The Avago Advantage

Avago Product Solutions for Data Centers

Application Solutions

Your Imagination, Our Innovation
Sense • Illuminate • Connect
Enabling Bigger, Flatter and Faster Data Center Networks

Current data center infrastructure is being challenged with the burgeoning growth of cloud computing and mobile internet data usage. Many data centers worldwide are undergoing major transformations to keep pace with current needs and future-proof networks to meet higher bandwidth demands.

The prevalent trend in modern data centers is the architectural shift from a traditional 3-tier network to a simplified, cloud-ready, 2-tier network called the leaf-spine network (See Figure 1) that is massively scalable and more efficient. The leaf-spine network is a distributed core architecture that supports unrestricted communications between any two hosts in the network at full bandwidth, enabling a bigger and faster data center network. Compared with traditional 3-tier architecture, the leaf-spine network has higher port counts and longer links between the switches. In essence, modern data centers are getting bigger, flatter and faster, thereby increasing the demand for longer reach, higher channel density and faster interconnect fiber optic module and ASIC/ASSP solutions.
Avago’s Broad Portfolio of Data Center Solutions

### Fiber Optic Modules

<table>
<thead>
<tr>
<th>Speed</th>
<th>≤20m</th>
<th>≤100m</th>
<th>≤150m</th>
<th>≤550m</th>
<th>≤2 km</th>
<th>≤10 km</th>
</tr>
</thead>
<tbody>
<tr>
<td>100G</td>
<td>MicroPOD™ &amp; MiniPOD™ (12x10G/12.5G/14G)</td>
<td>CXP AOC (10x10G, 12x10G/12G)</td>
<td>MicroPOD &amp; MiniPOD (12x10G/12.5G)</td>
<td>CFP2 (10x10G)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40G</td>
<td>QSFP+ AOC (4x10G)</td>
<td>QSFP SR4 (4x10G)</td>
<td>QSFP + eSR4 (4x10G)</td>
<td>QSFP + LR4*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10G</td>
<td>SFP + AOC</td>
<td>QSFP + iSR4 (4x10G)</td>
<td>QSFP + eSR4 (4x10G)</td>
<td>QSFP + iSM4 (4x10G)</td>
<td>XFP LR</td>
<td>SFP+ LR</td>
</tr>
<tr>
<td>1G</td>
<td>SFP Copper (RJ45)</td>
<td>SFP SX</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### ASIC/ASSP

<table>
<thead>
<tr>
<th>Speed</th>
<th>AVSP-44xx*</th>
<th>AVSP-88xx*</th>
<th>AVSP-1104</th>
<th>ASIC*</th>
</tr>
</thead>
<tbody>
<tr>
<td>100G</td>
<td>4x25G</td>
<td>8x25G</td>
<td>10x10G</td>
<td>Custom</td>
</tr>
<tr>
<td>40G</td>
<td>4x10G</td>
<td>8x10G</td>
<td>8x10G</td>
<td>Custom</td>
</tr>
<tr>
<td>10G</td>
<td>4x10G</td>
<td>4x2.5G</td>
<td>8x10G</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Note: All ASIC/ASSP devices support CEI-28G SR/VSR and CEI-25G LR channels.

* Please contact Avago sales representative for more information.

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Avago’s broad portfolio of fiber optic modules offer speeds up to 100G and beyond.
Another significant transformation is the upgrade of data speeds across the networks (See Figure 2). Many factors are driving the need for higher speeds: exponential growth of mobile internet data usage; increased video traffic from video on demand (VOD) services and video sharing websites; and rapid growth in cloud computing. In order to satisfy higher bandwidth demands and improve network capacity, many data centers around the world are driven to support 40G/100G server uplinks. As a result, 1G systems are being upgraded to 10 Gb/s at the host connections where servers reside. 10G systems are being upgraded to 40 Gb/s and 100 Gb/s at the switch-to-switch connections.

Figure 2. Data Speed Transformation
Avago's innovative fiber optic module and ASIC/ASSP solutions address the needs of modern data centers supporting an ever increasing demand of mobile internet, video streaming and cloud computing applications.

With these changes come major technical challenges for optical module, component and chip suppliers. Avago Technologies has addressed these technical challenges and brought to market highly differentiated solutions that meet the growing needs of modern data centers:

- **Comprehensive portfolio of fiber optic transceiver, transmitter and receiver module solutions supporting 1G, 10G, 40G, 100G and beyond from 20m to 10km distance.**
- **Extensive ASIC/ASSP solutions solving challenging chip-to-chip and chip-to-module interfaces for network backplanes at 10G, 25G, 28G and beyond.**
- **Industry’s broadest selection of long-reach parallel optic transceiver, transmitter and receiver solutions exceeding industry standards.**

Avago Technologies has a long-standing history of providing innovative fiber optic module and ASIC/ASSP solutions for data center applications. Based on proven laser and IC technology, Avago provides a comprehensive portfolio of fiber optic transceiver, transmitter and receiver module solutions with unmatched quality and performance. Avago fiber optic modules come in a wide range of form factors including SFP/SFP+, QSFP+, CFP2, CXP, MiniPOD™ and MicroPOD™ that support 1G, 10G, 40G, 100G, 150G and 168G applications. In addition, Avago has a proven track record in providing complex, high-performance ASIC/ASSP solutions with unparalleled SerDes performance. Avago has shipped more than 350 million embedded SerDes channels in ASICs and ASSPs for networking, computing and storage applications.
Long Reach Advantage

Avago has a unique selection of highly differentiated fiber optic module and ASIC/ASSP solutions that extend beyond industry standards. Avago's QSFP+ eSR4 and QSFP+ eSM4 are respectively the industry's longest reach multi-channel multi-mode and single-mode 40G parallel optic transceiver module solutions. The QSFP+ eSR4 module extends multi-mode fiber (MMF) link distance to 400 meters or longer enabling data center operators to maintain their existing MMF cable infrastructure and save additional CAPEX spending for data center upgrade. For single-mode fiber (SMF) applications, the QSFP+ eSM4 module is an ideal solution for supporting extended SMF link distance up to 10 kilometers. Both the QSFP+ eSR4 and QSFP+ eSM4 also support high-density 10G Ethernet links. In addition, Avago's Vortex Gearbox™ AVSP-1104 is the industry's longest-reach 100G 10:4 gearbox IC withstanding up to 32 dB of channel loss. The AVSP-1104 is ideal for driving both backplane and portside for data center applications, enabling data center designers to use highly lossy backplanes, cables and connectors.

High Channel Density Advantage

Avago has the broadest selection of multi-channel parallel optic transceiver module and ASIC/ASSP solutions. For high channel density module applications, Avago offers various module form factors including CXP, CFP2, MiniPOD and MicroPOD that support up to 10-12 lanes of 10G Ethernet links per module. Compared with conventional SFP+ solutions, Avago's 4-channel products such as the QSFP+ iSR4 and QSFP+ eSR4 reduce both power consumption per channel
and module footprint by half. Similarly, Avago’s 12-channel products such as the MiniPOD, MicroPOD and CXP reduce both power consumption per channel and board space by a minimum of two thirds. For ASIC applications, Avago’s SerDes IP cores can easily be integrated due to their modular, multi-rate architecture. More significantly, Avago has integrated over 400 SerDes channels on a single ASIC and proven SerDes performance up to 32 Gbps in 28nm CMOS.

High Speed Interconnect Advantage

Avago has a wide array of high-speed parallel optic transceiver module and ASIC/ASSP solutions supporting 40G and 100G connections. Avago’s 40G/100G module solutions come in QSFP+, CXP, CFP2, MiniPOD and MicroPOD form factors. In addition, Avago also offers ASIC/ASSP solutions supporting long reach chip-to-chip and chip-to-module interconnects for challenging 40G/100G network backplane and portside applications

Further information on Avago fiber optics solutions is available at:
www.avagotech.com/fiber
www.avagotech.com/asics
Avago Technologies is a leading designer, developer and global supplier of a broad range of analog, mixed signal and optoelectronics components and subsystems with a focus in III-V compound semiconductor design and processing. Backed by an extensive portfolio of intellectual property including approximately 4,200 patents and pending applications, Avago products serve three primary target markets: wireless communications, wired infrastructure, and industrial and other. Avago has a global employee presence and heritage of technical innovation dating back 50 years to its Hewlett-Packard roots.

Avago products serve three diverse end markets

**Wireless Communications** serving the smartphone/handset and Base Station infrastructure markets with over 250 patents and leading-edge products that include:
- Power Amplifiers
- Front End Modules
- Film Bulk Acoustic Resonator (FBAR) Filters
- GPS/GLONASS LNAs
- Optical Finger Navigation
- LED Backlighting, Screen Illumination
- Ambient Light and Proximity Sensors

**Wired Infrastructure** for switches/routers, data centers, supercomputers and storage/servers with over 200 patents in parallel optics alone and products that include:
- 16Gb Parallel Optic Arrays
- 28Gb SerDes ASICs in 28nm
- Storage Fibre Channel Transceivers
- QSFP+/SFP+ Ethernet Transceivers

**Industrial and Other** for alternative energy power generation, electronic sign and signals, automated manufacturing, automotive lighting, GPS/GLONASS navigation, motor inverter system, battery charging and management, infotainment systems and vehicle safety systems with products that include:
- Inverters
- Isolation and Digital Optocouplers
- Motion Control Optical & Magnetic Encoders
- Polymer Optical Fiber
- Indicator and Display LEDs