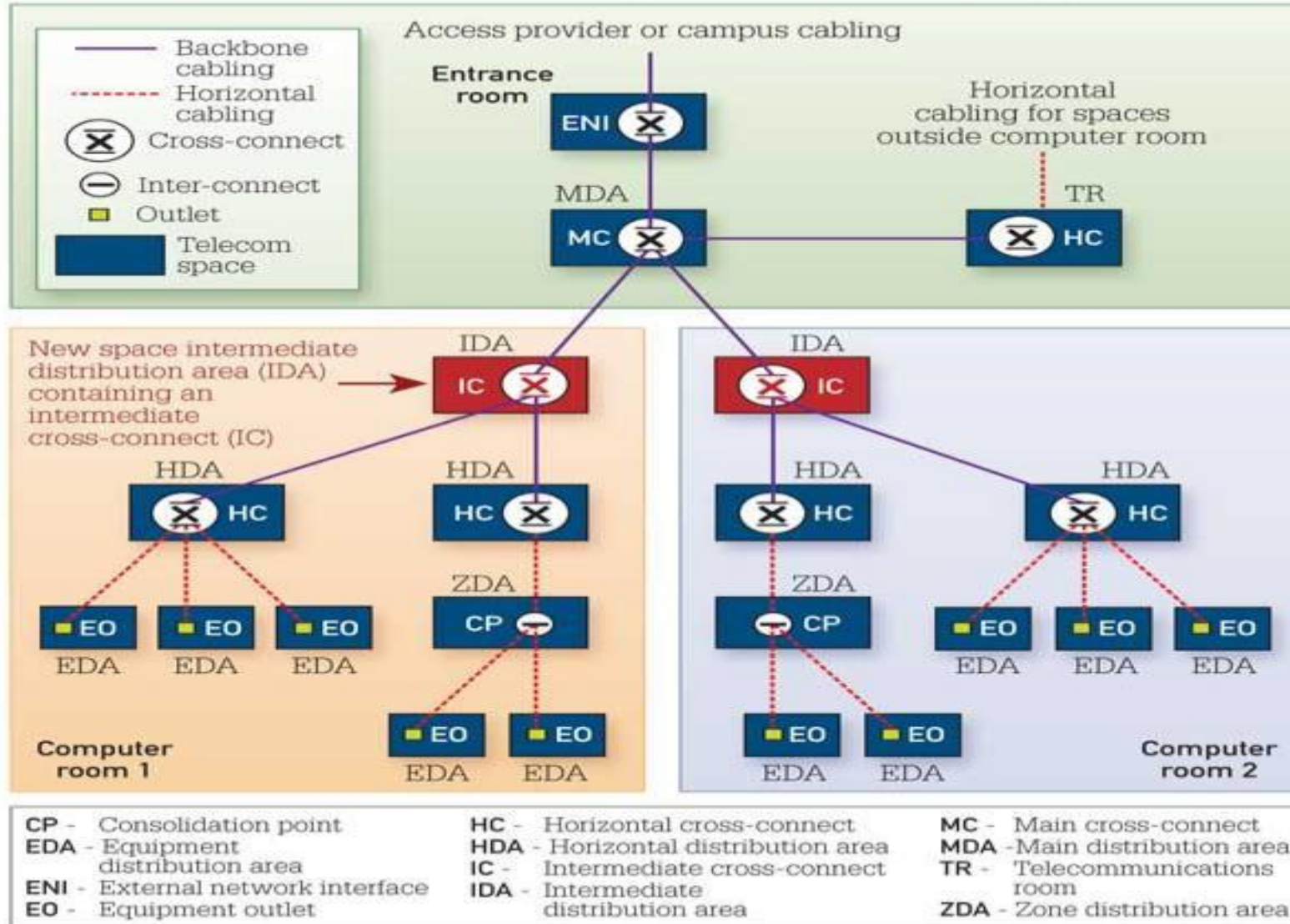
标准的发展

# ANSI/TIA 美国布线标准体系



# 数据中心布线拓扑

Draft TIA-942-A example data center topology





# TIA942B的主要变更(T4-R4)

## 305 Major modifications from ANSI/TIA-942-A

306 The major modifications in ANSI/TIA-942-B from ANSI/TIA-942-A include:

- 307 • Added MPO-16 and MPO-32 (ANSI/TIA-604-18) and MPO-24 (ANSI/TIA-604-5) as  
308 options for termination of more than two fibers in addition to the MPO-12 connector.
- 309 • Added category 8 as an allowed type of balanced twisted-pair cable. Changed  
310 recommendation for category 6A balanced twisted-pair cable to category 6A or higher.
- 311 • Added wideband laser-optimized 50/125 um multimode (OM5) as an allowed and  
312 recommended type of multimode fiber cable.
- 313 • Added 75-ohm broadband coaxial cables and connectors as specified in ANSI/TIA-  
314 568.C-4 as allowed types of coaxial cables and connectors.
- 315 • Added recommendation to not install optical fiber cords and cables (both bend insensitive  
316 and non-bend insensitive) without adequate armoring of sufficiently thick jacket in  
317 pathways that can create microbends, such as non-continuous cable supports, wire  
318 basket trays, and cable ladders without radiused cable supports or solid bottoms.
- 319 • Reduced quantity of convenience outlets required on computer room walls.
- 320 • Local fire protection codes may be used instead of NFPA 75.
- 321 • Power for air conditioning systems and controls in computer rooms and entrance rooms  
322 should be redundant, but do not need to be powered from the same PDUs or panel  
323 boards that serve ICT equipment in the room.
- 324 • Recommended maximum cable lengths for direct attach cabling in EDAs has been  
325 reduced from 10 m (33 ft) to 7 m (23 ft). Additional guidance added that direct attach  
326 cabling between rows is not recommended.

# 未来还有那些MPO光纤连接器？

## TIA-942-B 最新数据中心标准 (2017.7发布)



Significant technical changes: 重大技术变革:

1. Added MPO-16, MPO-32 (ANSI/TIA-604-18) & MPO-24 (ANSI/TIA-604-5) 增加 **MPO-16, MPO-32, MPO-24**
2. Added category 8 增加Cat8类
3. Changed recommendation to category 6A or higher 铜缆布线推荐Cat6A 或更高
4. Added wideband laser-optimized 50/125 um multimode (**OM5**)
5. Added recommendations for fiber in non-continuous pathways that could cause micro bends 非连续 (平面) 的线槽可能导致微弯损耗 (光纤槽道)
6. 设备之间的直连线缆最长从10米降到7米

## ANSI/TIA-568.3-D Optical Fiber update highlights

- Replaced ANSI/TIA-568-C.3 (published June 2008) and -C.3-1 (published Dec. 2011)
- Incorporates polarity of cords and connectivity methods supporting parallel optical signals for transceivers, array cords and cables employed over 2 rows of fibers per plug
- OM1, OM2, and OS1 demoted to not-recommended status
- Adds Wideband MMF (OM5)
- Lowers the maximum allowable OM3 and OM4 attenuation at 850nm to 3.0 dB/km from 3.5 dB/Km
- Raises minimum RL of single-mode connections and splices from 26dB to 35dB in harmony with ISO/IEC (IEEE RL requirements)
- Accounts for the insertion loss of reference-grade test connections.
- Eliminates testing multimode connector performance at 1300nm (850 was worse case)

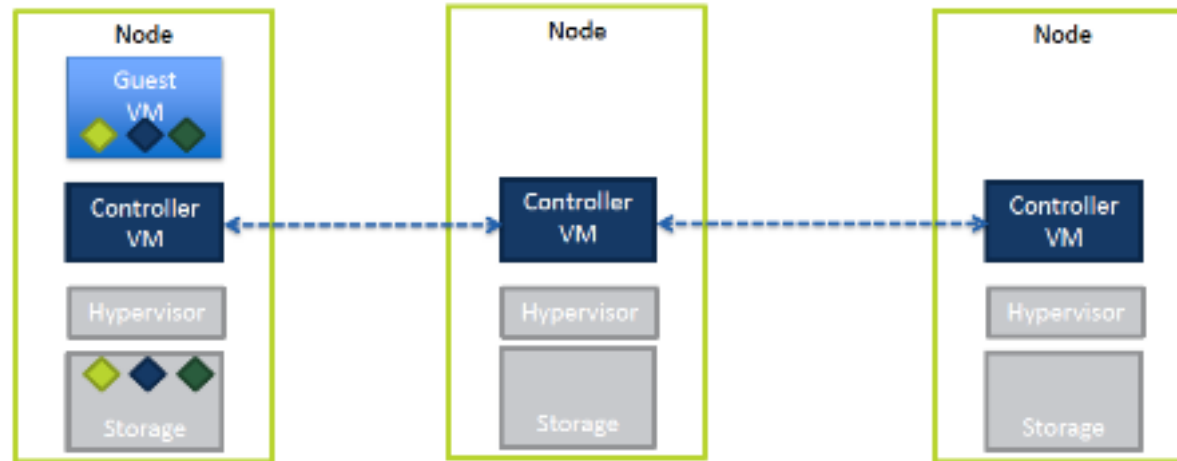
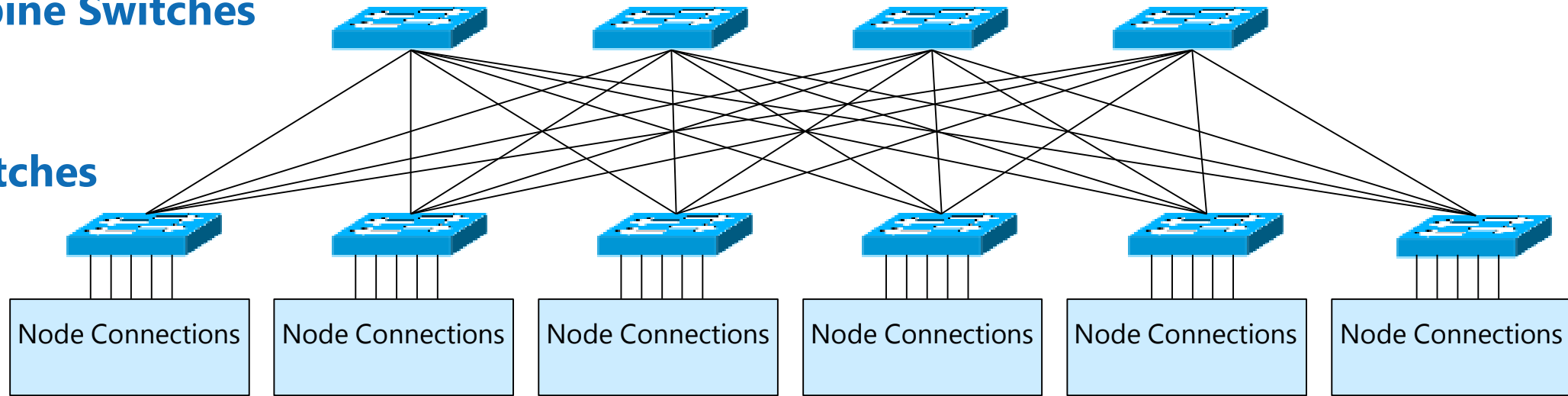
# 数据中心网络架构



# Enterprise Scale Fabric Networks

## Spine Switches

## Leaf Switches

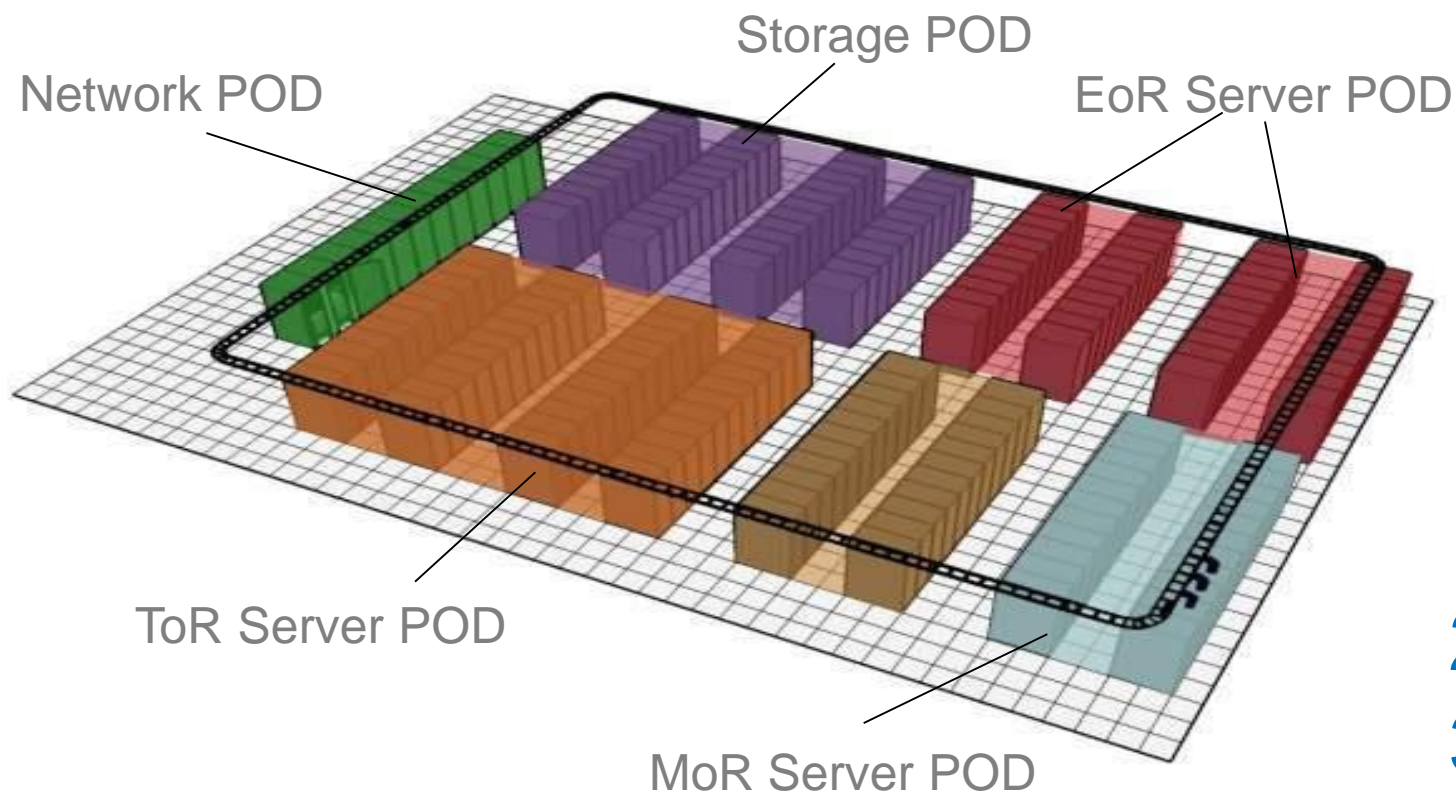


Software ties  
Compute, storage  
and control networks  
together



# 数据中心的发展趋势

## 模块化成长



## 迁移路径

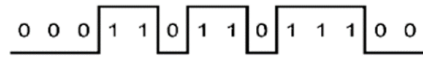
核心柜	40G	100G	200G/400G
汇聚柜	40G	100G	200G/400G
设备柜	10G	25G	50G

1. 不同区域分区
2. 考虑未来扩展升级
3. 智能化管理实现远程管理

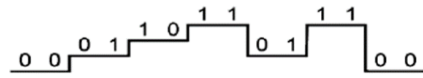
# 高速网络与光纤发展

# 如何实现更快速的网络?

PAM2-NRZ

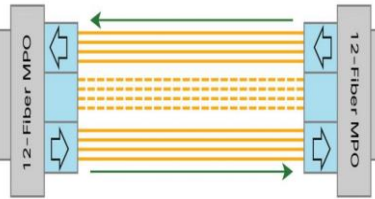


PAM4



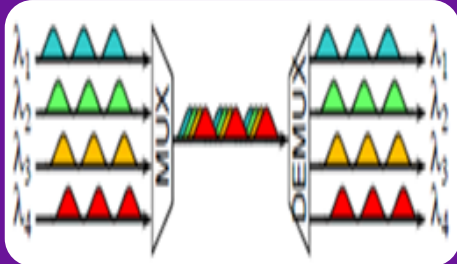
## 增加通道速率

- 增加波特率
- 采用更高级的编码方式



## 增加光纤芯数

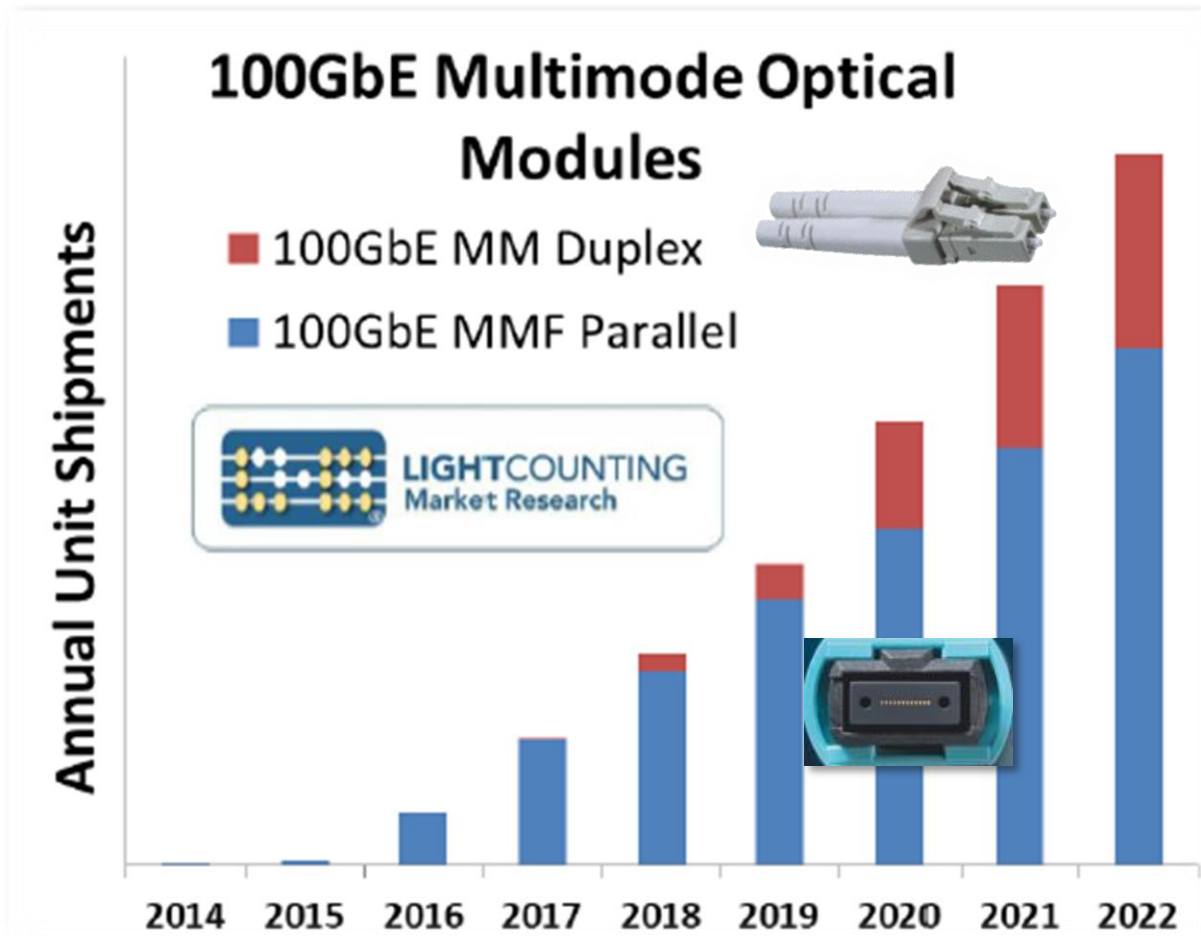
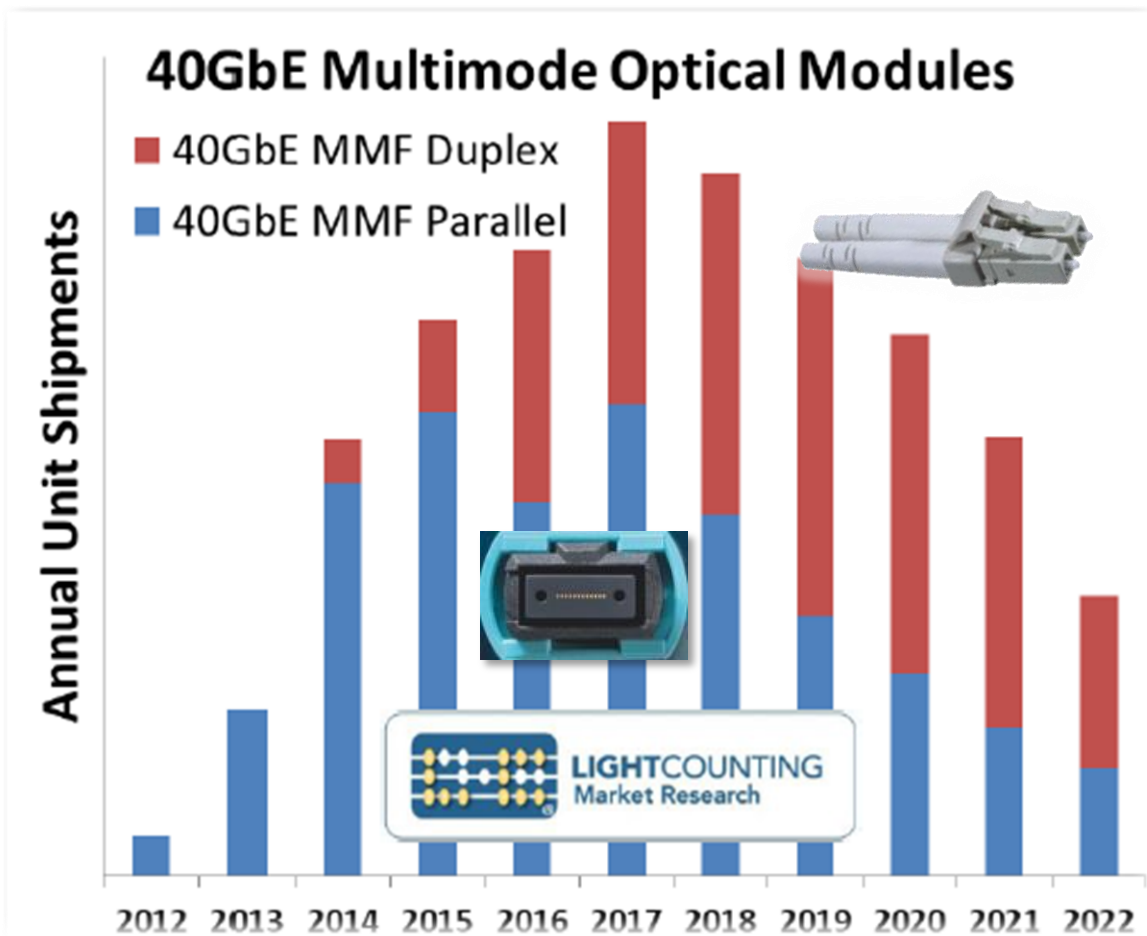
- 采用MPO连接器



## 增加波长数量，采用更好的光纤

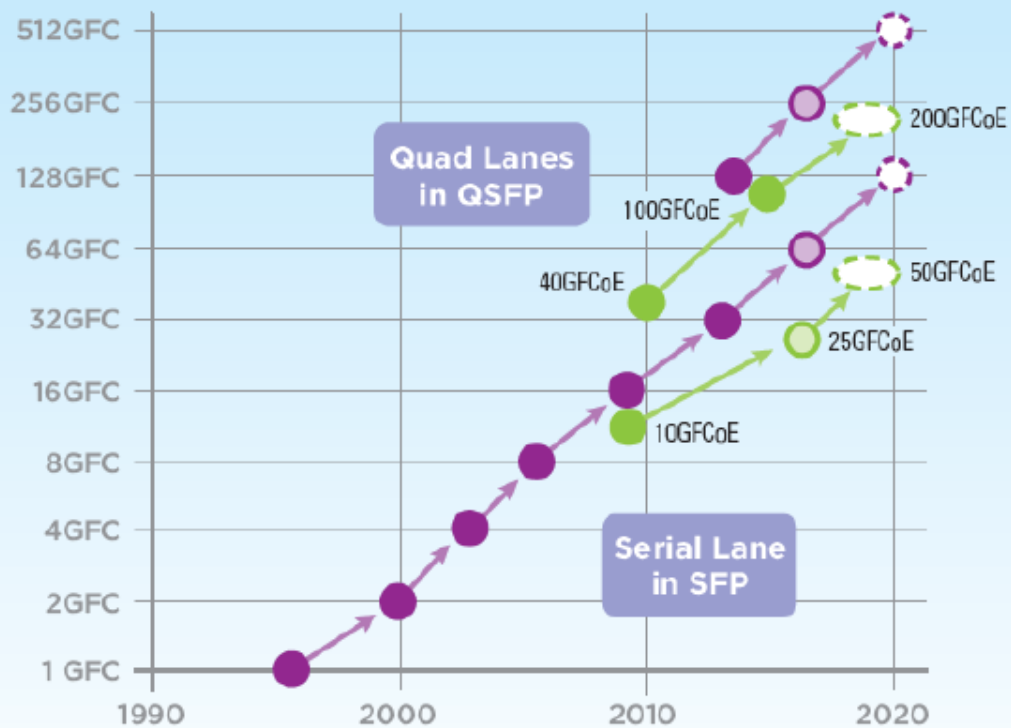
- 波分复用CWDM/DWDM/SWDM
- 更好的光纤(OM5)

# 100G 以太网发展趋势带来的挑战

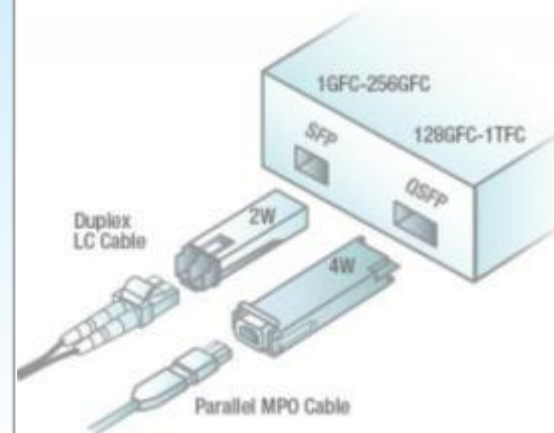
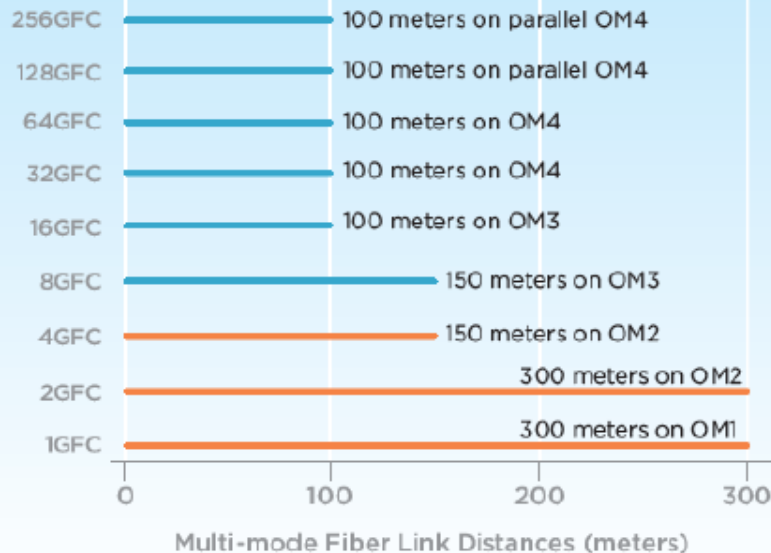


# SAN FC 存储网发展路线图

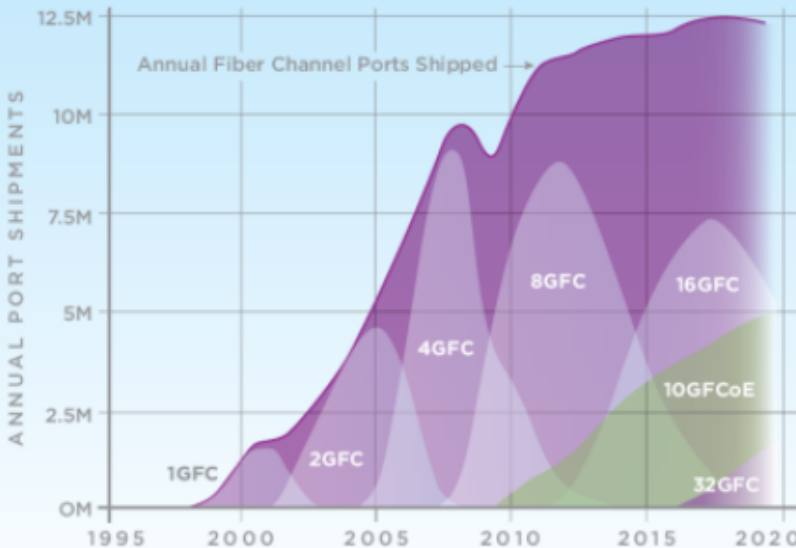
## THE PAST, PRESENT AND FUTURE OF FIBRE CHANNEL



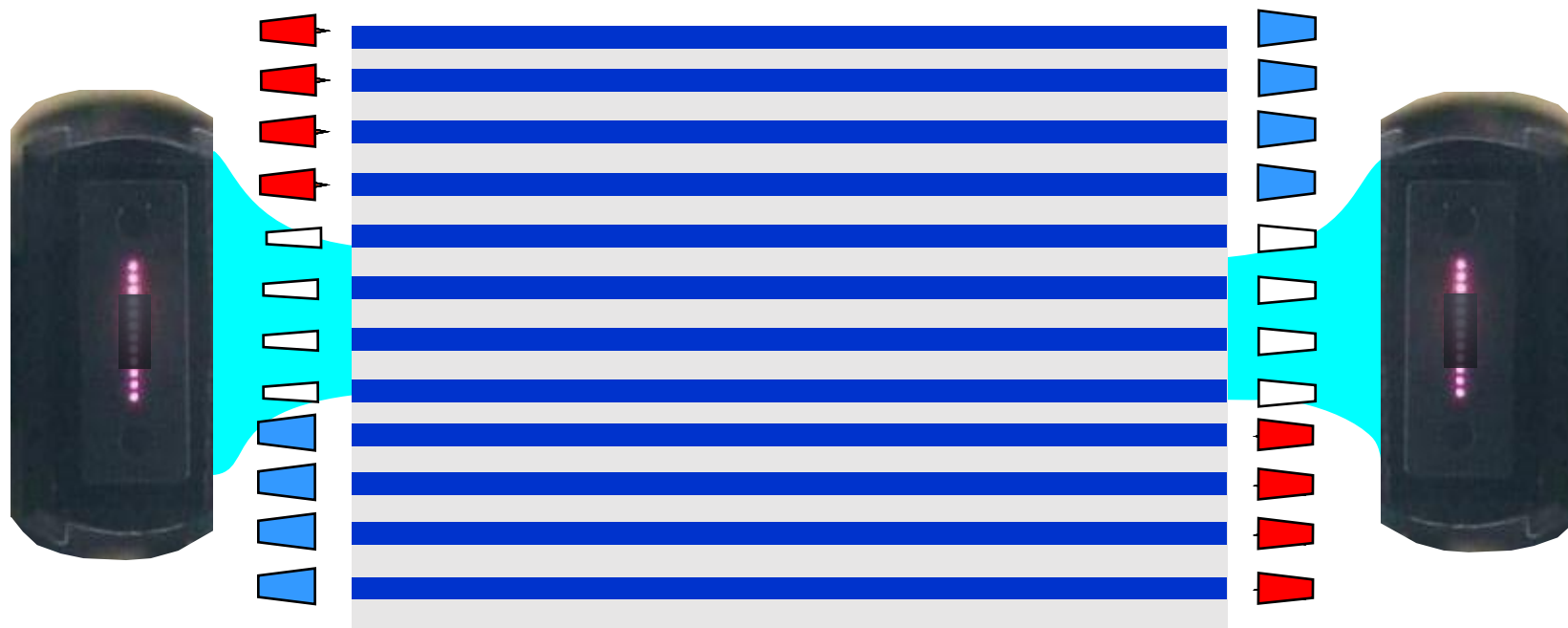
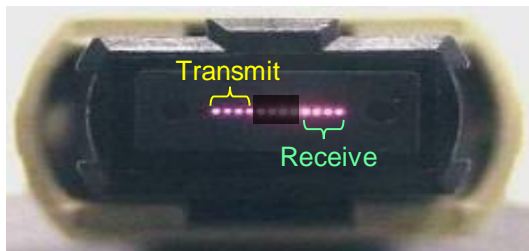
● Fibre Channel Speed    ○ Speed in Development    ⊙ Future Speed  
● FCoE Speed    ○ Speed in Development    ⊙ Possible Future Speed



Media and Modules



# 40GBASE-SR4 并行光学



# 高速网络升级采用哪种MPO光纤连接器?

## MPO-24



面向未来  
最低的成本  
最高的配线架密度

## MPO-12



目前市场安装最多  
市场上出现最早，最熟悉的MPO  
光纤连接器

## MPO-8

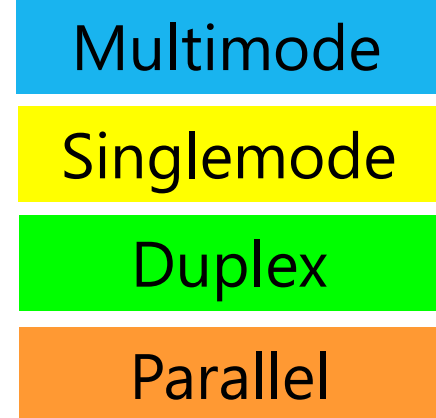


支持QSFPs 封装的模块  
针对并行应用设计  
最低配线架密度



# 100G以后的发展 – IEEE 802.3标准

Rate	PMD	Media	Reach	#Fibers	Wlengths	Lane rate	IEEE Project
25G	SR	1-pair MM	100 m	2	1	25G	802.3by (2016)
40G	SR4	4-pair MM	150 m	8	1	10G	802.3ba (2010)
	FR	1-pair SM	2 km	2	1	40G	802.3bg (2011)
	LR4	1-pair SM	10 km	2	4	10G	802.3ba (2010)
	ER4	1-pair SM	40 km	2	4	10G	802.3ba (2010)
50G	SR	1-pair MM	100 m	2	1	50G	802.3cd (2018)
	FR	1-pair SM	2 km	2	1	50G	802.3cd (2018)
	LR	1-pair SM	10 km	2	1	50G	802.3cd (2018)
100G	SR2	2-pair MM	100 m	4	1	50G	802.3cd (2018)
	SR4	4-pair MM	100 m	8	1	25G	802.3bm (2015)
	SR10	10-pair MM	150 m	20	1	10G	802.3ba (2010)
	DR	1-pair SM	500 m	2	1	100G	802.3cd (2018)
	LR4	1-pair SM	10 km	2	4	25G	802.3ba (2010)
	ER4	1-pair SM	40 km	2	4	25G	802.3ba (2010)
200G	SR1.4	1-pair MM	100 m	2	4	50G	NGMMF SG or MSA?
	SR4	4-pair MM	100 m	8	1	50G	802.3cd (2018)
	DR4	4-pair SM	500 m	8	1	50G	802.3bs (2018)
	FR4	1-pair SM	2 km	2	4	50G	802.3bs (2018)
	LR4	1-pair SM	10 km	2	4	50G	802.3bs (2018)
400G	SR4.2	4-pair MMF	100 m	8	2	50G	NGMMF SG (Jan '18)
	SR8	8-pair MMF	100 m	16	1	50G	NGMMF SG (Jan '18)
	SR16	16-pair MM	100 m	32	1	25G	802.3bs (2018)
	DR4	4-pair SM	500 m	8	1	100G	802.3bs (2018)
	FR8	1-pair SM	2 km	2	8	50G	802.3bs (2018)
	LR8	1-pair SM	10 km	2	8	50G	802.3bs (2018)



IEEE Study Group for “Next Generation 400 and 200 Gb/s over fewer multimode pairs”

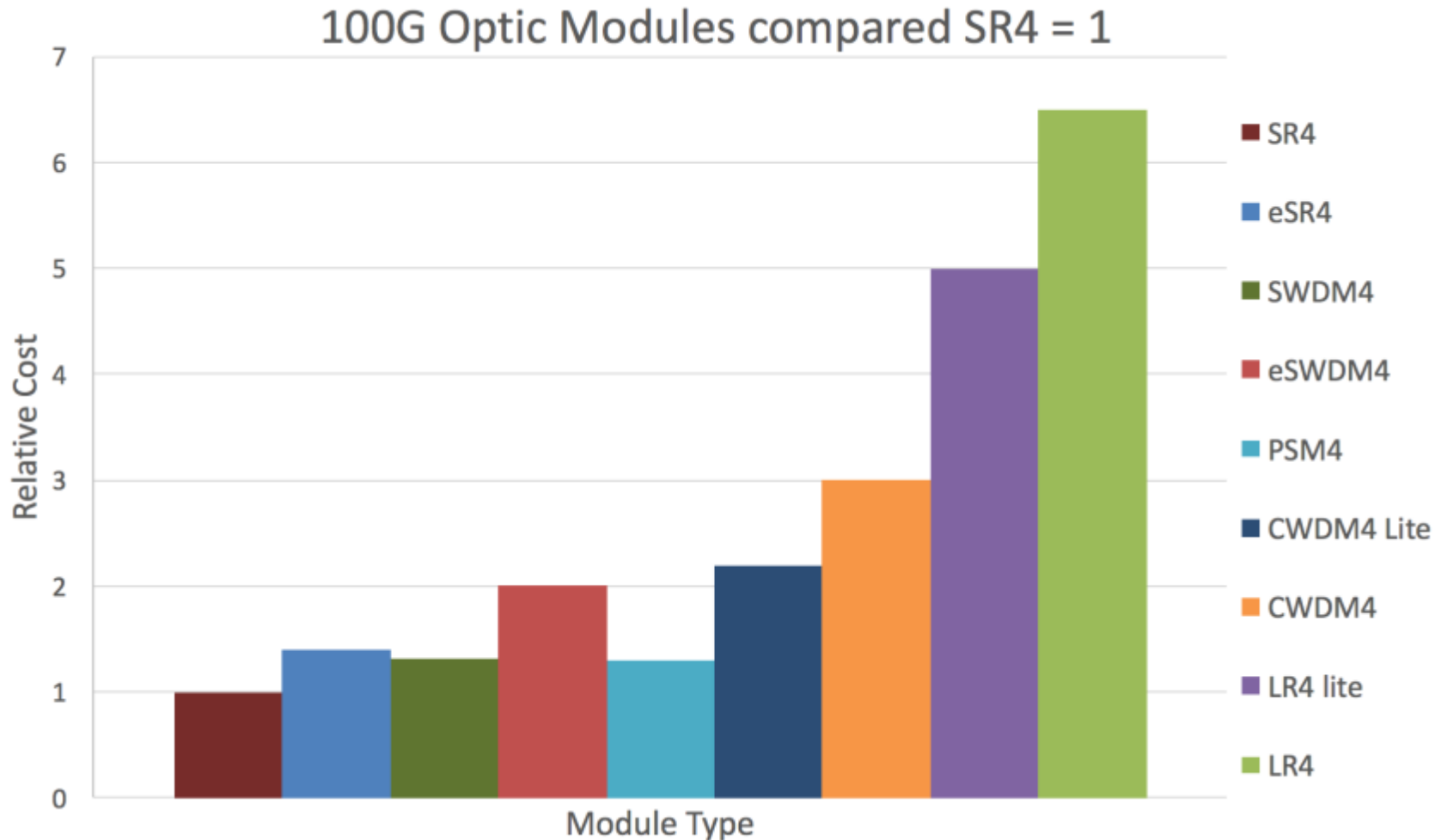
200 Gb/s:  
200GBASE-SR1.4 proposed

400 Gb/s:  
400GBASE-SR4.2 and SR8 adopted as preliminary objectives



# 100G Optic Module cost comparison

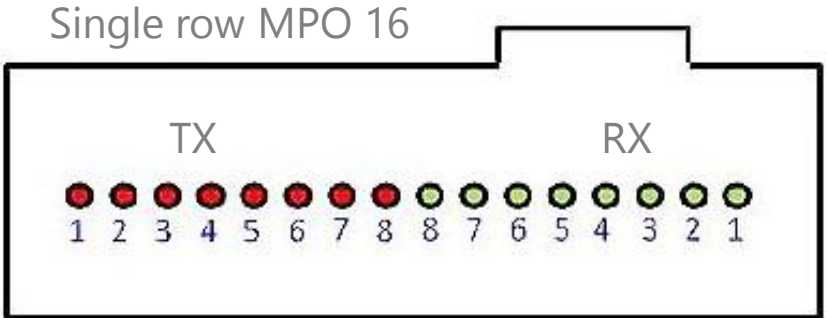
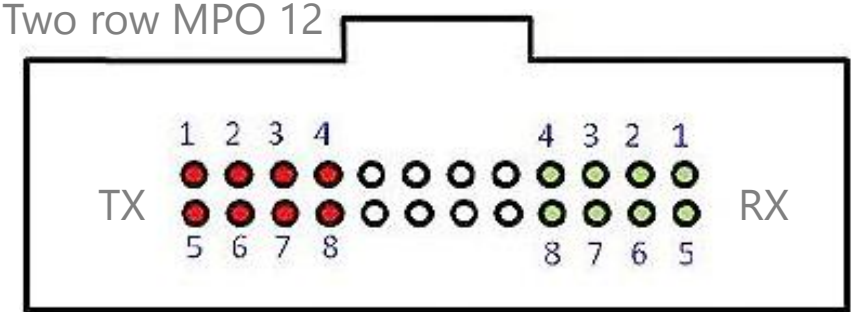
- Large volume market customer reports late 2017



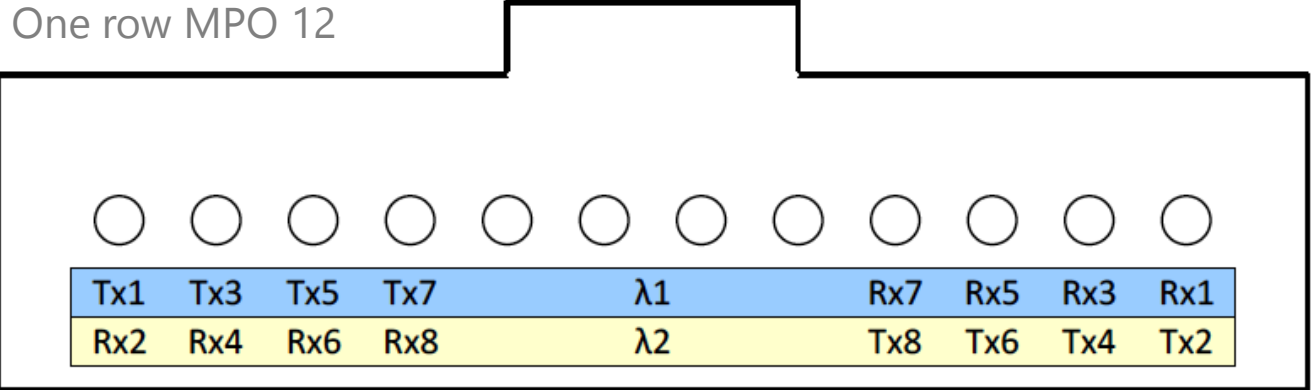
Data source – industry interviews, colleagues and industry experts

# Media Dependent Interface (MDI)

## 400GBASE-SR8



## 400GBASE-SR4.2

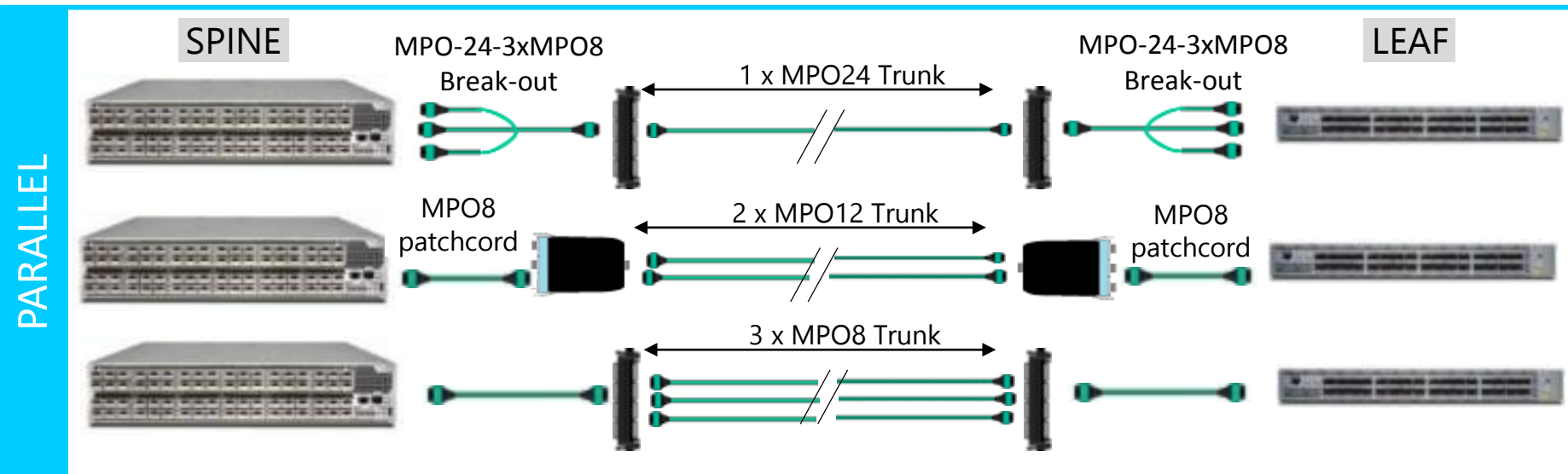
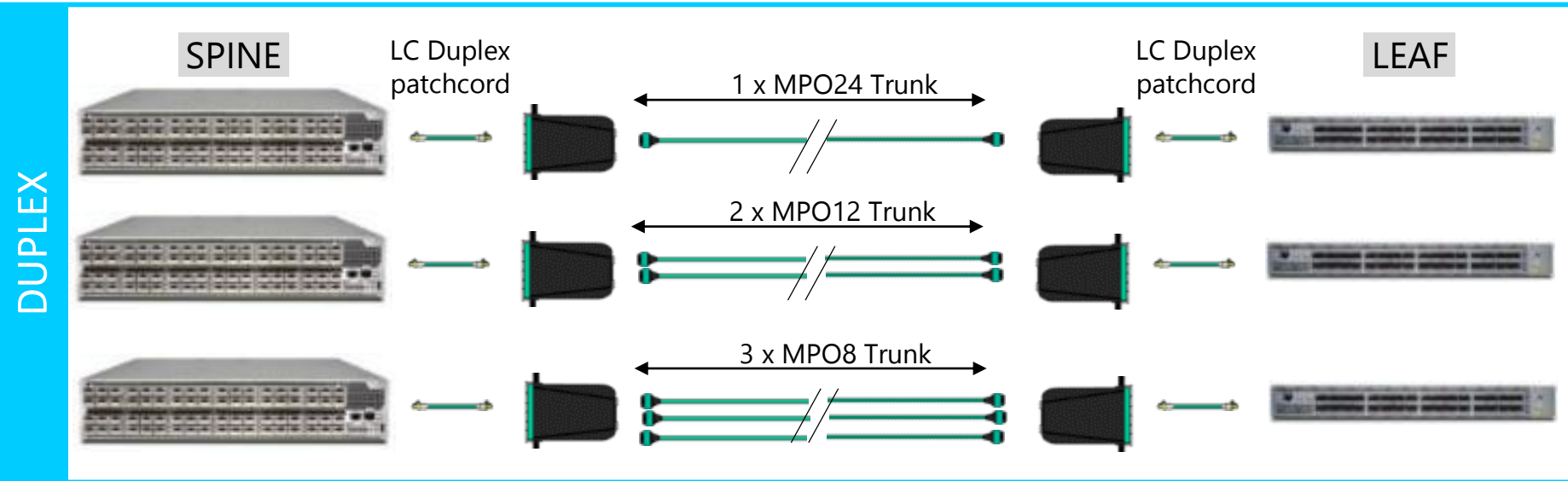


Two wavelengths per fiber in opposite directions (Bi-Di)

# MPO24 vs MPO12 vs MPO8 比较

Leaf-Spine Applications on multimode fiber

Application	#Fibers
<b>10GBASE-SR</b>	<b>2</b>
<b>40G-SR4</b>	<b>8</b>
40G-BiDi	2
40G-SWDM4	2
<b>100G-SR4</b>	<b>8</b>
<b>100G-SR2</b>	<b>4</b>
100G-SWDM4	2
100G-BiDi (?)	2
<b>200G-SR4</b>	<b>8</b>
200G-SR1.2 (?)	2
400G-SR4.2/4.4	
(?)	8
400G-SR2.4 (?)	4
400G-SR1.4 (?)	2

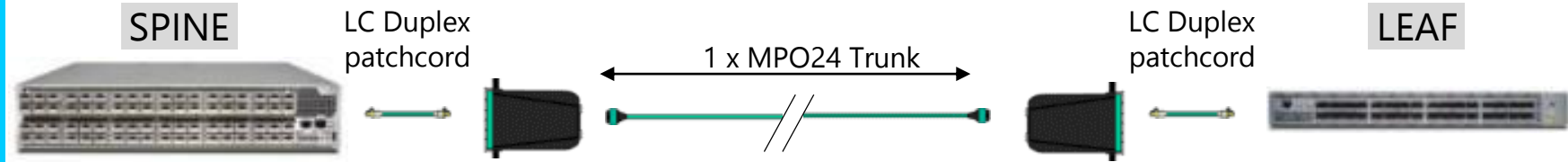


# 多芯数MPO24优势

Leaf-Spine Applications  
on multimode fiber

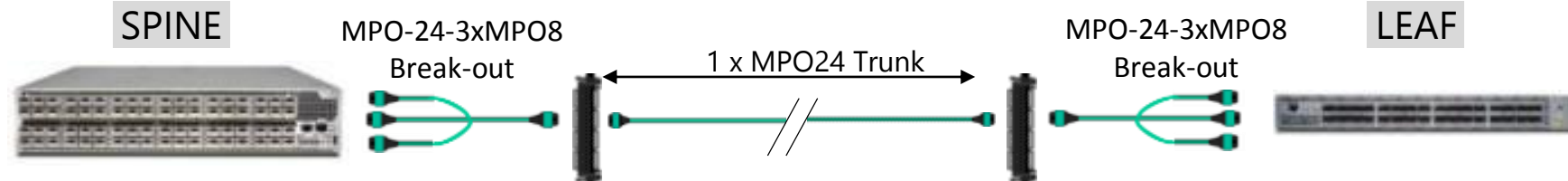
Application	#Fibers
<b>10GBASE-SR</b>	<b>2</b>
<b>40G-SR4</b>	<b>8</b>
40G-BiDi	2
40G-SWDM4	2
<b>100G-SR4</b>	<b>8</b>
<b>100G-SR2</b>	<b>4</b>
100G-SWDM4	2
100G-BiDi (?)	2
<b>200G-SR4</b>	<b>8</b>
200G-SR1.2 (?)	2
400G-SR4.2/4.4	
(?)	8
400G-SR2.4 (?)	4
400G-SR1.4 (?)	2

DUPLEX



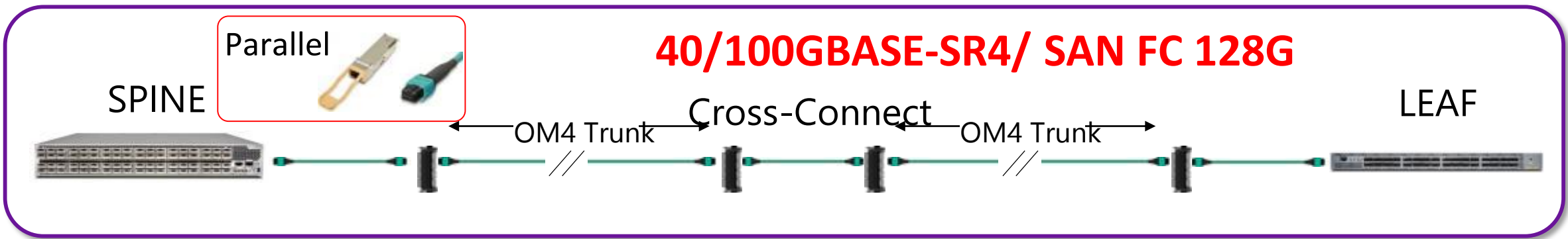
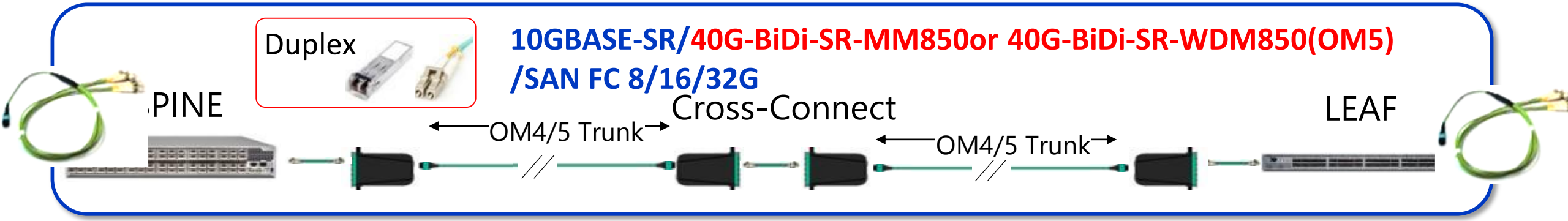
Fastest Installation  
Best pathway efficiency  
Lowest cost

PARALLEL



Fastest Installation  
Best pathway efficiency  
Highest panel density  
Lowest cost

# MPO的应用变迁：40G和100G光纤布线比较



**MPO 跳线**



**MPO/MPO  
适配器**



**MPO 主干光缆**



**MPO/MPO  
适配器**



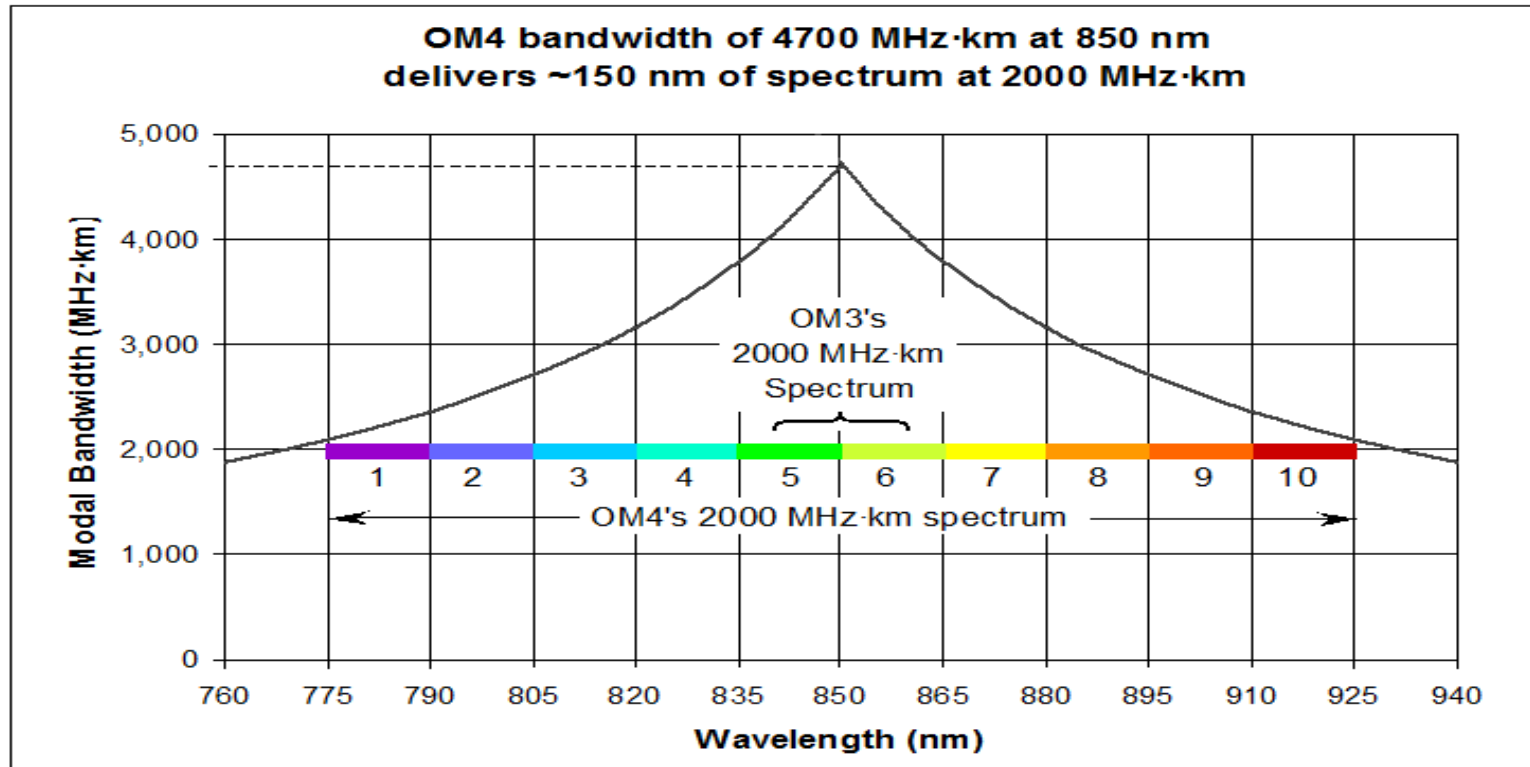
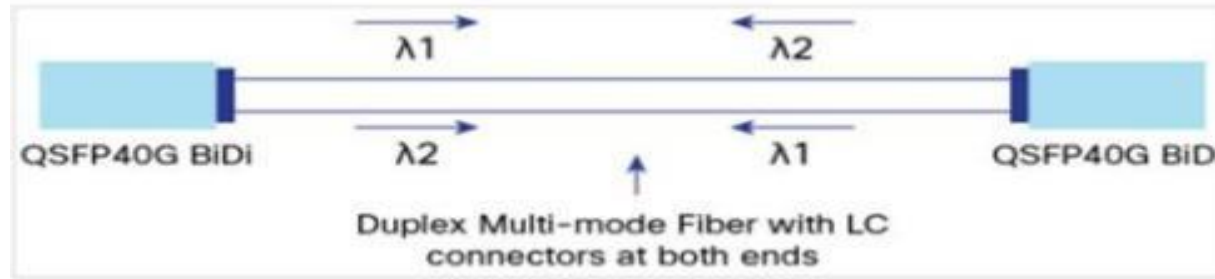
**MPO 跳线**





OM5

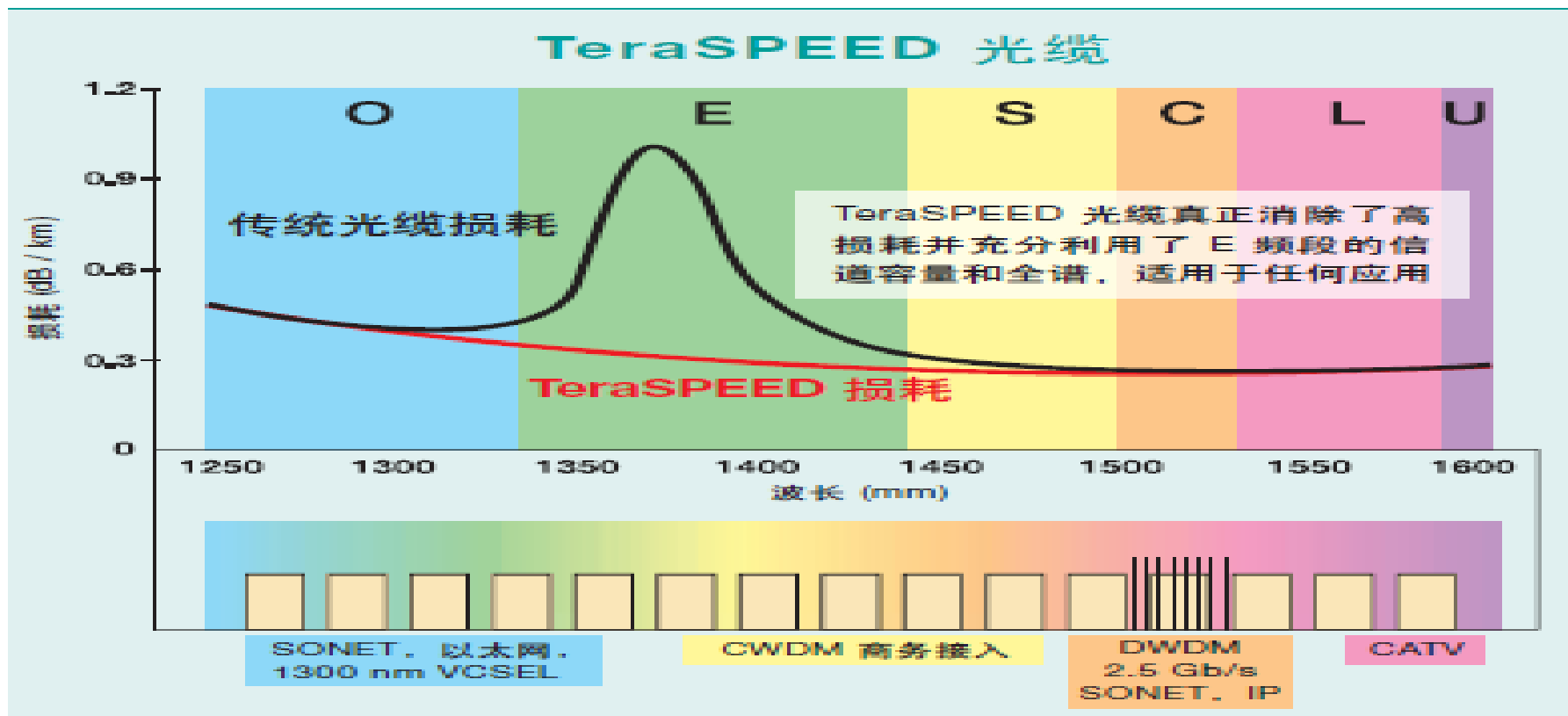
# BiDi 技术



100G BiDi 100m/OM4 150m/OM5

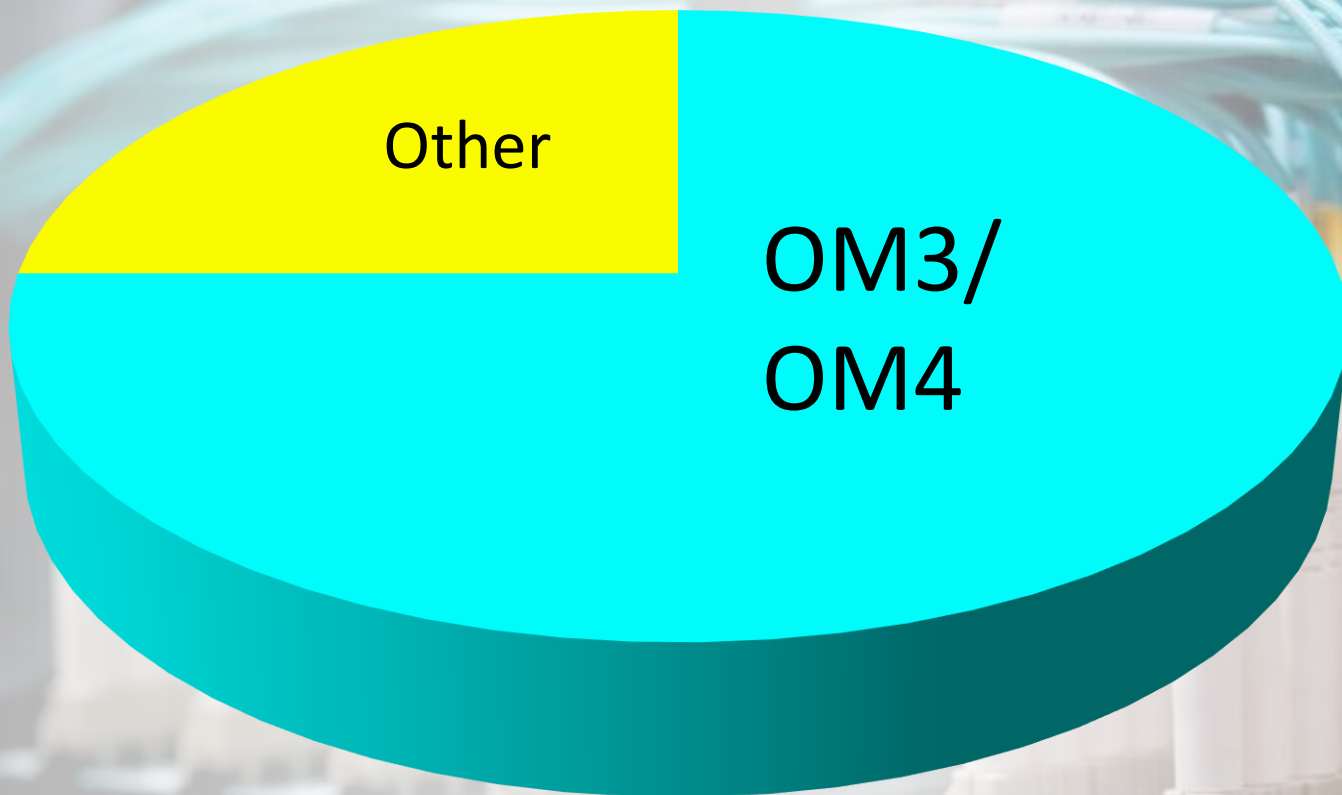
# 零水峰单模光缆的优势

- 单模光纤的水峰效应
  - TeraSPEED 超过 OS2 最高等级: ITU-T G.652.D 标准要求





# 对OM3/OM4兼容性考虑



Significant Embedded Base – Compatibility is Important

# 宽带多模的发展WBMMF



850 nm

Single high speed signal sent down the “850nm” lane

# SWDM技术与WBMMF结合



850 nm



880 nm



910 nm



940 nm

“Lanes” 2, 3 and 4 not optimized for high speed

# SWDM技术与WBMMF结合



850 nm



880 nm



910 nm



940 nm

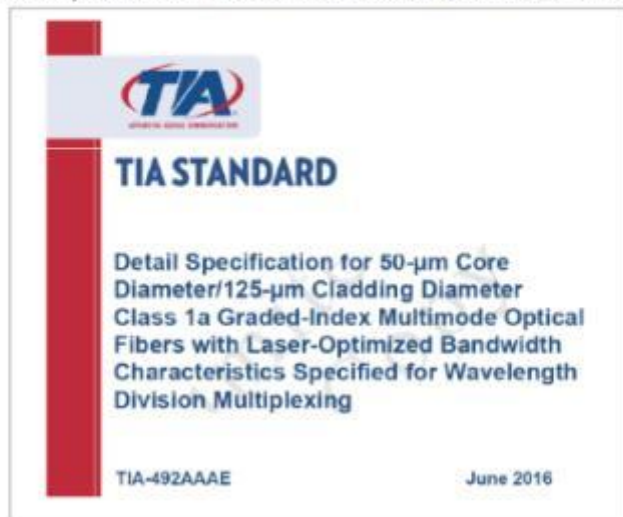
**ALL “Lanes” are optimized for high speed**



# 国际标准已经建立 TIA-492AAAE

## WBMMF Standardization - TIA

- TR-42 published TIA-492AAAE in June 2016
  - 6 meetings, 13 teleconferences and 3 ballots over 20 months
  - Participation from IEC 86A members and transceiver makers



## WBMMF Cabling Standardization – ANSI/TIA & ISO/IEC

- ANSI/TIA-568.3-D
  - Emerging revision of optical fiber structured cabling standard (2016)
  - Approves cabling made with TIA-492AAAE fibers
- ISO/IEC 11801 ed. 3
  - Emerging revision of international structured cabling standard (2017)
  - Tentatively specifies cabling made with WBMMF
  - Dependent upon IEC fiber specification maturation



ISO/IEC JTC 1/SC 25 **N2615**

Date: 2016-10-06

Replaces ISO/IEC JTC 1/SC 25 N/A

ISO/IEC JTC 1/SC 25  
INTERCONNECTION OF INFORMATION TECHNOLOGY EQUIPMENT  
Secretariat: Germany (DIN)

**DOC TYPE:** Information  
**TITLE:** Result SC 25 internal ballot on Naming of a new wideband multimode fibre cable type  
**SOURCE:** SC 25 Secretary  
**PROJECT:**  
**STATUS:** At the spring 2016 meeting, SC 25/WG 3 discussed the naming of a new wideband multimode fibre, which is to be included in ISO/IEC 11801-1. There were three proposed names, without substantial support within the Working Group.

Result internal ballot (SC25N2589):

Option 1	OM4W	2
Option 2	OM5	13
Option 3	OM5W	1
Abstention		2

WBMMF is OM5

**ACTION ID:** N/A  
**DUE DATE:** N/A  
**REQUESTED ACTION:**  
**MEDIUM:** open  
**DISTRIBUTION:** Members of SC 25, SC25 WG 3

No of Pages: 1 (including cover)

Secretary - ISO/IEC JTC 1 / SC 25  
Juergen Tretter  
[tretterconsult@gmail.com](mailto:tretterconsult@gmail.com)

# SWDM

- Industry group to promote SWDM technology for duplex multimode fiber in data centers.
- Finisar is a founding member of the SWDM Alliance and SWDM MSA.
- More information at [www.swdm.org](http://www.swdm.org)



Founding Members



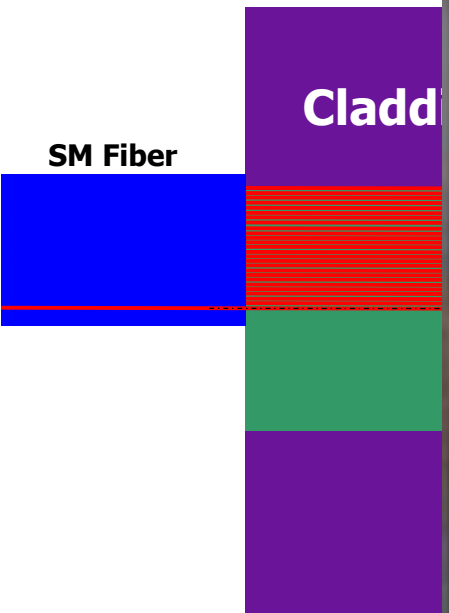
# Standardized multimode fiber cabling

	OM3	OM4	OM5
TIA Standard	TIA-492AAAC-B	TIA-492AAAD	TIA-492AAAE
EMB @ 850nm	2000 MHz*km	4700 MHz*km	4700 MHz*km
EMB @ 953nm	-	-	2470 MHz*km
100G SWDM4 Reach (850, 880, 910, 940nm)	70m	100m	150m
100G BiDi Reach (850 and 900nm)	70m	100m	150m

The long wavelength EMB spec for OM5 enables longer reach transmission for

- 100G SWDM4
- 100G BiDi

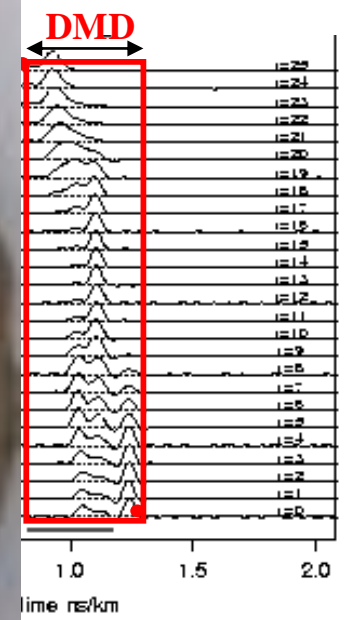
# 对模式色散的测量DMD



Sample MM Side View

- Single Mode 850
- 300m or 550m le
- Standard - 100ps
- CommScope -

## an Example



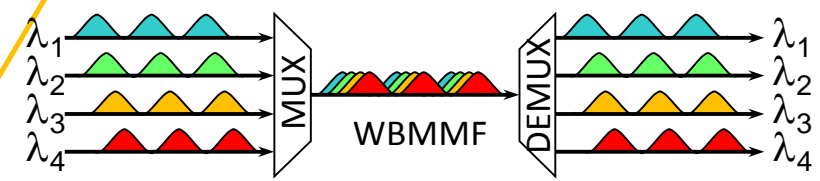
ifference in delay  
between the latest and  
arriving pulses



# 多模光纤的应用前景OM5

Data Rate	10G Parallel TX RX	25G Parallel TX RX	10G, 25G WDM & Parallel TX RX
40G		N/A	
100G			
400G	N/A		

SWDM enabling factor of 4 fiber count reduction



Legend

- parallel fiber transmission
- WDM transmission
- WDM + parallel transmission

\*Parallel fibers remain essential to support break-out functionality

# 大规模采用WBMMF的成功案例 Golden 1 Center



# 40G/100G Applications and Multimode Fiber

Maximum reach based on Standards, MSAs and/or vendor specifications



40G

Standard	# fibers	maximum distance
<b>40GBASE-SR4</b>	<b>(8)</b>	OM3 100 m
		OM4/OM5 150 m
40G-BiDi	(2)	OM3 100 m*
		OM4 150 m*
		OM5 200 m
40GBASE-eSR4	(8)	OM3 300 m
		OM4/OM5 400 m
40G-SWDM4	(2)	OM3 240 m*
		OM4 350 m*
		OM5 440 m

100G

<b>100GBASE-SR4</b>	<b>(8)</b>	OM3 70 m
		OM4/OM5 100 m
<b>100GBASE-SR10</b>	<b>(20)</b>	OM3 100 m
		OM4/OM5 150 m
100GBASE-eSR4	(8)	OM3 200 m
		OM4/OM5 300 m
100G-SWDM4	(2)	OM3 75 m*
		OM4 100 m*
		OM5 150 m

\*OM3/OM4 effective modal bandwidth only specified at 850 nm

"In addition to supporting the same 850nm and 1300nm applications as OM4, OM5 provides advantage in the support of future applications using WDM in the wavelength range 850nm to 953nm" (FDIS ISO/IEC 11801-1)

# ISO/IEC TR 11801-990x 多模光纤支持高速网络技术白皮书

Speed	Duplex Applications	Parallel Applications	Maximum Reach (m)			Number of Fiber Pairs
			OM3	OM4	OM5	
10 Gb/s	10GBASE-SR		300	400	400	1
16 Gb/s	16G Fibre Channel		100	125	125	1
25 Gb/s	25GBASE-SR		70	100	100	1
	25G-eSR <sup>1</sup>		200	300	300	1
32 Gb/s	32G Fibre Channel		70	100	100	1
40 Gb/s	40G-BiDi <sup>2</sup>		100 <sup>5</sup>	150 <sup>5</sup>	200	1
			240 <sup>5</sup>	350 <sup>5</sup>	440	1
	40GBASE-SR4		100	150	150	4
		40G-eSR4 <sup>4</sup>	300	400	400	4
50 Gb/s	50GBASE-SR		70	100	100	1
64 Gb/s	64G Fibre Channel		70	100	100	1
100 Gb/s	100G-BiDi <sup>2</sup>		70 <sup>5</sup>	100 <sup>5</sup>	150	1
			75 <sup>5</sup>	100 <sup>5</sup>	150	1
			200 <sup>5</sup>	300 <sup>5</sup>	400	1
	100GBASE-SR2		70	100	100	2
		100GBASE-SR4	70	100	100	4
100G-eSR4 <sup>4</sup>		200	300	300	4	
100GBASE-SR10		100	150	150	10	
128 Gb/s		128G Fibre Channel	70	100	100	4
200 Gb/s	200GBASE-SR1.4 <sup>6</sup>		75 <sup>5*</sup>	100 <sup>5*</sup>	150 <sup>8</sup>	1
	200GBASE-SR4		70	100	100	4
400 Gb/s		400GBASE-SR4.2 <sup>7</sup>	70 <sup>5*</sup>	100 <sup>5*</sup>	150 <sup>8</sup>	4
		400GBASE-SR8 <sup>7</sup>	70 <sup>5*</sup>	100 <sup>5*</sup>	100 <sup>8</sup>	8
		400GBASE-SR16	70	100	100	16

Table 1 Multimode Data Center Applications

## ➤ ISO/IEC JTC1/SC25 技术白皮书

➤ 2018年2月最新版本,一致通过

## ➤ 在多模光纤上传输高速网络技术白皮书

- 网络应用从 **10 Gb/s 到 400 Gb/s**
- 包含IEEE 以太网和 光纤通道Fibre Channel
- 包含市场上的其他光模块(eSR, BiDi, SWDM)

## ➤ 列出OM3, OM4, OM5 支持的最远距离

- OM5光纤支持BiDi, SWDM光模块传输更远的距离
- 传统的 OM3/OM4 光纤主要针对850 nm波长的光模块设计

## ➤ 提出在双工/并行之间升级的考量因素

## ➤ 新的数据中心建议采用 OM5 多模光纤

Annex A  
(informative)

### Multimode fibre cabling for new installations

OM5 multimode fibre cabling is recommended for new multimode installations, to support all single wavelength applications to at least the same reach of OM4 while supporting longer reach and/or providing additional performance margin for emerging multi-wavelength applications.



## ➤ 连接器质量问题

- ◆ 平整度、光洁度、椭圆度、同心度
- ◆ 凸台过高、裂纹制造缺陷

FiberInspector™  
Video Microscopes

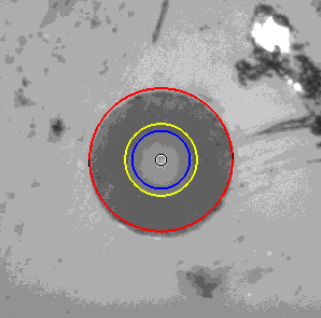


光缆视频检测表



**FIBERINSPECTOR™** OFTM-5602

05/16/2002 2:20:17 p.m.



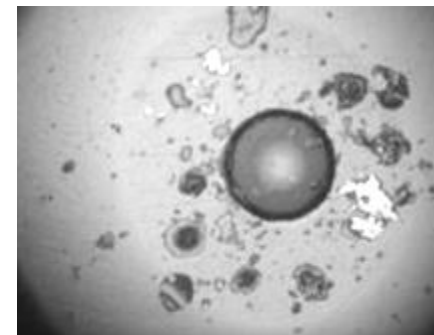
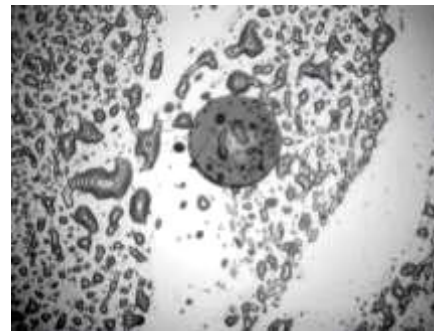
Magnification: 250X

Visual Quality  
**Not Graded**

LIMITS: IEC11801 with OTD  
OPERATOR: HEIDNER  
DATE: 05/16/2002  
TIME: 2:20:17 p.m.

PAN IMAGE

More
Remove Scale
Grade Image
Auto Center
Real Time



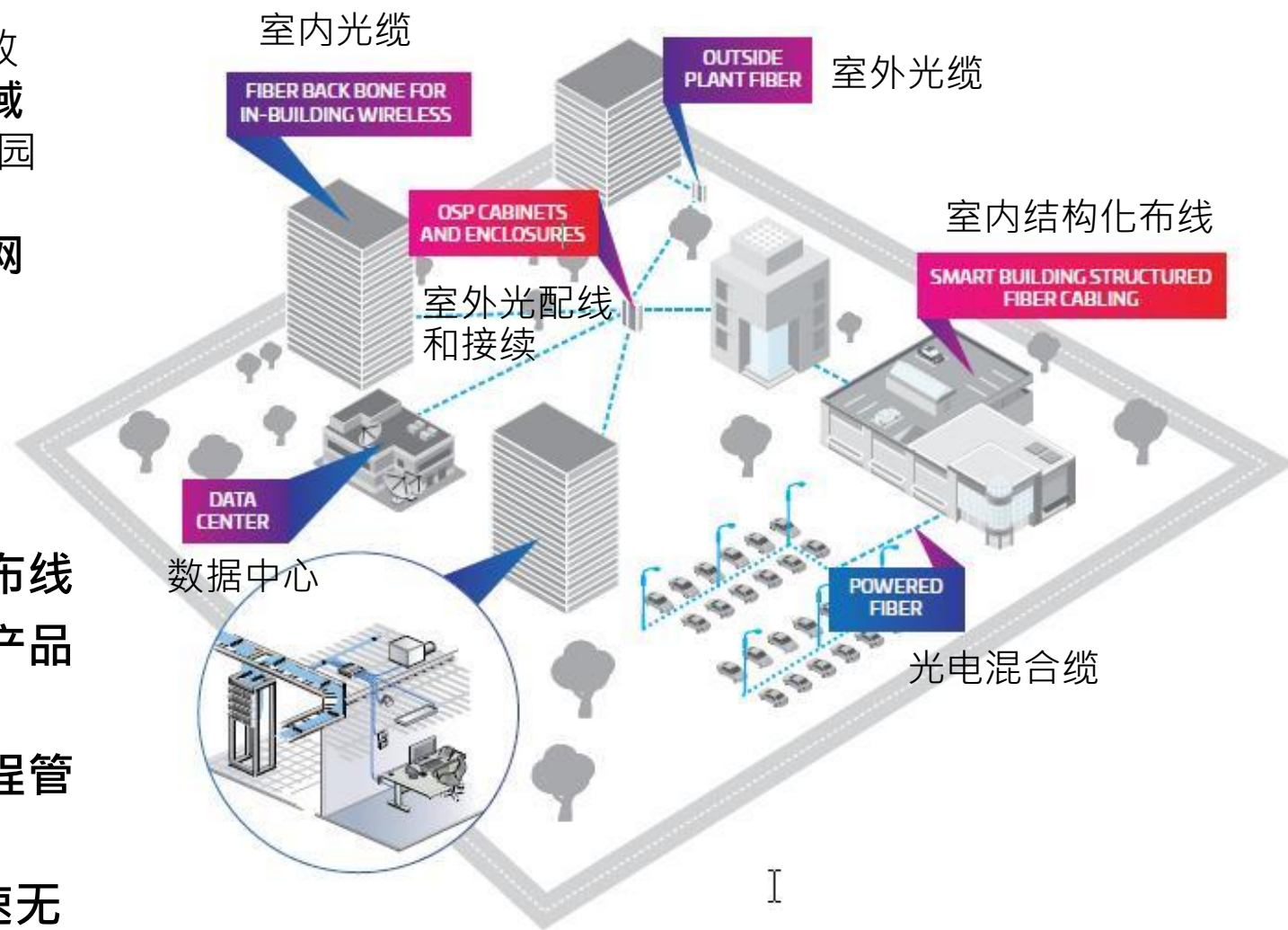
# 园区网光纤发展

# 园区定义及网络基础设施特点

园区网络是为专用局域网（LAN）或为公司、政府机构、大学或类似组织服务的一组互连的局域网LAN。典型的园区包含一些相邻的建筑物。园区网络中的最终用户比在单个LAN中更广泛地（在地理上）分散，但是他们通常不像在广域网（WAN）中那样分散。

## 园区网络基础设施特点：

- 包含园区室外、建筑物室内和数据中心布线
- 大量使用光纤传输，尤其单模，室外光产品投资占比较大
- 覆盖面积广，信息点多且分散，需要远程管理
- 一些远程区域需要部署PoE摄像机和高速无线覆盖

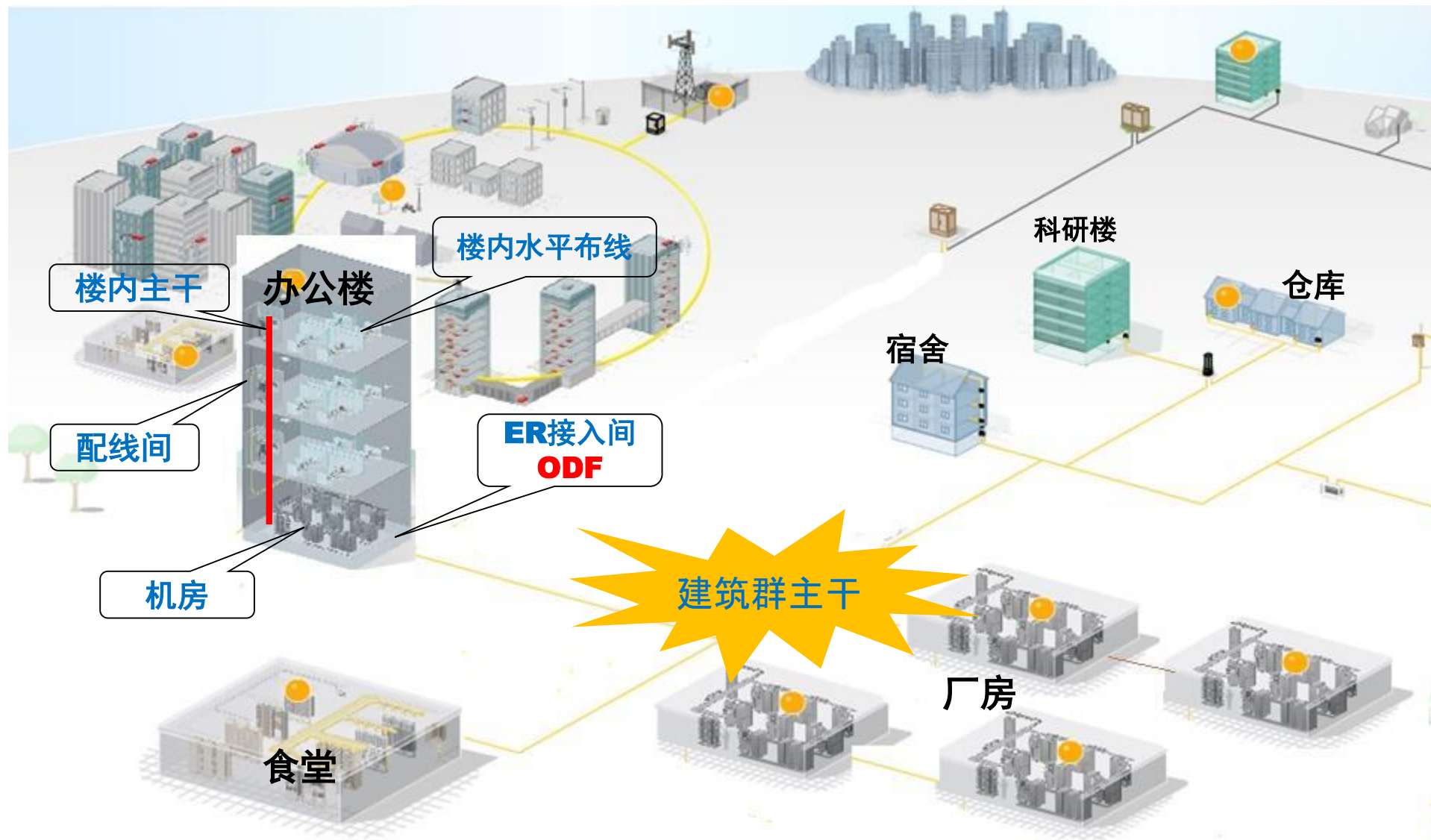






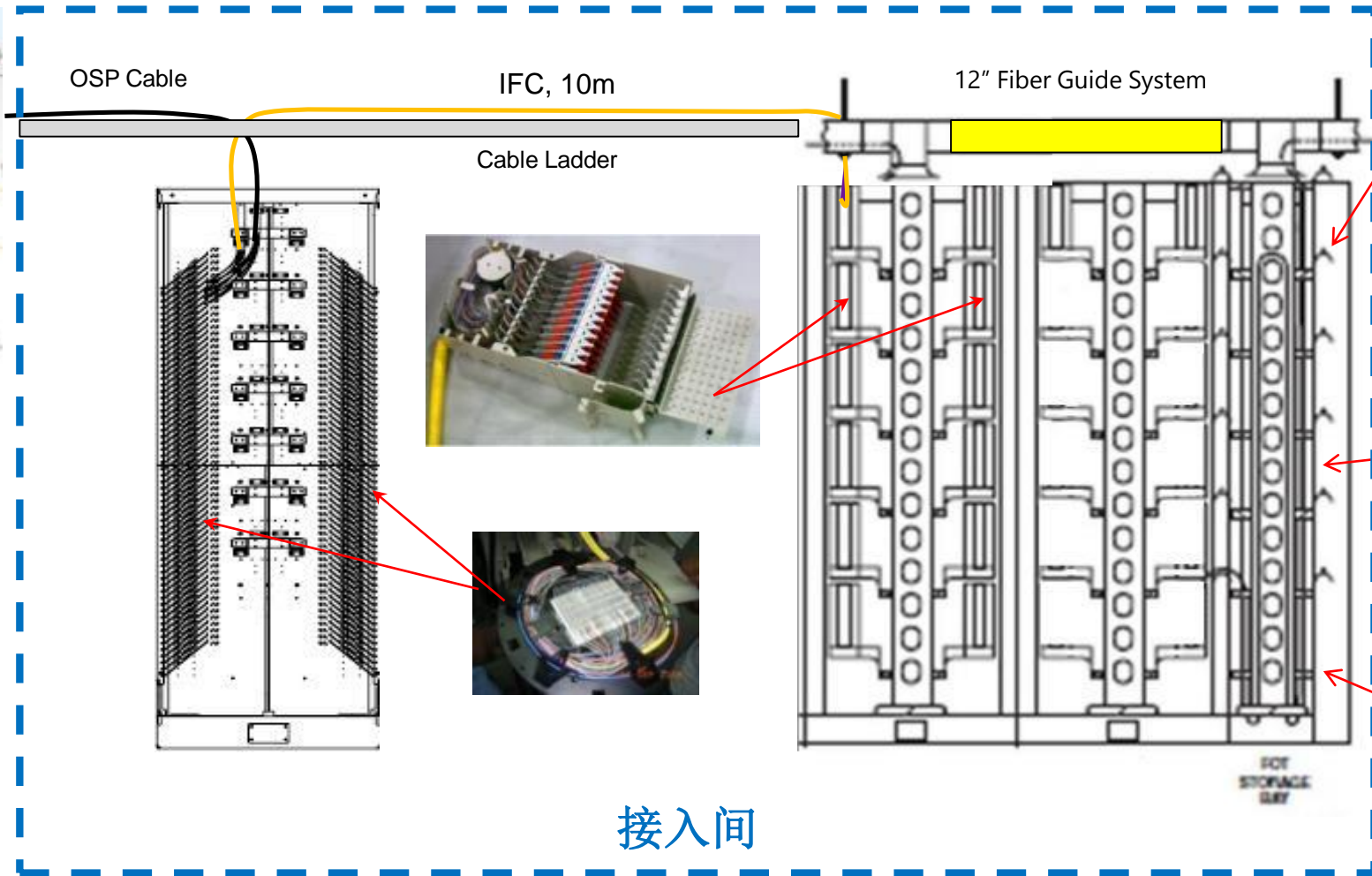
## 康普ODF光纤系统解决方案

# ODF应用在园区





# 园区项目ODF应用场景



外缆侧与机房侧分界清晰，便于日常维护和管理

# 康普大容量ODF光纤解决方案

## 安全

- 全程弯曲保护
- 光纤信号监控VAM模块

## 可维护

- 水平和垂直线缆管理
- 交错式适配器

## 高密度

## 快速部署

- 模块化，支持MPO，IFC预端接光缆
- 6米定长跳线，减少订货长度

## NG4

- 3456 LC / 机架
- 前后操作
- 符合GR-449 Issue 3
- 满足Seismic Zone 4 地震要求，抵抗8级地震



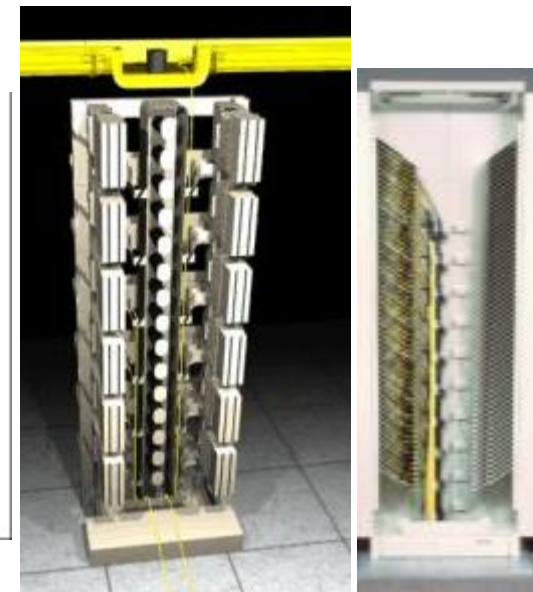
## FACT

- 2688 LC / 机架
- 可用于19寸标准机架也可配FIST GR3机架
- 前端操作
- 容易装卸



## NGF

- 2304 LC / 机架
- 前后操作
- 应用案例最多





# 中铁大桥局桥梁科技大厦



此项目位于湖北武汉市，建筑面积9.5万平方米、建筑总高度约100米，该大厦是集桥梁科技研发、办公、国际学术会议、桥梁科技博览和后勤服务等多种功能于一体的综合体。

- 数据点：3000点6A类UTP, 语音点：2000点Cat5e UTP
- 会议点：400点OS2单模光缆
- 光纤主干：OM5光缆\OFNP阻燃
- 机房汇聚：OMX+NGF高密度光纤配线系统



# ODF如何应用在中铁大桥局



NGF机架



NGF自带尾缆模块



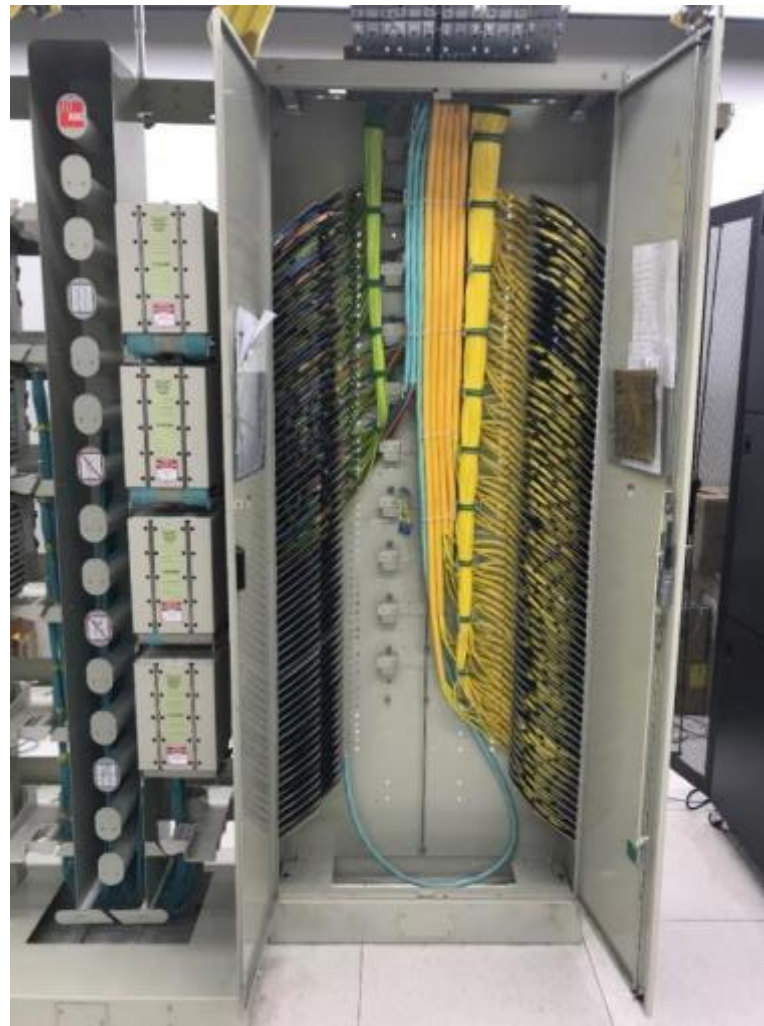
NGF模块上架



# ODF如何应用在中铁大桥局



NGF尾缆及大楼主干进入OMX柜



NGF尾缆与大楼主干在OMX内熔接

# ODF如何应用在中铁大桥局



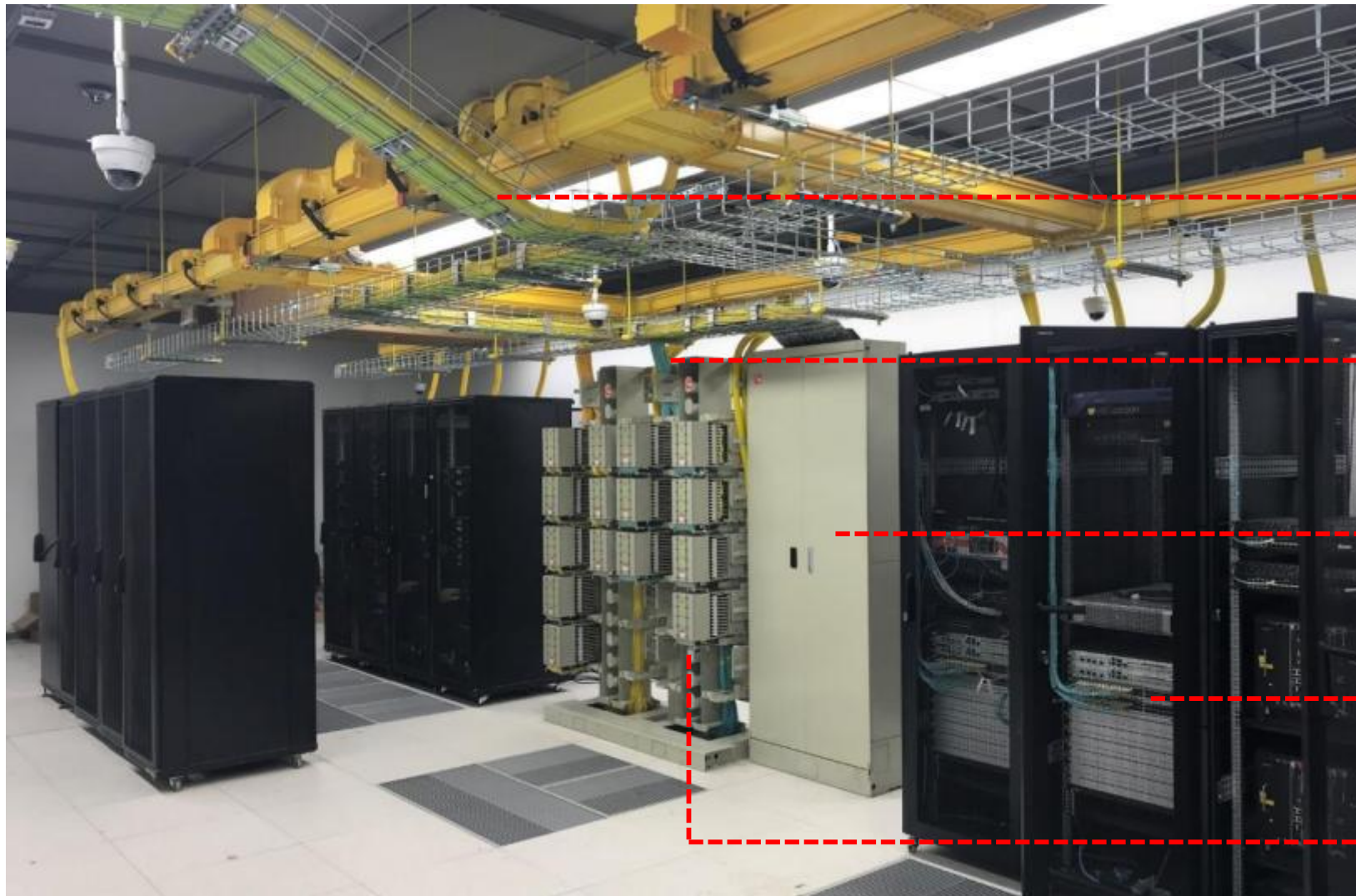
交换机端口通过长跳线



映射至NGF耦合器模块



# 大楼项目ODF应用场景



① 大楼主干&会议系统光缆进入OMX柜

② NGF模块自带尾缆进入OMX柜

③ 大楼光缆与NGF模块的尾缆在OMX柜内熔接

④ 交换机端口通过长跳线映射至NGF模块

⑤ 大楼光缆与交换机映射端口在NGF内进行交叉跳线

# 小结：康普ODF解决方案

- 高密度，大容量
- 熔配分离，工程界面清晰
- 全开放结构，有利于管理和维护
- 相同长度跳线
- 跳纤路由清晰
- 标准模块/增值模块

跨越的机架数量	跳线长度（米）
1	6
2至3	7.5
4至5	9
6至7	10.5
8至9	12

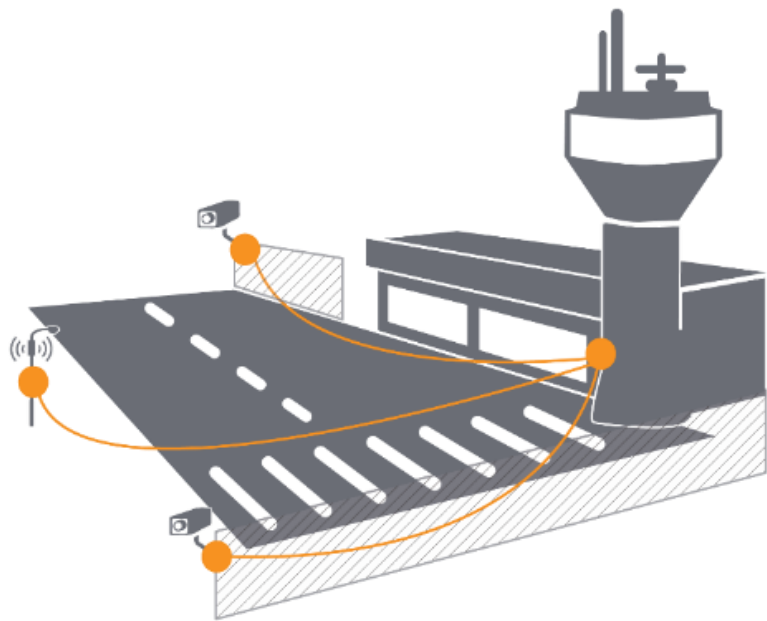


A decorative graphic consisting of a large purple rectangle on the right and a blue triangle on the left that points towards the purple rectangle. The text 'Powered Fiber System' is centered within the purple area.

Powered Fiber System

# 康普光电混合缆系统解决方案

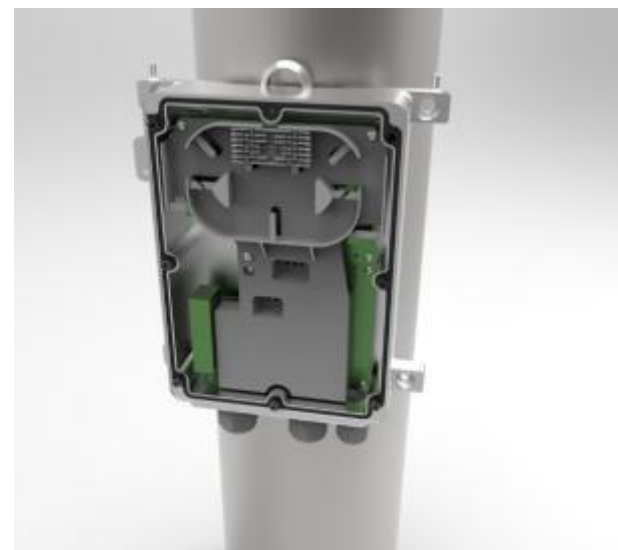
- 可以给远程的PoE设备，例如摄像头、Wi-Fi AP提供PoE供电和数据通信
- 混合电缆（光纤 + 直流供电铜缆）、PoE扩展器和直流供电电源
- 6类及以上铜缆跳线连接至终端PoE设备
- 可支持最高60W功率的PoE终端设备



机场



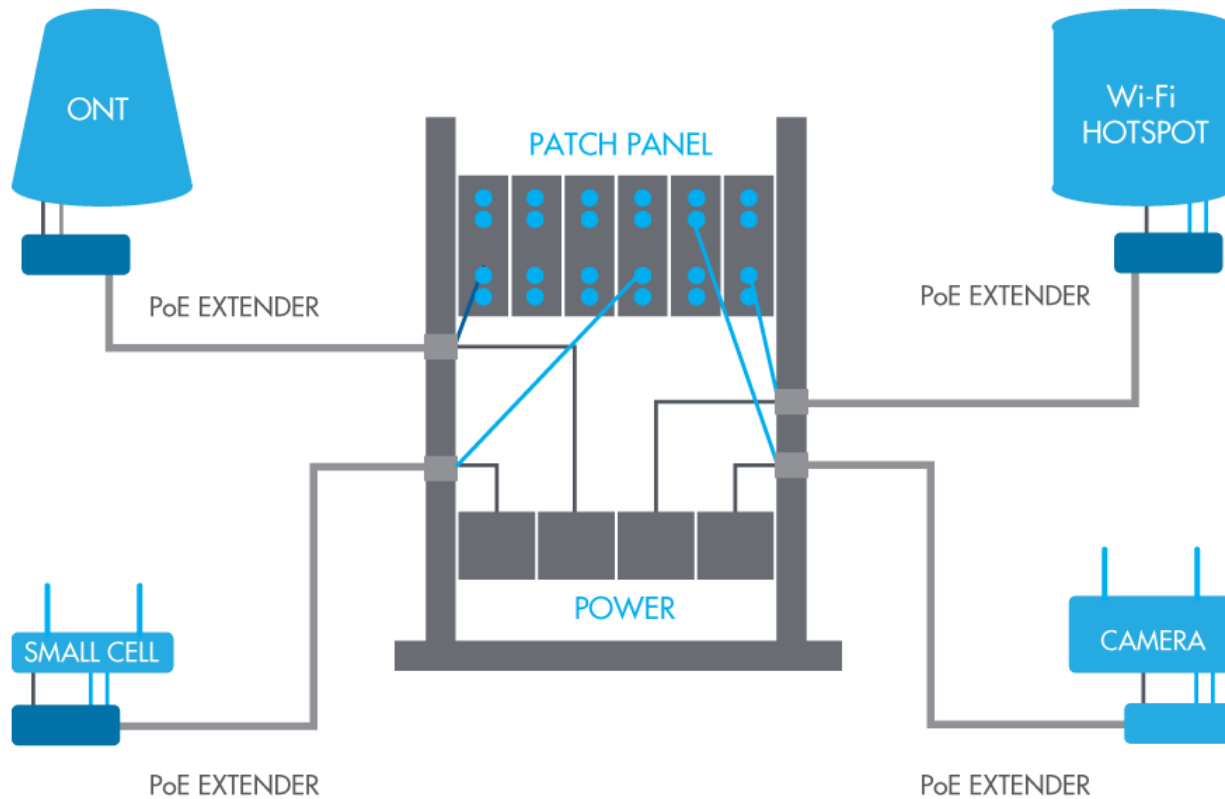
园区





# 康普光电混合缆系统

在一根线缆中提供完整简单的通信及供电解决方案。例如高清摄像头，Wi-Fi 热点、小型基、ONT（光网络终端）设备等。



## 目标

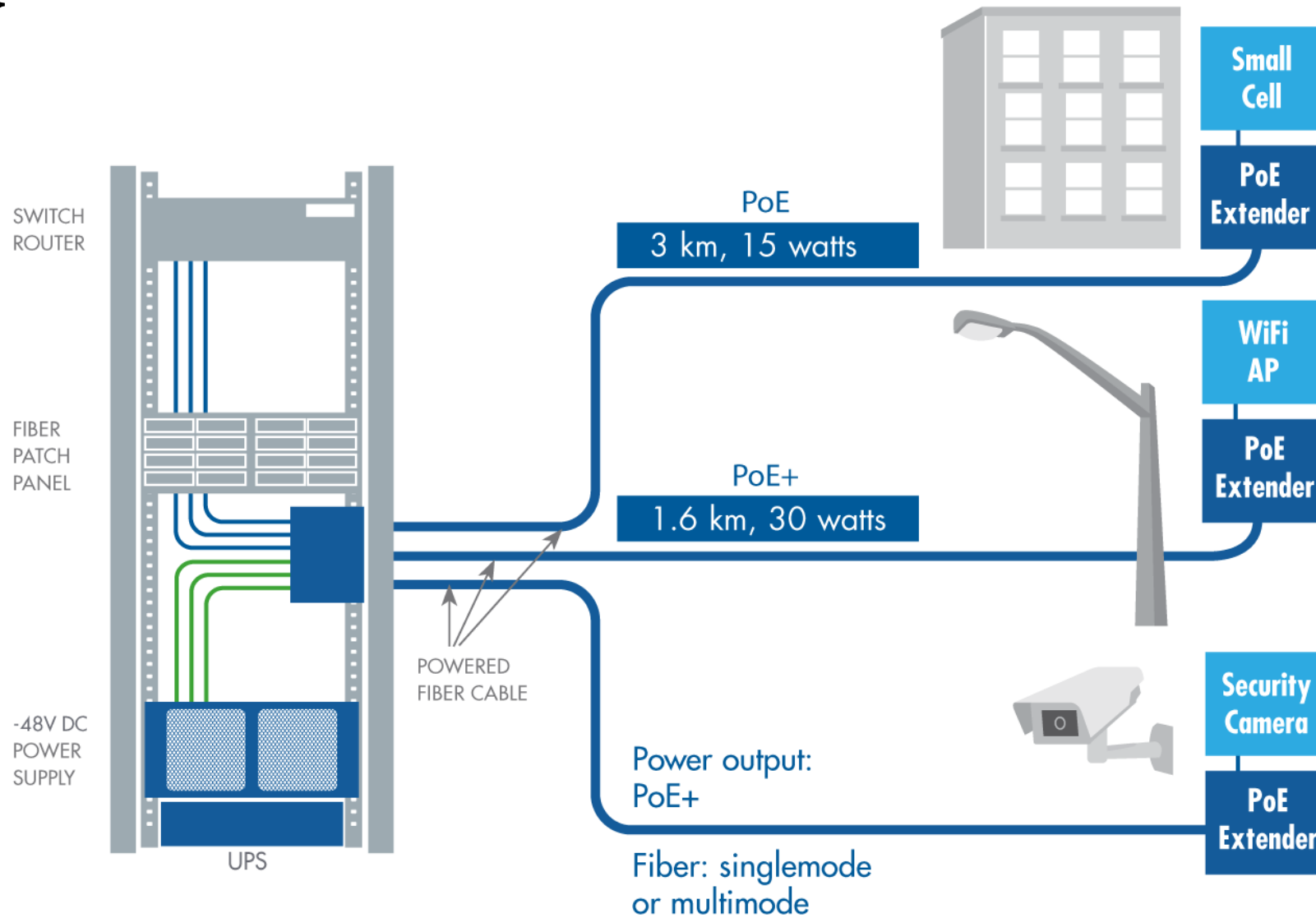
整个系统在外部看来只是延长了系统的距离，对系统功能无任何的影响。

## 系统组件：

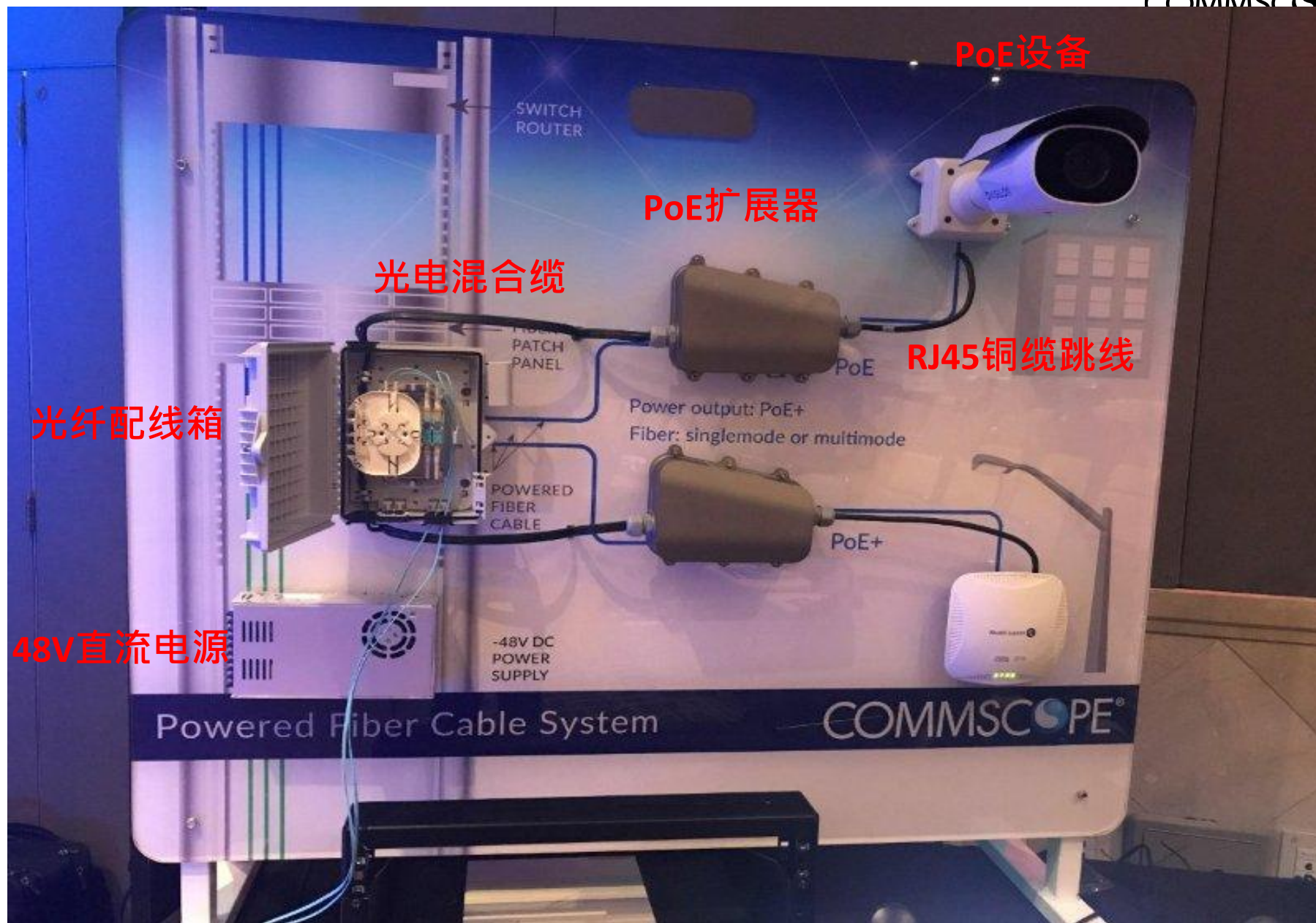
- 光电混合缆
- PoE 扩展盒
- 光纤，电源管理
- 供电系统



# 系统框架



# 系统框架





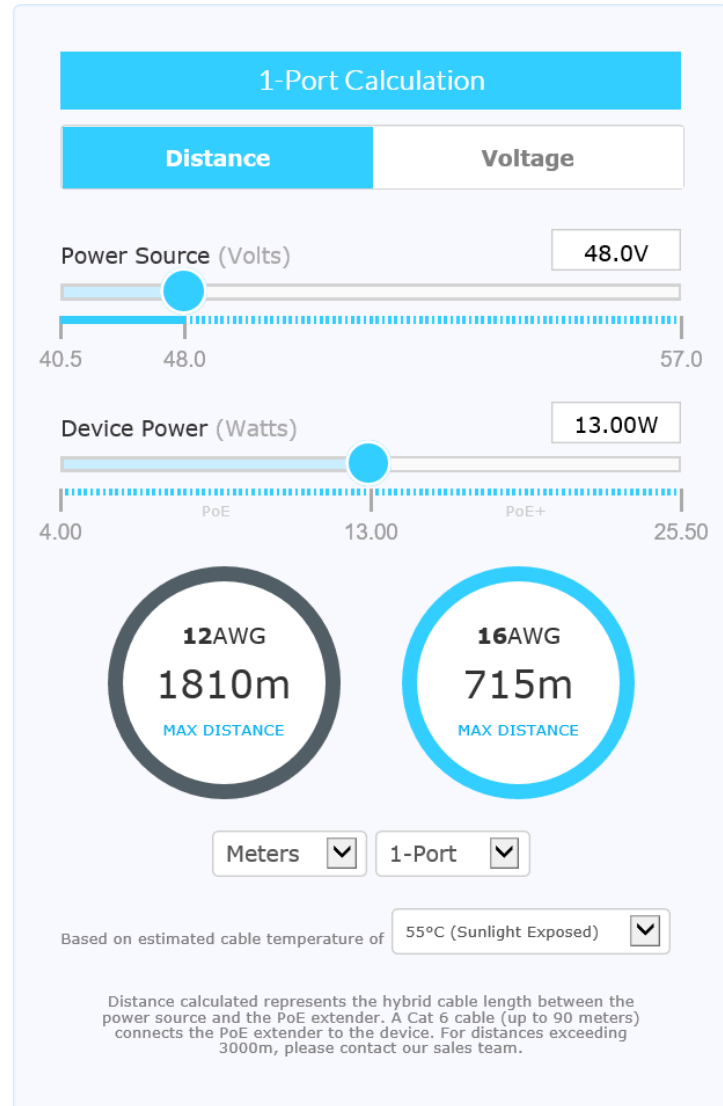
# 康普光电混合缆成功案例

- 澳大利亚国防部
- QLD 大学
- Central QLD 大学
- James Cook 大学
- Perth Stadium 体育场
- Adelaide 大学
- Wolf Blass Wines 酒庄
- Flinders 大学
- Adelaide 市议会
- Christchurch 市议会
- Department of Infrastructure & Transport  
澳洲基础设施及交通部
- 新西兰议会



# PoE Distance and Voltage Calculator

To determine the maximum distance or input voltages configurable with your PoE and PoE+ devices, move the slider with your mouse or type in the variables in the boxes on the right.



康普官网提供计算工具可以帮助您根据**PoE**设备的功率快速地计算出系统能够支持的最长距离

POE与智能管理



# Cat.6A同时适用于智能建筑和数据中心

## Building

Prevalence of Cat 6A  
NBASE-T Support  
Low Voltage Infrastructure  
Internet of Things / Sensors  
HDBASE-T

Cat 5e

Cat 6

Cat 6A

Cat 8

100M

1G

2.5G

5G

10G

25G

40G

End of Row Connectivity  
Top of Rack Connectivity

# Category 8 and 25G/40GBASE-T

## Data Center Application for End/Middle of Row



Unified industry support around Category 8 for 25G/40GBASE-T Standards in TIA and ISO/IEC are being developed around:

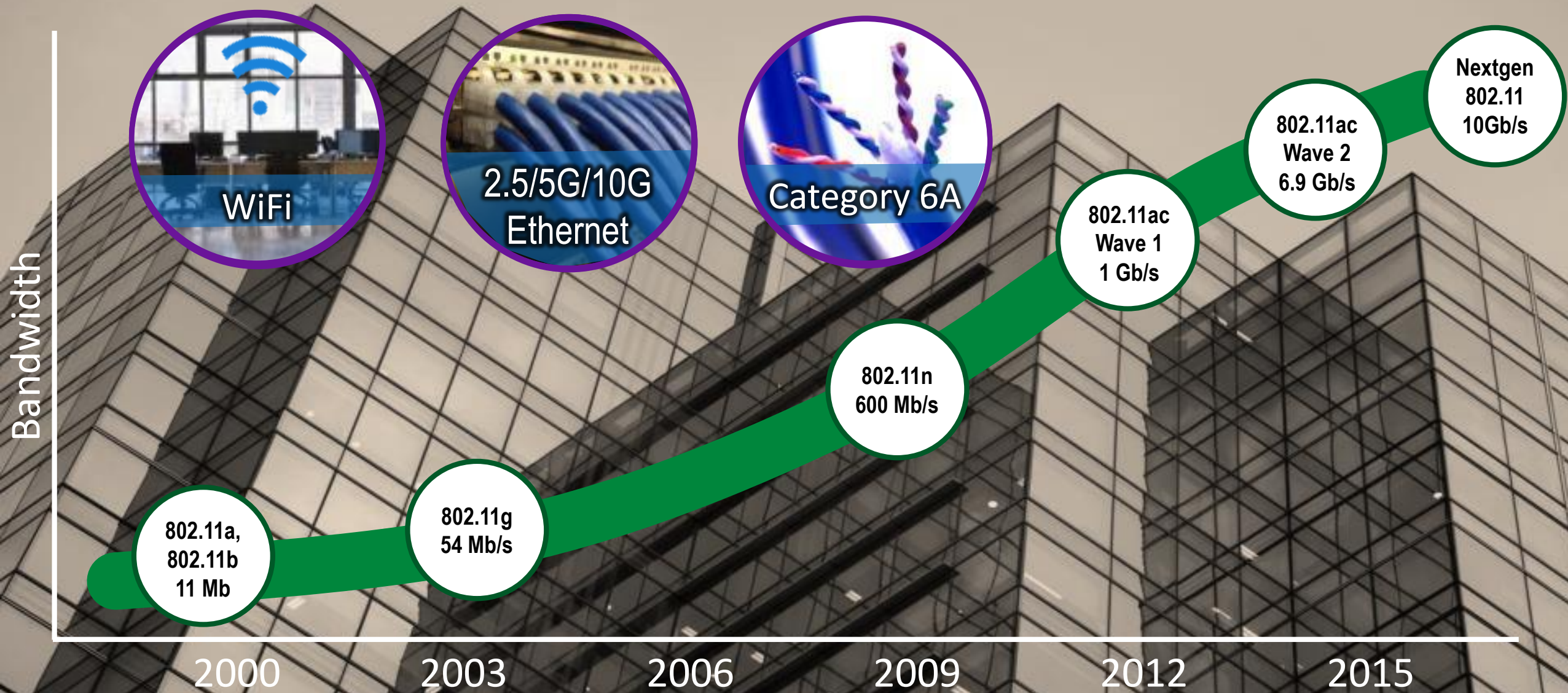
- 30-meter length
- 2-connector channel
- Bandwidth specified up to 2 GHz

# 高性能铜缆的两大驱动力

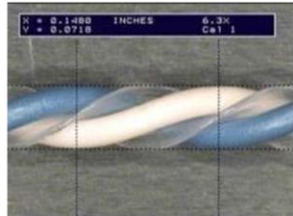




# WiFi 的演进



# ISO/IEC 的风险分析



ISO/IEC TR 11801-9904 风险评估表

## Class D (Cat 5e)

Bundled Distance	Speed	Victim Length		
		1 m to 20 m	20 m to 75 m	75 m to 100 m
Up to 20 m	2.5G	Low	Low	Low
	5G	Low	Low	Medium
20 m to 75 m	2.5G	N/A	Low	Medium
	5G	N/A	Medium	High
75 m to 100 m	2.5G	N/A	N/A	Medium
	5G	N/A	N/A	High

## Class E (Cat 6)

Bundled Distance	Speed	Victim Length		
		1 m to 20 m	20 m to 75 m	75 m to 100 m
Up to 20 m	2.5G	Negligible	Low	Low
	5G	Negligible	Low	Low
20 m to 75 m	2.5G	N/A	Low	Low
	5G	N/A	Medium	Medium
75 m to 100 m	2.5G	N/A	N/A	Medium
	5G	N/A	N/A	High

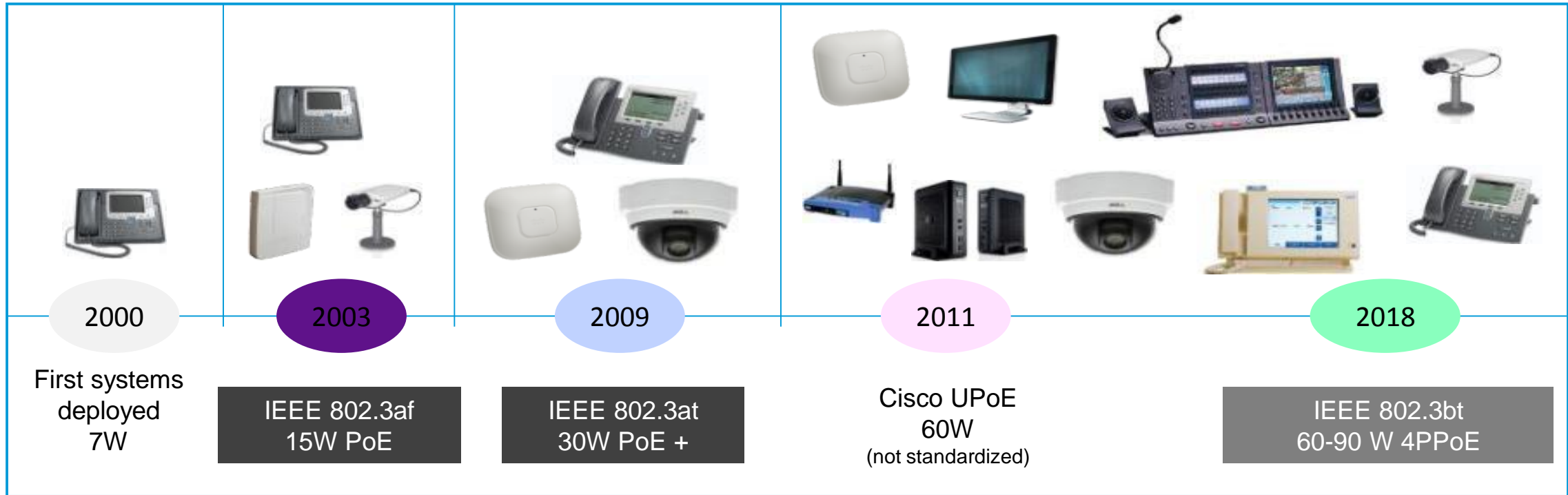
## Class E<sub>A</sub> (Cat 6A)

Bundled Distance	Speed	Victim Length		
		1 m to 20 m	20 m to 75 m	75 m to 100 m
Up to 20 m	2.5G	None	None	None
	5G	None	None	None
20 m to 75 m	2.5G	N/A	None	None
	5G	N/A	None	None
75 m to 100 m	2.5G	N/A	N/A	None
	5G	N/A	N/A	None

更高的网络带宽和远程供电的需求驱动了6A类布线系统的部署

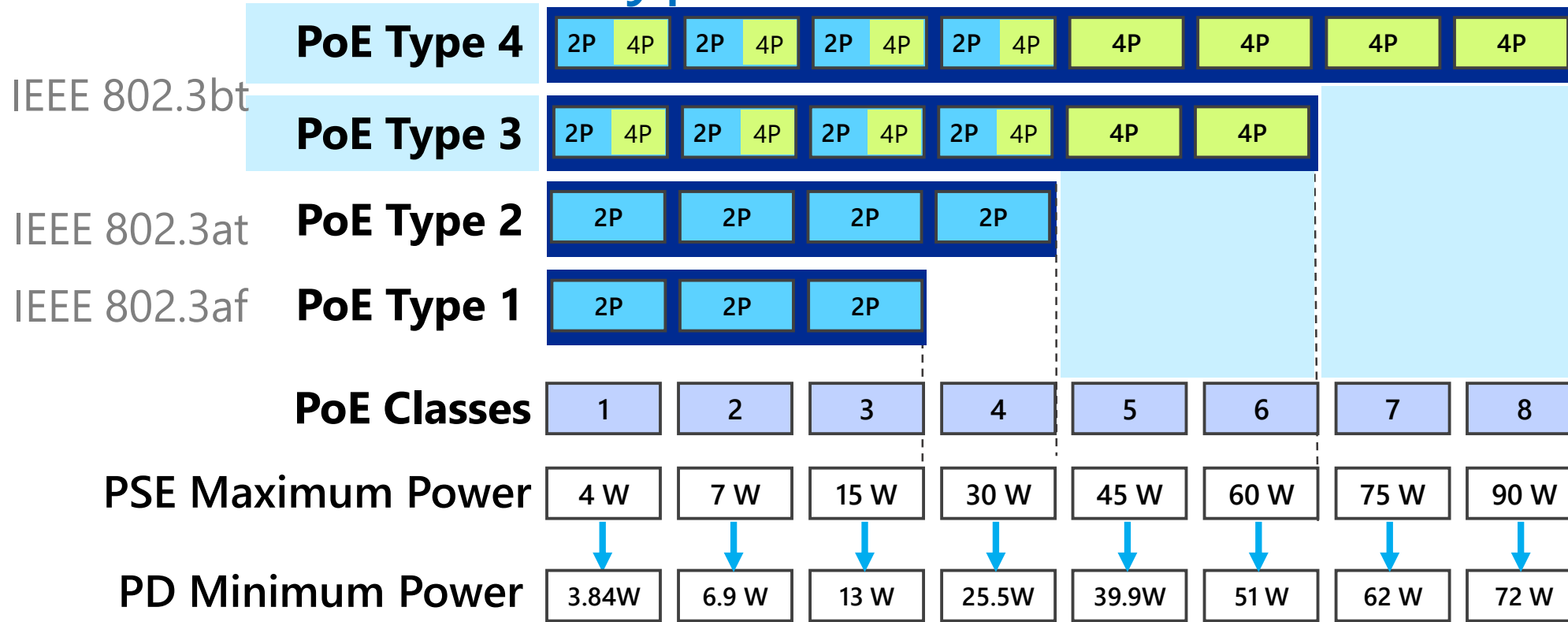


# IEEE 802.3 POE的演进



	IEEE 802.3af PoE PD Type 1	IEEE 802.3at PoE + PD Type 2	Cisco UPOE	IEEE 802.3bt 4PPoE PD Type 4
Output voltage (Vdc)	36-57	42.5-57	42.5-57 (implied)	42.5-57
Output Current (mAdc)	350	600	1200	1920
Power @ PD (Watts)	12.95 (max)	25.5 (avg)	51 (max)	72 (max)
Power @ PSE (Watts)	15 (max)	30 (max)	60 (max)	90 (max)
Pairs Used	2-pr	2-pr	4-pr	4-pr

# IEEE 802.3bt PoE Types and Classes

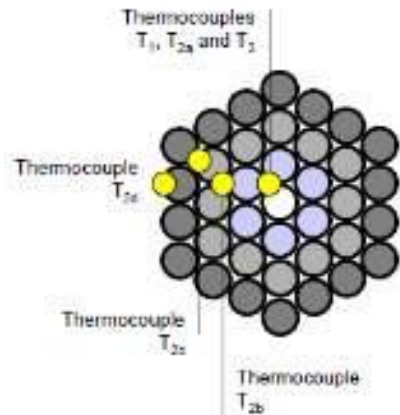


Maintain Power Signature (MPS)

Autoclass

Power Demotion

Support for 2.5G/5G/10Gbps



Open Air



Supported Tray



Open Conduit



Conduit w/ Sealed Ends

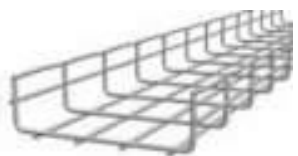
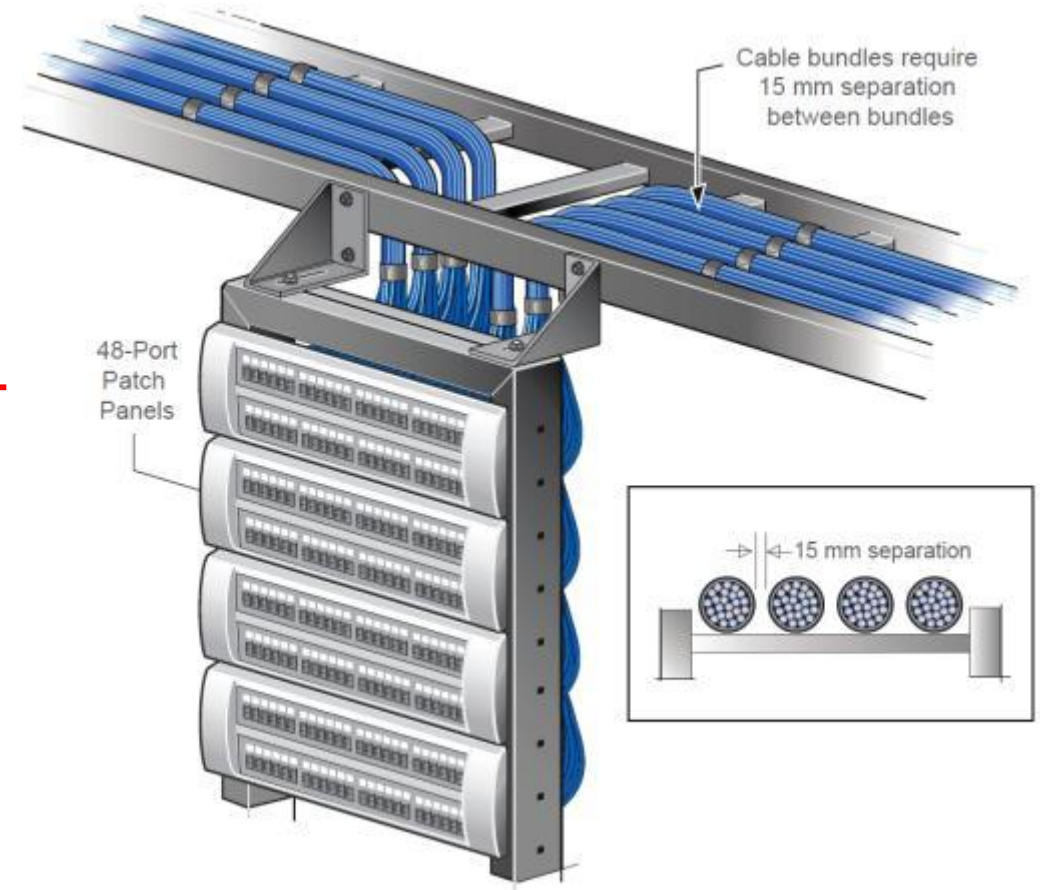
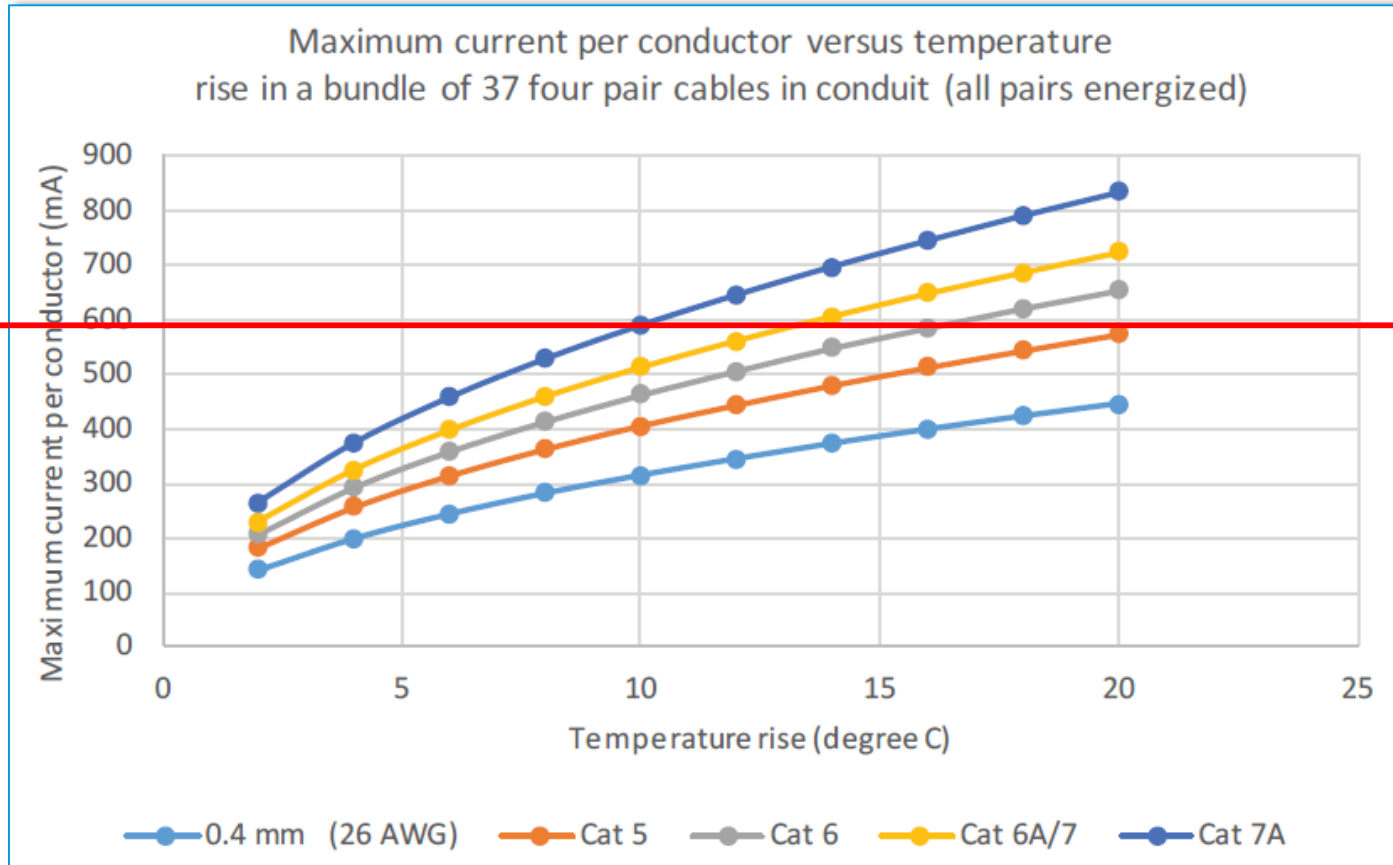


Table 16- Technology-independent channel length vs. temperature

$T_{global}$ (°C)	Total length of cords (m)		
	10	15	20
	Channel length (m)		
20	100	98	95
25	98	96	93
30	97	94	91
35	95	92	89
40	93	90	87
45	90	87	85
50	86	84	82
55	83	81	79
60	80	78	76

NOTE: The channel length values assume the use of cords with an attenuation premium of 50% and an overall temperature coefficient of 0,4 % per °C up to 40 °C and 0,6 % per °C between 40 °C and 60 °C

# 以太网供电PoE的发展和布线安装考虑



ISO / IEC TR 29125 和 TIA-184A 提供热模式和铜缆捆绑指南  
(每捆最多推荐24根双绞线铜缆)

PoE 的发展在智能楼宇内驱动了6A类布线系统的采用



# POE应用下的注意事项

- 双绞线上的产生的热量 = 电流<sup>2</sup> x 电阻
- 在持续传输电流的影响下，捆扎的线缆数量越多，可预见的PoE传输时的线缆温度升高越多
- 线缆温度的增高会导致信道衰减和插入损耗的性能下降
- 线缆的温度升高可能会超过双绞线缆正常的工作温度





# Multigigabit Ethernet Cabling

Would Multigigabit Ethernet require new cabling infrastructure?

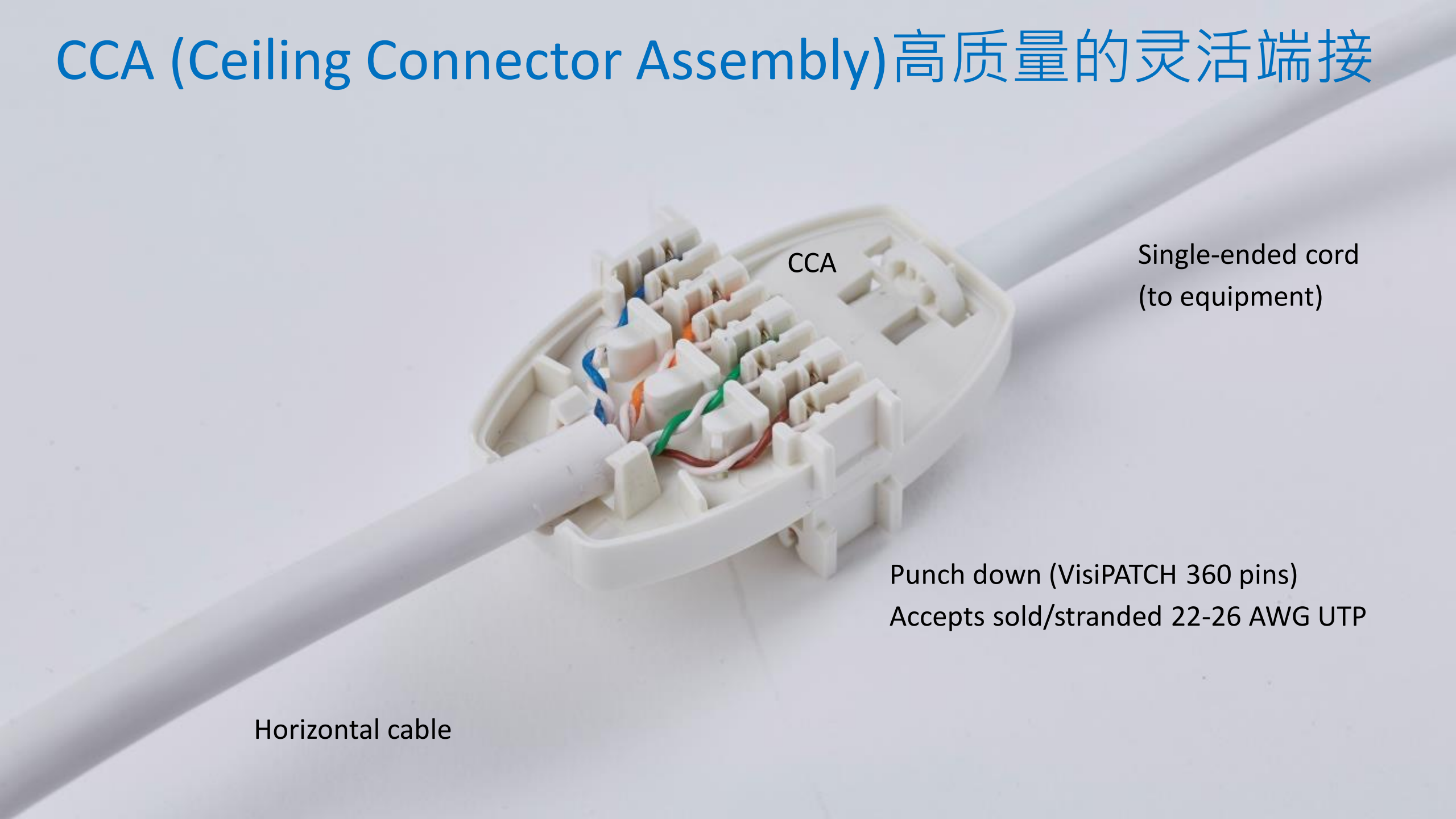


## Answer

**Cat6  
a**

- 1 Gbps
- 2.5 Gbps
- 5 Gbps
- 10Gbps

# CCA (Ceiling Connector Assembly) 高质量的灵活端接



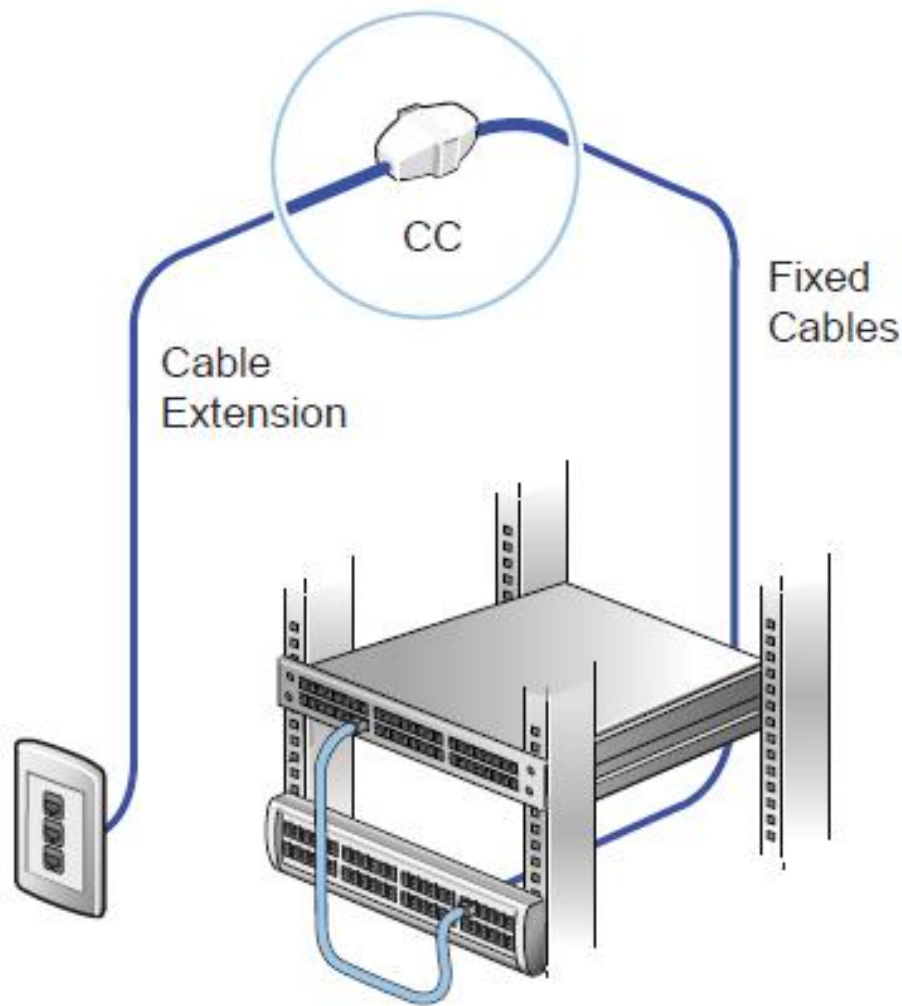
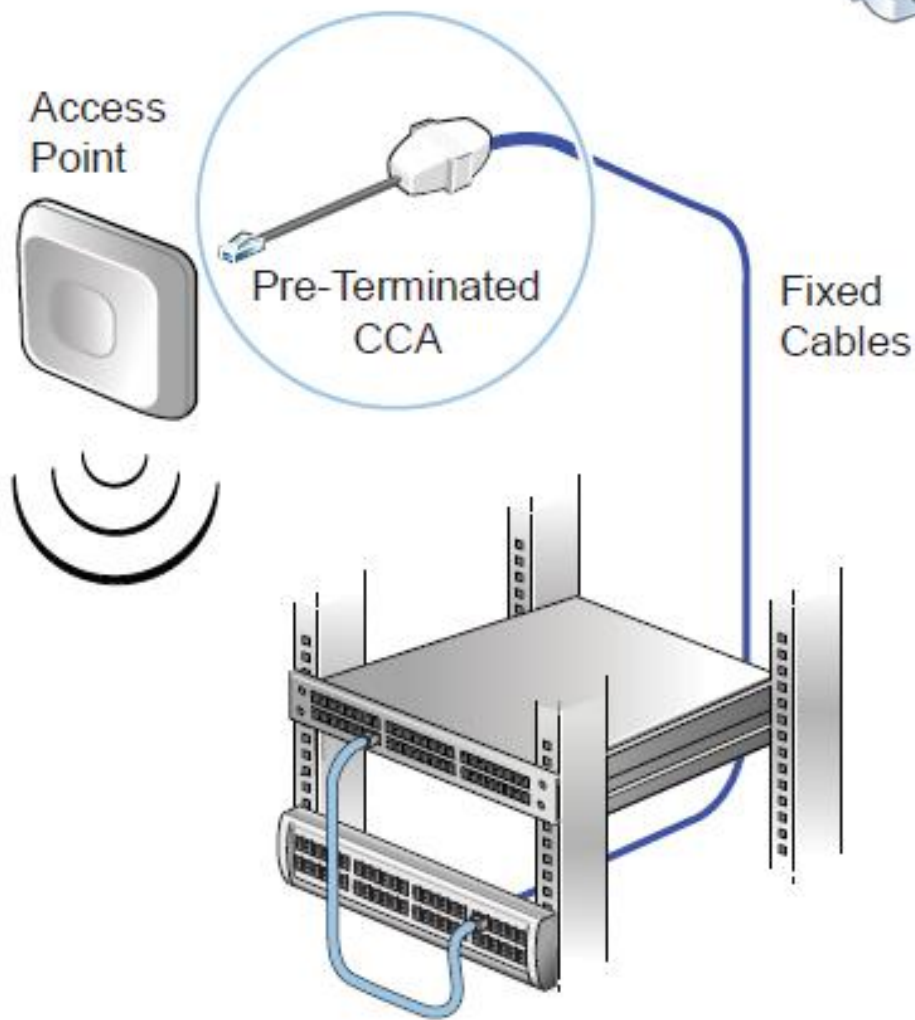
CCA

Single-ended cord  
(to equipment)

Punch down (VisiPATCH 360 pins)  
Accepts solid/stranded 22-26 AWG UTP

Horizontal cable

# CCA的应用场景



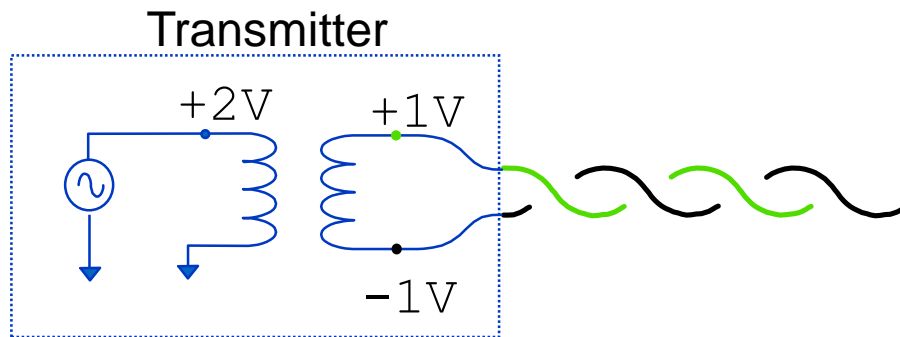
铜缆安装

# 施工注意事项

- 避免电缆进水、高湿度、化学品腐蚀和在低温下弯折电缆
- 铜缆的布放和工作温度范围在  $-4^{\circ}\text{F}$  到  $140^{\circ}\text{F}$  ( $-20^{\circ}\text{C}$  到  $60^{\circ}\text{C}$ ) 之间，在布放之前应将电缆在室温下放置至少4小时。
- 电缆的绑扎应比较松，使绑扎带可以在电缆卷中滑动
- 不建议将电缆编成带状
- 电缆的布放不应造成电缆护套的明显变形
- 对于4对线的电缆，最大拉力不应超过110N ( 25磅 )
- 保证一定的弯曲半径，避免死弯。4对线的铜缆的最小弯曲半径是电缆直径的四倍，柔软铜缆跳线的最小弯曲半径是跳线线径的一倍。
- 应避免将线对去扭绞或分离开，保持线对的绞距直至电缆末端并避免缠绕。

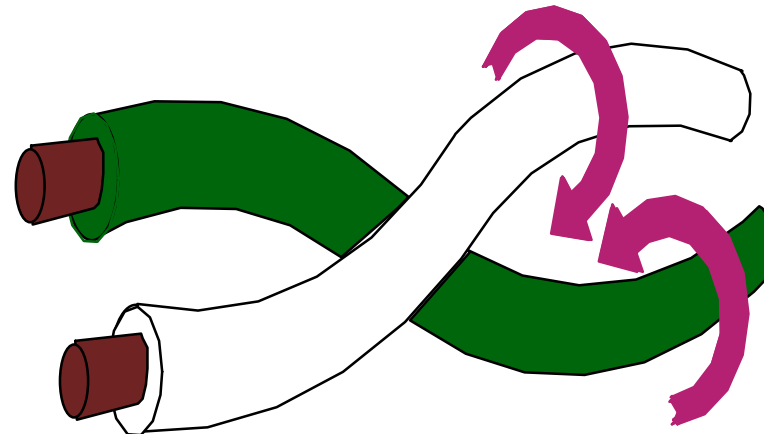


# Balanced Signalling

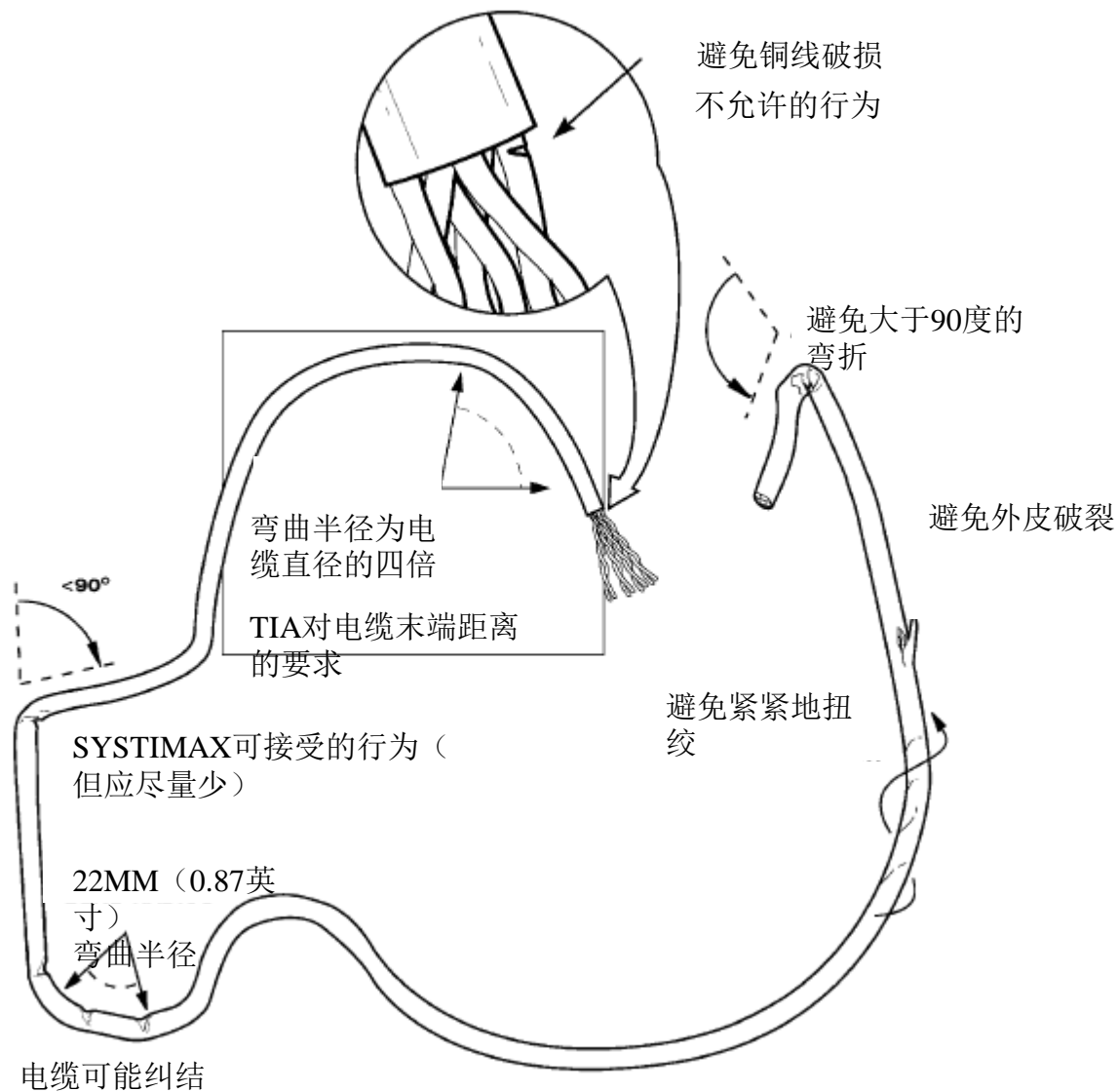


Transmitters and Receivers 'transform' the signals to a twisted pair

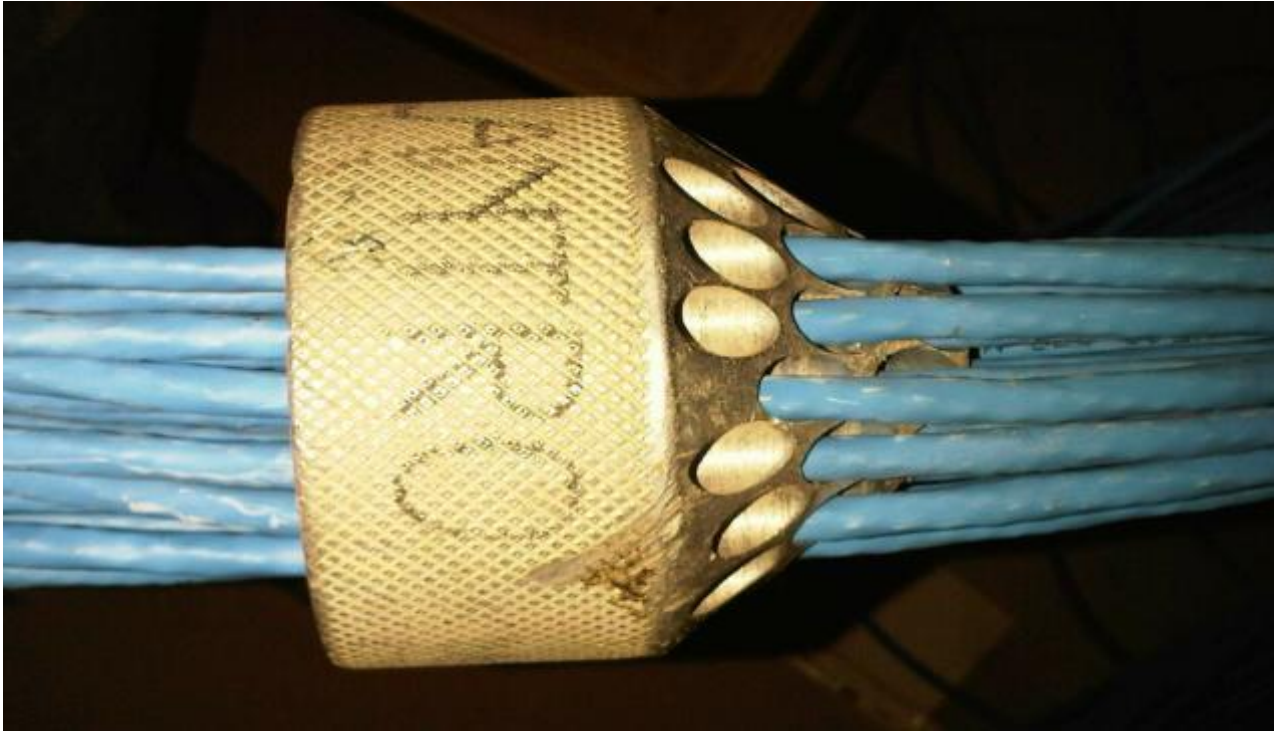
- **Some energy is lost in the creation of counter rotating magnetic fields**

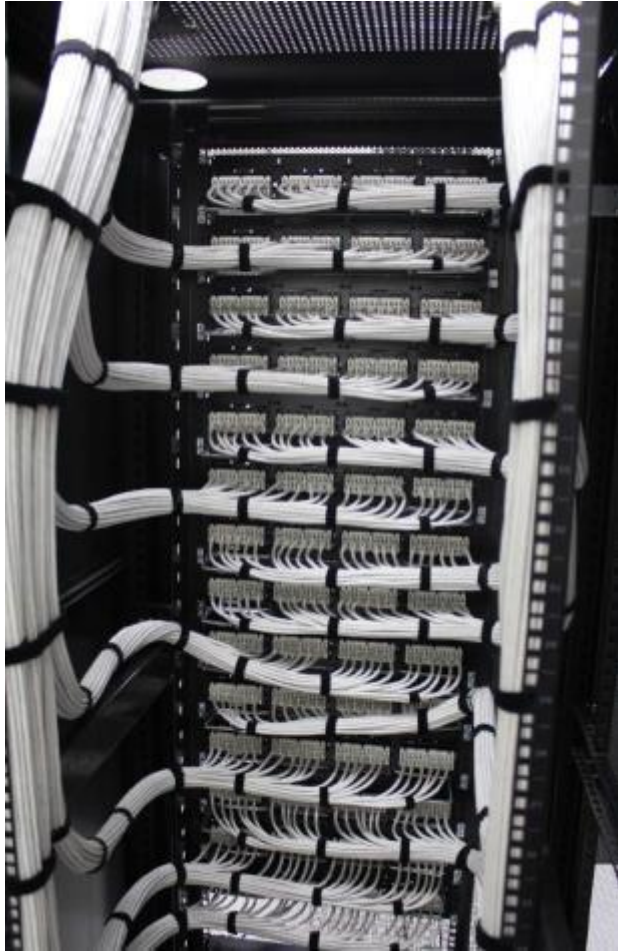


# 线缆敷设



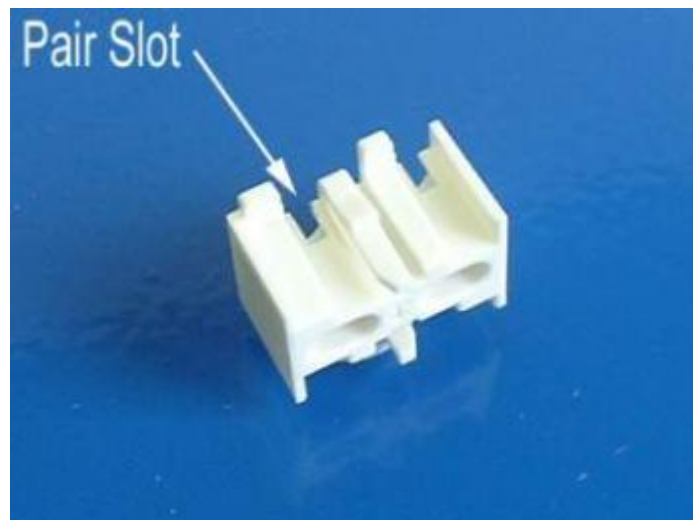
# 线缆敷设







# 四对线缆安装



- 注: 线对槽口the pair slot refers to the cut in each 'pair guide'
- 线对用指定的方式被折进线槽

- 蓝对/橙对 '彩色线在上面'
- 棕对/绿对 '白线在上面'
- 若需要加一个扭





## 新的端接管理器用于6类和万兆的各种铜缆配线架



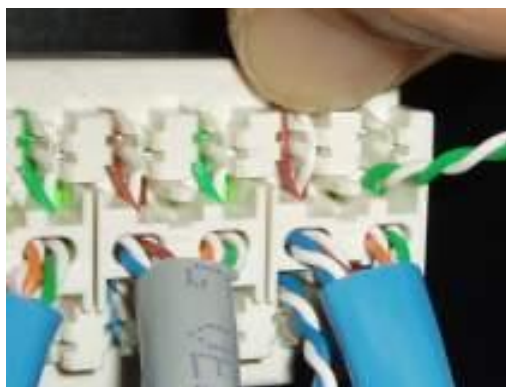
穿入线对



固定在线槽



卡入到位



打开线对



打线



完成

COMMSCOPE®



AIM

# imVision® 智能系统简单的结构

➤ 智能化铜缆光缆配线架 **Evolve**



➤ 管理单元



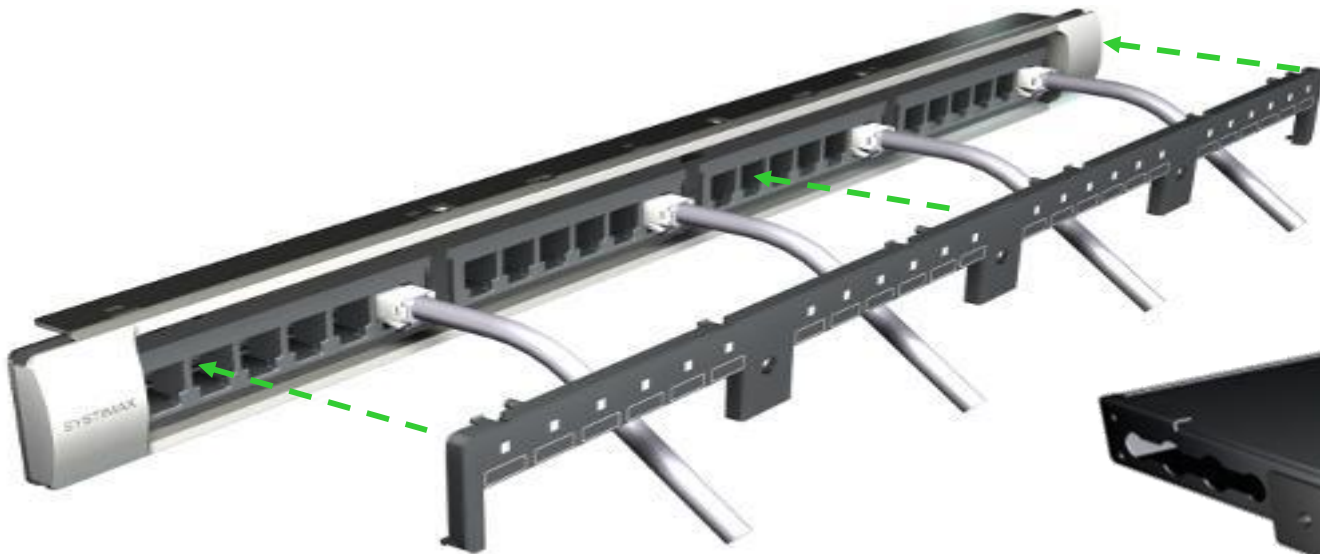
➤ 智能管理软件 v7



# 升级到智能化只是简单的 1-2-3 步骤




- ❖ iPatch配线架和光纤箱是“准智能”设计
  - 第1步. 剥除面板上的标签
  - 第2步. 装上升级套件
  - 第3步. 接上iPatch总线并确认连接信息

在线升级  
Zero Breakdown!



**网络不会有任何停顿!**  
**跳线不需要拔插!**

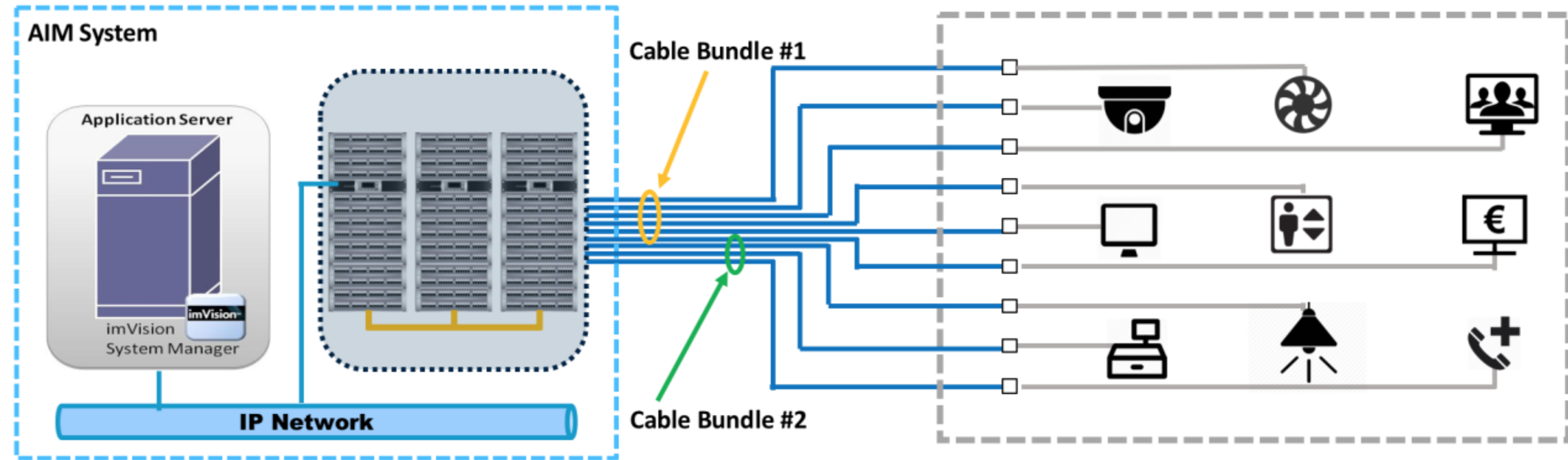
# 融合平台进一步推进POE的管理

			
<b>Automated Infrastructure Management</b>	<b>ISO/IEC 18598 *</b>	<b>ANSI/TIA-5048</b>	<b>EN 50667</b>
<b>Planning, installation, operation</b>	<b>ISO/IEC 14763-2</b>	<b>ANSI/TIA-606-C</b>	<b>EN 50174-2</b>

\* 2017 WG3 同意在AIM标准中增加对 PoE的支持



# Automated Infrastructure Management for PoE Planning and Monitoring



# SNMP support for collecting PoE data from Switches



PoE Data	Cisco	HP	Juniper	Extreme	ATI	H3C
PoE port Status	Green	Green	Green	Green	Green	Green
PD Class	Green	Green	Green	Green	Green	Green
Nominal PoE/switch	Green	Green	Green	Green	Green	Green
PoE in use/switch	Green	Green	Green	Green	Green	Green
PoE Allocation Method	Green	Green	Yellow	Green	Yellow	Green
PoE type/port	Green	Green	Green	Green	Green	Yellow
PoE Allocated by PSE/port	Green	Green	Yellow	Yellow	Yellow	Yellow
PoE in use /port	Green	Green	Yellow	Green	Yellow	Yellow

# Collect PoE data from Switches/Cards



In line with TIA/EIA 606C

- PoE Capable (PSE):
- PoE Type
- PoE Ports
- Ports with PoE In Use
- PoE Total Capacity (W)
- PoE Allocated Capacity (W)
- PoE Remaining Capacity (W) = PoE Total - PoE Allocated

% of Occupied ports - Switch SW01

100%

% of PoE in Use ports for Switch SW01

29%

% of Consumed PoE Capacity for Switch SW01

13%

# Populate PoE Data into AIM Software (imVision)

COMMSCOPE<sup>®</sup> imVision<sup>®</sup> System Manager

admin | Log Out ?

Search Site Manager

Site Manager Administration Tools Reports

Site: 1:1 Rack 001

- Commscope\_Z1\_SW3
  - Panel 01
    - sw611E1-56.4.vwm
      - Card 01
      - Card 02
      - Card 03
      - Card 04
      - Card 05
      - Card 07
      - Card 08
      - Panel 02
      - Switch 03
    - Room Alg3&44
  - Building Chang
  - Building Colin
  - Building Demo
  - Building HP
  - Building Jarry
  - Building Jim
  - Building Luke
  - Building Nettie
  - Building Selina
  - Building Shenyang

Contents of Card 01

Type	Name	Position	Port Status	Link Status
01	01	1	Available	Up since 2017-07-27 at 11:03:34
02	02	2	Available	Down since 2017-07-27 at 11:03
03	03	3	Available	Up since 2017-07-27 at 11:03:34
04	04			
05	05			
06	06			
07	07			
08	08			
09	09			
10	10			
11	11			
12	12			
13	13			
14	14			
15	15			
16	16			
17	17			
18	18			
19	19			
20	20	20	Available	Up since 2017-07-27 at 11:03:34
21	21	21	Available	Up since 2017-07-27 at 11:03:34
22	22	22	Available	Up since 2017-07-27 at 11:03:34

Properties

Description

Serial Number\*

TPR Link\*

Project Number\*

Misc Note(s)

Port /Link Status	PoE Status
Enabled (link Up)	in use
Enabled (link Up)	not in use
Enabled (link Up)	disabled
Enabled (link down)	not in use
Enabled (link down)	disabled
Disabled	Not in Use
Disabled	disabled

Ports with PoE in Use: 15

PoE Total Capacity (W): 682

PoE Allocated Capacity (W): 115

PoE Remaining Capacity (W): 567

# Show Cable List for each Cable Bundle (imVision)



COMMSCOPE® imVision® System Manager

admin Log Out ?

Search Site Manager

Site Manager Tools Reports

In line with TIA/EIA 606C

Bundle ID	Number of Cables	Number of PoE Cable	PoE Consumption (W)	PoE Allocated (W)	Highest PoE Type
BundleID-001	11	2	30.8	30.8	15.4 W, Type 1
BundleID-002	10	0	0	0	
BundleID-003	25	0	0	0	

Cable Bundle Details for BundleID-001

10.211.55.4/systemmanager/Aspx/cablingbundledetail.aspx?bundleid=1&bundlename=QnVuZGxISUQtMDAx&userid=2

Rack	Panel	Port	PoE Consumption	PoE Allocated	PoE Type	Switch IP	Device Name	Cabled To
1:2 Rack 002	Panel 01	01	15.4	15.4	15.4 W, Type 1	10.0.0.223	WAP 01	Room 01/Faceplate 01/01-A
1:2 Rack 002	Panel 01	02				---	---	Room 01/Faceplate 01/01-B
1:2 Rack 002	Panel 01	03				---	---	Room 02/Faceplate 02/02-A
1:2 Rack 002	Panel 01	04				---	---	Room 02/Faceplate 02/02-B
1:2 Rack 002	Panel 01	05				---	---	Room 03/Faceplate 03/03-A
1:2 Rack 002	Panel 01	06	0	0	15.4 W, Type 1	10.0.0.223	imvisionsm	Room 03/Faceplate 03/03-B
1:2 Rack 002	Panel 01	07				---	---	Room 04/Faceplate 04/04-A
1:2 Rack 002	Panel 01	08	15.4	15.4	15.4 W, Type 1	10.0.0.223	Q Controller 01	Room 04/Faceplate 04/04-B
1:2 Rack 002	Panel 01	09				---	---	Room 05/Faceplate 05/05-A
1:2 Rack 002	Panel 01	10				---	---	Room 05/Faceplate 05/05-B
1:2 Rack 002	Panel 01	11				---	---	Room 06/Faceplate 06/06-A



# AIM应用视频

[..\..\2015COMMSCOPE\PRESENTATION\2014 roadshow\ipatch video\imvision-one button.avi](#)

[..\..\2015COMMSCOPE\PRESENTATION\2014 roadshow\ipatch video\imvison alert.avi.avi](#)

[..\..\2015COMMSCOPE\PRESENTATION\2014 roadshow\ipatch video\imvision order.avi](#)

[..\..\2015COMMSCOPE\PRESENTATION\2014 roadshow\ipatch video\imvision device.avi](#)

# 康普 imVision<sup>®</sup> 智能管理系统在园区中的部署

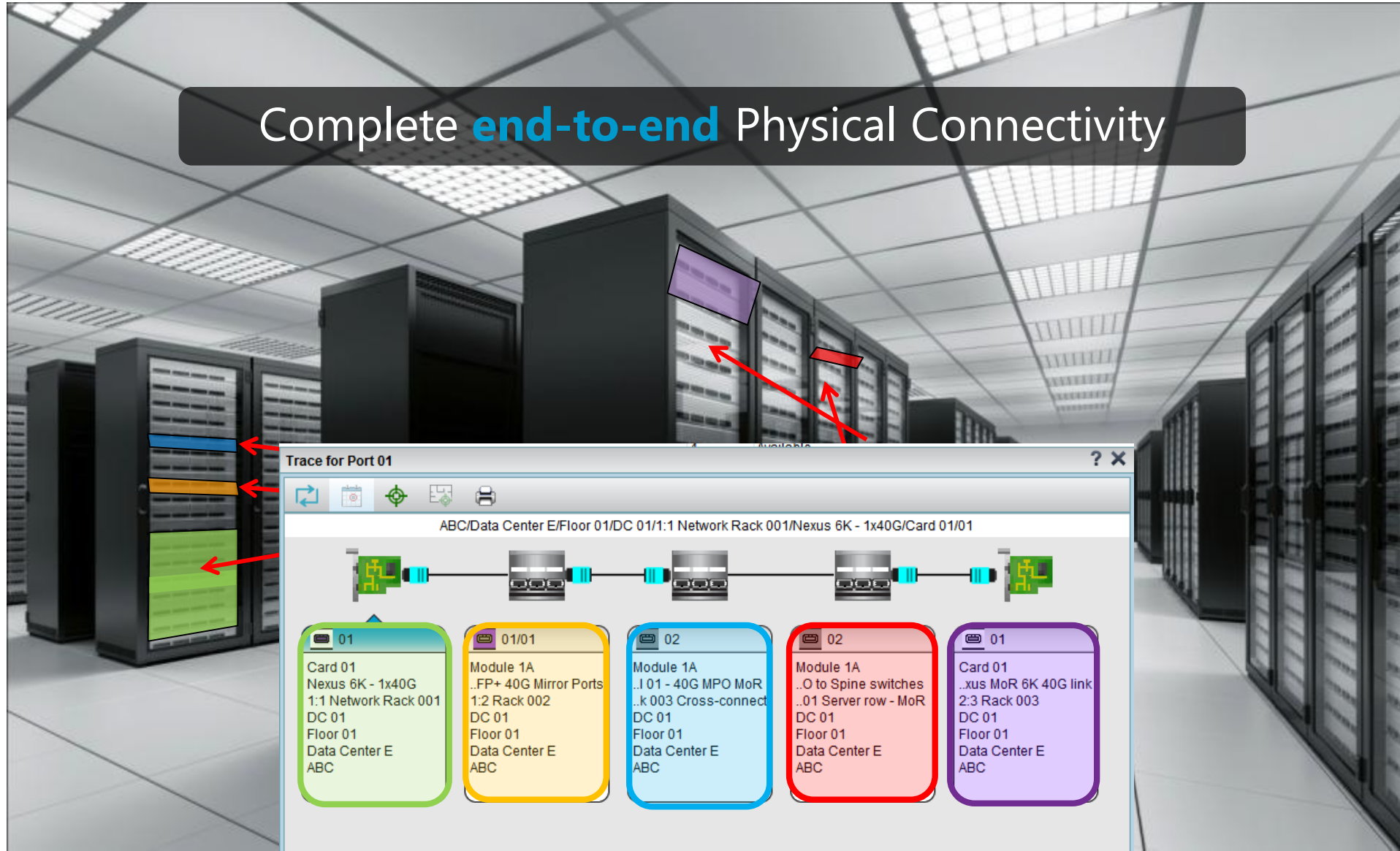
COMMScope<sup>®</sup>



电子工单  
事件通知  
远程管理

# 40G Physical Connectivity Map - Example

Complete **end-to-end** Physical Connectivity

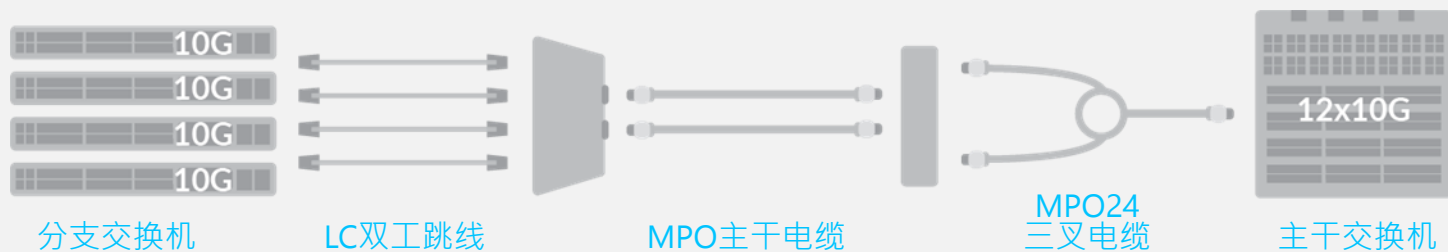




# imVision 核心优势

1. 标准跳线
2. 在线升级
3. 现场触摸屏
4. 支持MPO及高密度

## 5. POE支持



全球安全线缆标准



# 不同标准的侧重点不同，建立基础不同

## 美国UL标准

阻燃（强制通风）  
(CMP)

斯泰纳风洞(UL910)装置



CMP: 增压级，主干或强制通风环境中使用

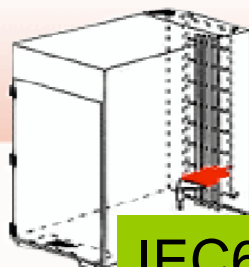
非助燃(CMR、  
CM、CMG)



CMR: 干线级，水平及主干用  
CM: 商用级，水平铺设电缆  
CMG: 通用级，水平铺设电缆

## 欧洲标准

LSZH or LSOH



IEC60332-3



IEC60332-1

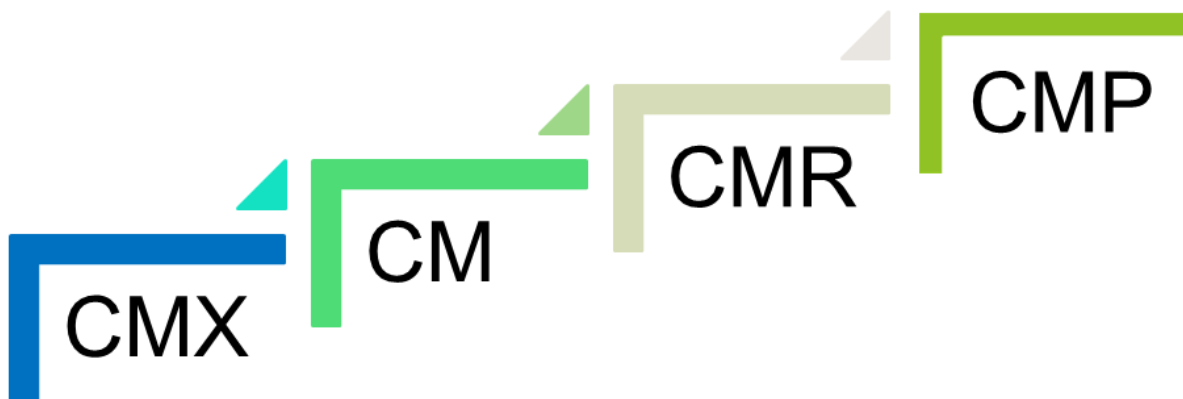
国家标准  
GB31247-2014

电缆及光缆燃烧性能分级  
-公安部消防局  
FIPEC实验



# OFNP/CMP在美国占据主导市场

## UL定义的阻燃等级



家居级	商用级	干线级	增压级
单根垂直燃烧	成束垂直燃烧	成束垂直燃烧	成束风道燃烧
UL 1581 VM1	UL1581	UL1666	UL910
	等同IEC 60332-3		EN 50339-2 HIFT



# CPR 欧洲新标准介绍 (EN 50575:2014)

## -以垂直燃烧为基础



Class	Fire safety	Classification criteria (mandatory)					Additional classification (optional)
		Flame spread (EN 50399)	Total Heat Release	Peak Heat Release Rate	Fire Growth Rate	Flame spread (EN 60332-1-2)	
B2ca		≤ 1,5 m	≤ 15 MJ	≤ 30 kW	≤ 150 Ws <sup>-1</sup>	≤ 425 mm	Smoke production (s) Flaming droplets (d) Acidity (a)
Cca		≤ 2,0 m	≤ 30 MJ	≤ 60 kW	≤ 300 Ws <sup>-1</sup>		
Dca			≤ 70 MJ	≤ 400 kW	≤ 1300 Ws <sup>-1</sup>		
Eca		Minimum fire performance classification					
Fca		Not advisable for public places					



Two other classes (A and B1) are not applicable to LSZH data and telecommunication cables.

Environment	Country A	Country B	Country C
Hospitals	B2ca	B2ca	Cca
Airports	Cca	B2ca	Cca
Commercial premises	Cca	Cca	Dca
Residential	Fca	Dca	Eca

### Class Dca, s2, d1, a1

Fire performance class: Dca  
Application to cables: s2, d1, a1

- Acidity rating
- Droplets rating
- Smoke rating

Subclassification	Smoke opacity	Droplets	Acidity
3: s3, a3		N/A	
2: s2, d2, a2			
1: s1, d1, a1			
0: d0	N/A		N/A

# 议程

- 数据中心发展趋势及标准
- 园区网技术发展
- POE ( 铜缆 )
- 智能化管理
- 安全线缆标准

谢谢！

[jwu@commscope.com](mailto:jwu@commscope.com)

吴健

美国康普北亚区技术总监

中国数据中心工作组专家技术委员会专家委员

中国工程标准化协会综合布线工作组副组长