[News] Mapping the Micro LED Optical Interconnect Ecosystem

[新闻] 绘制 Micro LED 光互连生态系统图谱

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As AI data centers continue to scale, power consumption and bandwidth bottlenecks in chip-to-chip interconnects are becoming increasingly difficult to address. Against this backdrop, Micro LED-based co-packaged optics (CPO) is emerging as a promising alternative.

随着 AI 数据中心的持续规模化，芯片间互连的功耗和带宽瓶颈正变得日益难以解决。在此背景下，基于 Micro LED 的共封装光学（CPO）正成为一种极具前景的替代方案。

By replacing traditional high-speed serial architectures with a “wide-and-slow” parallel optical approach, the technology transmits data through hundreds of low-speed optical channels operating simultaneously.

该技术通过采用“宽且慢”的并行光路方案取代传统高速串行架构，利用数百个同时运行的低速光通道传输数据。

This architecture eliminates the need for several power-hungry components—including DSPs, ADC/DACs, and CDRs—reducing energy consumption to just 1–2 pJ/bit. Overall system power is targeted at roughly 5% of that required by copper-cable solutions.

这种架构消除了对多种高功耗组件的需求——包括 DSP、ADC/DAC 和 CDR——将能耗降低至仅 1–2 pJ/bit。系统总功耗目标约为铜缆解决方案所需功耗的 5%。

In addition, Micro LED arrays can integrate more than 400 channels within a footprint of less than 1 mm², offering a compact structure, high reliability, and reduced sensitivity to temperature fluctuations.

此外，Micro LED 阵列可在不足 1 mm² 的面积内集成超过 400 个通道，不仅结构紧凑、可靠性高，而且对温度波动的敏感度更低。

Although transmission distances are currently limited to less than 10 meters, Micro LED CPO is well suited to scale-up interconnects within AI server racks—a use case that neither copper cables nor silicon-photonics-based CPO can fully address.

尽管目前的传输距离限制在 10 米以内，但 Micro LED CPO 非常适用于 AI 服务器机架内的扩展互连——这是铜缆和基于硅光子的 CPO 都无法完全满足的应用场景。

As a result, the technology has attracted growing interest from global technology leaders and semiconductor companies, triggering a wave of partnerships and ecosystem-building efforts.

因此，这项技术日益受到全球科技巨头和半导体公司的关注，引发了一波合作与生态系统构建的热潮。

Global Players Race to Define the Micro LED CPO Market

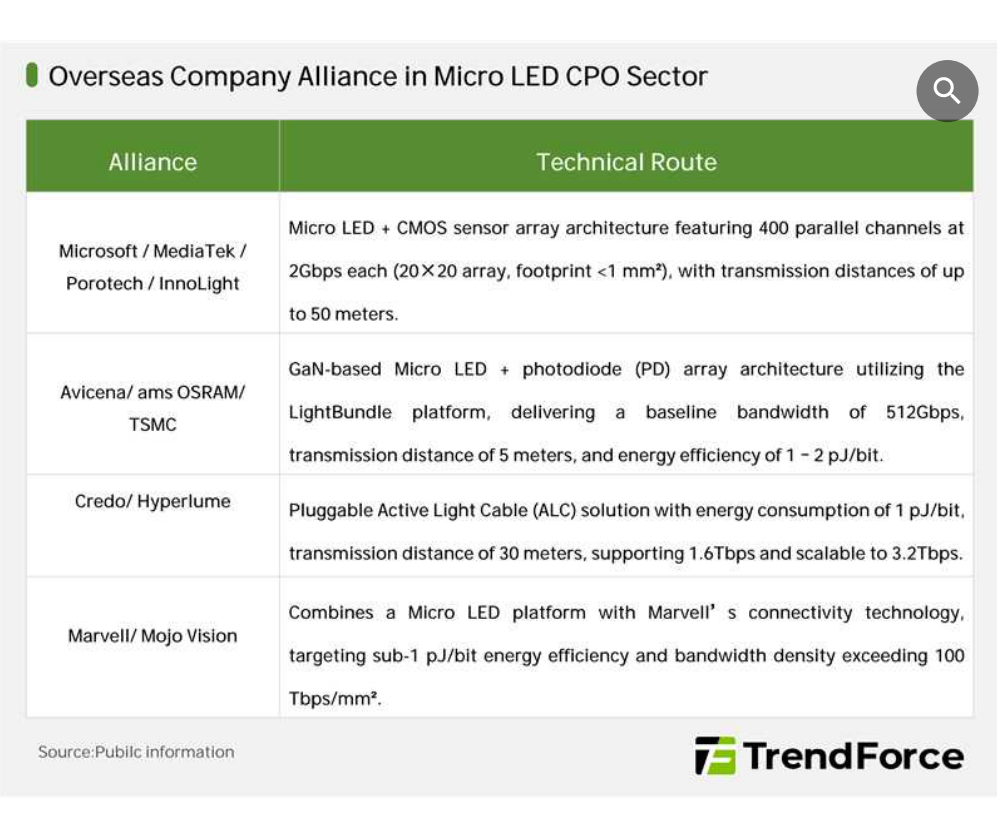
全球厂商竞相定义 Micro LED CPO 市场

The Micro LED CPO industry remains in an early stage, with standardization efforts progressing alongside technical development. Key specifications—including chip dimensions, per-channel data rates, transmission distances, and whether receivers should use photodiodes (PDs) or CMOS sensor arrays—have yet to be finalized.

Micro LED CPO 行业仍处于早期阶段，标准化工作与技术发展同步推进。关键规格——包括芯片尺寸、单通道数据速率、传输距离以及接收端应使用光电二极管（PD）还是 CMOS 传感器阵列——尚未最终确定。

In this context, competition today centers on influencing future standards, with alliances and resource integration emerging as the preferred strategy. Early participants range from major technology companies such as Microsoft and Marvell to startups including Avicena and Hyperlume.

在此背景下，当前的竞争核心在于影响未来的标准，而组建联盟与整合资源已成为首选策略。早期参与者涵盖了从 Microsoft 和 Marvell 等科技巨头，到 Avicena 和 Hyperlume 等初创企业。



Overseas Company Alliance in Micro LED CPO Sector

Alliance	Technical Route
Microsoft / MediaTek / Porotech / InnoLight	Micro LED + CMOS sensor array architecture featuring 400 parallel channels at 2Gbps each (20×20 array, footprint <1 mm²), with transmission distances of up to 50 meters.
Avicena/ ams OSRAM/ TSMC	GaN-based Micro LED + photodiode (PD) array architecture utilizing the LightBundle platform, delivering a baseline bandwidth of 512Gbps, transmission distance of 5 meters, and energy efficiency of 1 - 2 pJ/bit.
Credo/ Hyperlume	Pluggable Active Light Cable (ALC) solution with energy consumption of 1 pJ/bit, transmission distance of 30 meters, supporting 1.6Tbps and scalable to 3.2Tbps.
Marvell/ Mojo Vision	Combines a Micro LED platform with Marvell' s connectivity technology, targeting sub-1 pJ/bit energy efficiency and bandwidth density exceeding 100 Tbps/mm².

Source:Public information

Microsoft’s MOSAIC architecture exemplifies the “wide-and-slow” philosophy. While a conventional 800Gbps optical link typically consists of eight 100Gbps channels, MOSAIC distributes data across 400 parallel 2Gbps optical channels arranged in a 20×20 array occupying less than 1 mm².

Microsoft 的 MOSAIC 架构体现了“宽慢（wide–and–slow）”的设计理念。虽然传统的 800Gbps 光链路通常由八个 100Gbps 通道组成，但 MOSAIC 将数据分配到 400 个并行的 2Gbps 光通道上，这些通道排列成 20×20 阵列，占用面积不足 1 mm²。

The lower per-channel data rate significantly simplifies signal equalization requirements and eliminates the need for DSPs, ADC/DACs, and CDRs. Power consumption is reduced to 3.1–5.3W, representing a 56–68% improvement over mainstream optical-link solutions.

较低的每通道数据速率显著简化了信号均衡要求，并消除了对 DSP、ADC/DAC 和 CDR 的需求。功耗降至 3.1–5.3W，相比主流光链路方案提升了 56–68%。

The use of multicore imaging fiber further tackling wiring challenges associated with hundreds of parallel optical channels.

多芯成像光纤的使用进一步解决了与数百个并行光通道相关的布线挑战。

Avicena has taken a different approach with its LightBundle platform, pairing GaN-based Micro LED arrays with PD receivers.

Avicena 在其 LightBundle 平台上采用了不同的方法，将基于 GaN 的 Micro LED 阵列与 PD 接收器配对使用。

Leveraging advanced semiconductor manufacturing processes from TSMC, the solution delivers a baseline bandwidth of 512Gbps, scalable to 896Gbps, while maintaining energy efficiency of 1–2 pJ/bit and stable transmission over distances of up to five meters.

该方案利用 TSMC 的先进半导体制造工艺，提供 512Gbps 的基准带宽，可扩展至 896Gbps，同时保持 1–2 pJ/bit 的能效，并实现长达五米的稳定传输。

In March 2026, Avicena signed a joint development agreement with ams OSRAM. The partnership is expected to accelerate commercialization by combining LightBundle with ams OSRAM’s mass-production expertise in automotive Micro LED technologies.

2026 年 3 月，Avicena 与 ams OSRAM 签署了一项联合开发协议。此次合作旨在将 LightBundle 与 ams OSRAM 在汽车 Micro LED 技术方面的量产专长相结合，预计将加速商业化进程。

Meanwhile, Marvell, a leading supplier of optical networking DSP, has partnered with Mojo Vision in a strategic move to maintain relevance in a future where DSPs may no longer be required in certain optical interconnect architectures.

与此同时，领先的光网络 DSP 供应商 Marvell 与 Mojo Vision 建立了合作伙伴关系，这一战略举措旨在确保其在未来的相关性，因为在某些光互连架构中可能不再需要 DSP。

High-speed connectivity specialist Credo directly acquired Canadian startup Hyperlume in the third quarter of 2025. The company plans to launch a new category of Active Light Cable (ALC) products offering reliability comparable to AEC copper cables while extending transmission distances to 30 meters.

高速互联专家 Credo 于 2025 年第三季度直接收购了加拿大初创公司 Hyperlume。该公司计划推出一类新的有源光缆（ALC）产品，其可靠性可与 AEC 铜缆相媲美，同时将传输距离延长至 30 米。

Sample shipments are expected in fiscal 2027, followed by volume production ramp-up in fiscal 2028.

样品预计将于 2027 财年出货，随后于 2028 财年逐步实现量产。

While major technology companies and startups have collectively outlined the early framework of the Micro LED CPO ecosystem, significant differences remain in chip specifications, receiver architectures, and system integration approaches.

尽管主要科技公司与初创企业共同勾勒出 Micro LED CPO 生态系统的早期框架，但芯片规格、接收器架构及系统集成方案仍存在显著差异。

Industry-wide standards are still several years away, making the next two to three years a critical period for specification battles and market positioning.

全行业标准的建立仍需数年时间，这使得未来两到三年成为规格之争与市场定位的关键时期。

China’s Emerging Micro LED CPO Ecosystem

中国新兴的 Micro LED CPO 生态系统

Companies in Chinese Mainland and Taiwan have adopted distinct strategies for entering the Micro LED CPO market.

中国大陆与台湾的企业在进入 Micro LED CPO 市场时采取了截然不同的策略。

In Chinese mainland, participation has been more diversified. Traditional LED manufacturers are expanding into optical communications, while cross-industry collaborations seek to accelerate technological breakthroughs.

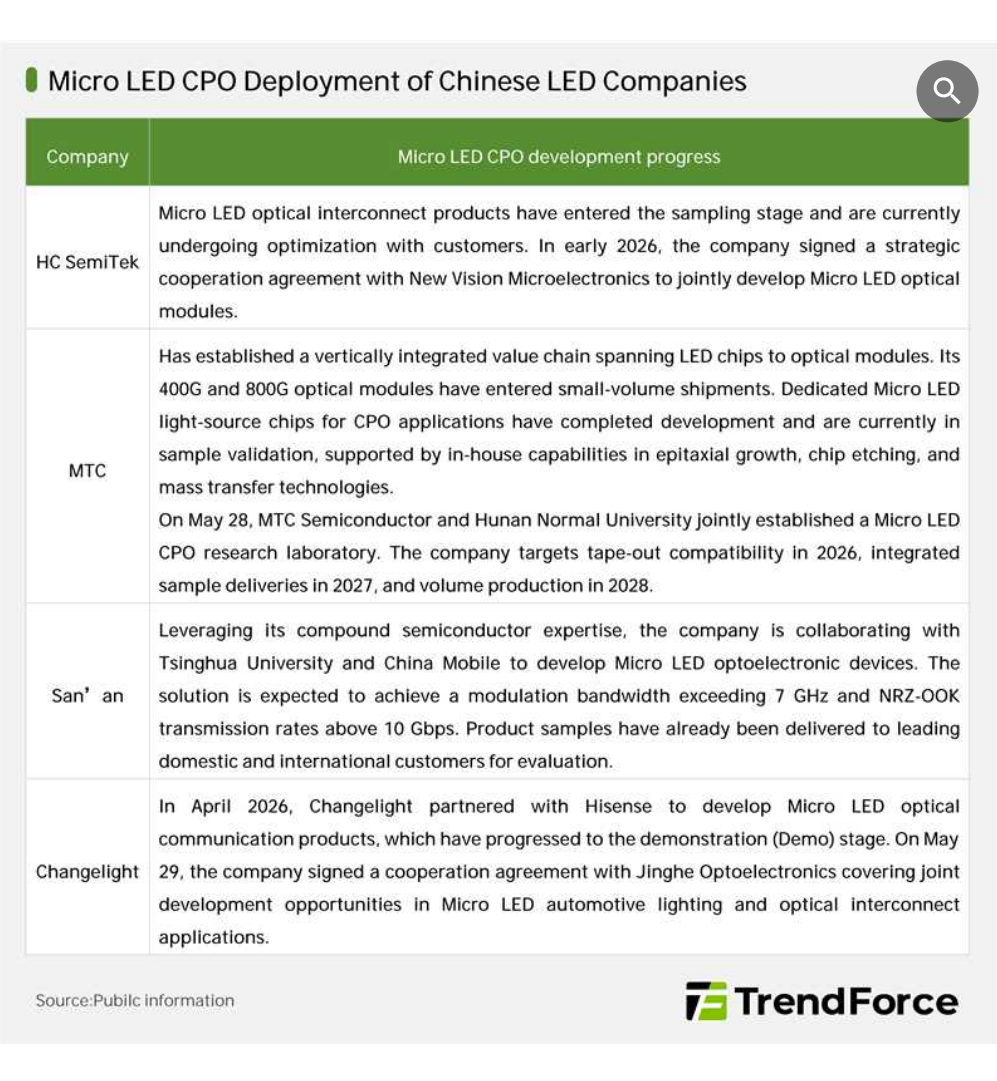
在中国大陆，参与主体更加多元化。传统 LED 制造商正向光通信领域拓展，而跨行业合作则致力于加速技术突破。

Most projects remain in the sample-development and customer-validation stage, though commercialization efforts are steadily advancing.

大多数项目仍处于样品开发和客户验证阶段，尽管商业化进程正在稳步推进。

Companies with active Micro LED CPO initiatives include HC SemiTek, MTC, San’an, Changelight, Chip Foundation, Leyard, Saphlux, Azure, and SmartSens.

积极开展 Micro LED CPO 项目的公司包括华灿光电、MTC、三安光电、乾照光电、基石光子、利亚德、Saphlux、Azure 和思特威。



Micro LED CPO Deployment of Chinese LED Companies

Company	Micro LED CPO development progress
HC SemiTek	Micro LED optical interconnect products have entered the sampling stage and are currently undergoing optimization with customers. In early 2026, the company signed a strategic cooperation agreement with New Vision Microelectronics to jointly develop Micro LED optical modules.
MTC	Has established a vertically integrated value chain spanning LED chips to optical modules. Its 400G and 800G optical modules have entered small-volume shipments. Dedicated Micro LED light-source chips for CPO applications have completed development and are currently in sample validation, supported by in-house capabilities in epitaxial growth, chip etching, and mass transfer technologies. On May 28, MTC Semiconductor and Hunan Normal University jointly established a Micro LED CPO research laboratory. The company targets tape-out compatibility in 2026, integrated sample deliveries in 2027, and volume production in 2028.
San’ an	Leveraging its compound semiconductor expertise, the company is collaborating with Tsinghua University and China Mobile to develop Micro LED optoelectronic devices. The solution is expected to achieve a modulation bandwidth exceeding 7 GHz and NRZ-OOK transmission rates above 10 Gbps. Product samples have already been delivered to leading domestic and international customers for evaluation.
Changelight	In April 2026, Changelight partnered with Hisense to develop Micro LED optical communication products, which have progressed to the demonstration (Demo) stage. On May 29, the company signed a cooperation agreement with Jinghe Optoelectronics covering joint development opportunities in Micro LED automotive lighting and optical interconnect applications.

Source:Public information

Taiwan-based companies, by contrast, are pursuing vertically integrated strategies. Display makers and LED manufacturers are leveraging internal group resources to establish end-to-end supply chains spanning light sources, detectors, and modules before industry standards are finalized.

相比之下，台湾企业正采取垂直整合策略。显示器制造商和 LED 厂商正利用集团内部资源，在行业标准确立之前，建立涵盖光源、探测器和模块的端到端供应链。

Among the most notable examples is AUO, which has integrated LED supplier Ennostar and photodiode maker Tyntek into its ecosystem. By adopting a glass-RDL interposer solution, AUO allows customers to deploy Micro LED CPO without investing in their own mass-transfer production lines, largely lowering adoption barriers.

其中最引人注目的例子之一是友达光电（AUO），其将 LED 供应商富采投控和光电二极管制造商光鋐科技纳入了生态系统。通过采用玻璃重布线层（RDL）中介层解决方案，友达允许客户无需投资自建巨量转移生产线即可部署 Micro LED CPO，大幅降低了采用门槛。

The company has already begun system-level CPO validation with international AI and optical communications customers and expects commercialization to progress over the next two to three years.

该公司已开始与国际 AI 及光通信客户进行系统级 CPO 验证，并预计商业化将在未来两到三年内逐步推进。

In late May, AUO also announced a strategic partnership with French Micro LED specialist Aledia to develop next-generation display technologies combining high brightness, low power consumption, and high resolution. The collaboration could eventually expand into optical communications applications.

5 月下旬，友达还宣布与法国 Micro LED 专家 Aledia 建立战略合作伙伴关系，共同开发兼具高亮度、低功耗和高分辨率特性的下一代显示技术。此次合作未来有望拓展至光通信应用领域。

PlayNitride has entered into cooperation with Brillink, while Innolux is widely viewed as a potential beneficiary of its subsidiary’s electro-optical packaging capabilities, strengthening its vertical integration strategy and competitive positioning.

錼创科技已与 Brillink 展开合作，而群创光电被广泛视为其子公司光电封装能力的潜在受益者，此举将强化其垂直整合策略与竞争优势。

CPO Reshapes the Value Proposition of Micro LED

CPO 重塑 Micro LED 的价值主张

Whether through vertical integration in Taiwan, cross-sector partnerships in Chinese mainland, or strategic alliances among overseas technology companies, Micro LED CPO deployments today remain largely focused on sampling and qualification programs. Large-scale shipments have yet to materialize.

无论是通过台湾的垂直整合、中国大陆的跨领域合作，还是海外科技公司之间的战略联盟，目前的 Micro LED CPO 部署主要仍集中在样品制作和验证项目上。大规模出货尚未实现。

The key questions for the industry now lie in when market adoption will accelerate, how large the potential could become, and how Micro LED CPO will interact with the broader Micro LED ecosystem.

目前产业的关键问题在于市场普及何时加速、潜在规模能有多大，以及 Micro LED CPO 将如何与更广泛的 Micro LED 生态系统互动。

According to TrendForce, the global market for AI-focused optical transceiver modules is expected to grow from USD 16.5 billion in 2025 to USD 26 billion in 2026, representing annual growth of more than 57%. Modules operating at 800G and above are projected to account for over 60% of the market in 2026, laying a solid foundation for broader CPO adoption.

根据 TrendForce 预测，全球聚焦 AI 的光收发模块市场预计将从 2025 年的 165 亿美元增长至 2026 年的 260 亿美元，年增长率超过 57%。预计到 2026 年，800G 及以上速率的模块将占据超过 60% 的市场份额，这为 CPO 的更广泛普及奠定了坚实基础。

Against this backdrop, TrendForce forecasts that CPO penetration in AI data center optical modules will rise from approximately 0.5% in 2026 to nearly 35% by 2030.

在此背景下，TrendForce 预测，AI 数据中心光模块中 CPO 的渗透率将从 2026 年的约 0.5% 上升至 2030 年的近 35%。

Shipments of Micro LED CPO optical transceiver modules are expected to begin ramping in the second half of 2028, with the market projected to generate approximately USD 848 million in revenue by 2030.

Micro LED CPO 光收发模块的出货量预计将于 2028 年下半年开始攀升，预计到 2030 年该市场将产生约 8.48 亿美元的收入。

Beyond enabling more efficient AI data-center interconnects, Micro LED CPO is expected to create meaningful spillover benefits for the display industry.

除了实现更高效的 AI 数据中心互连，Micro LED CPO 预计还将为显示行业带来显著的溢出效益。

Manufacturing capabilities developed for optical interconnect applications—including ultra-miniaturized Micro LED chips, higher-precision mass transfer processes, and stringent yield-management expertise—are likely to migrate into display production, helping reduce manufacturing costs and accelerate adoption in consumer markets.

为光互连应用开发的制造能力——包括超微型 Micro LED 芯片、更高精度的巨量转移工艺以及严格的良率管理技术——有望迁移至显示屏生产，从而有助于降低制造成本并加速在消费市场的普及。

Looking ahead, display and optical communication applications are expected to reinforce one another, creating a dual-engine growth model for the Micro LED industry and driving the technology toward large-scale commercialization.

展望未来，显示与光通信应用预计将相辅相成，为 Micro LED 产业构建双引擎增长模式，并推动该技术迈向大规模商业化。

(Photo credit: OSRAM) （图片来源：OSRAM）

CPO MicroLED