Photonic Integration, Super Channels & the March to Terabit Networks

EXECUTIVE SUMMARY

In this report, Heavy Reading takes an in-depth look at the present state and future evolution of photonic integrated circuits (PICs). PICs have been the subject of much academic and laboratory research, and significant market hype, over the past four decades. Commercial applications for PICs emerged during the 1990s, and commercial PICs took a great leap forward with Infinera's PIC-based DWDM systems in 2004. The introduction and, more importantly, significant success of that DWDM system, sparked new levels of interest in PICs.

Heavy Reading last explored PICs in depth in our March 2008 report, "Photonic Integration & the Future of Optical Networking." In that report, we stated: "Photonic integration is the optical industry's best hope for scaling to meet future bandwidth needs, while reducing costs per bit." At that time, we did not factor in the tremendous impact coherent detection would have on long-haul optical transport. In the past five years, we have seen an important shift in innovation in long-haul optical transport from optics to electronics – with the latter centered on coherent detection.

As of 2012, coherent detection has become a central technology for 100G long-haul DWDM transport. In short, the industry is using sophisticated electronic processing to enable 100G transport using less sophisticated optics. We believe coherent detection has, in essence, taken some of the burden off of photonic integration in fulfilling the mission to increase bandwidth and reduce cost per bit for the long-haul market specifically. Thus, in hindsight, we would amend our 2008 statement to include both photonic integration and coherent detection in scaling bandwidth and reducing costs in optical transport.

While photonic integration has not completely revolutionized the optical industry over the past five years, it has matured steadily and broadened its base of commercial suppliers and commercial applications. As we have noted, PICs can be found today in commercial line-side and client-side modules, optical interconnects, PON equipment, and elsewhere. Systems suppliers are increasingly viewing photonic integration as a strong potential differentiator and are moving to bring this optics expertise in-house.

Photonic Integration, Super Channels & the March to Terabit Networks provides an introduction to the topic of optical integration and includes definitions and technologies as well as an overview of the benefits of photonic integration. The report also provides a market overview, detailing the company landscape and discussing the main market opportunities and challenges for photonic integration. The report also profiles the four main DWDM systems suppliers with in-house photonic integration expertise and 16 leading optical components suppliers active in photonic integration.

As the industry looks at modules and applications three to five years into the future, photonic integration and PICs are widely viewed as an absolute requirement. Beyond the five-year horizon, Heavy Reading envisions PICs will enter a new phase of evolution focused on systems designs. In this third phase, optics will be pervasive down to centimeter reaches, with such advances leading to a new architecture at each level of design, including system, backplane, line card, and intra-chip. These advances will be required as
systems scale to tens and even hundreds of terabits per capacity in the future. The excerpt below depicts this optical integration evolution.

Excerpt 1: Optical Integration – Three Stages of Evolution

Optical integration expertise has become a key tool aiding optical component companies, especially the generalist players. Optical component specialists also have an important industry role, focusing on specific markets or using their expertise to develop differentiated products. Meanwhile, system vendors are realizing that owning key technologies such as optical integration is important if they want to better control costs and differentiate their products. For equipment vendors, optical integration is emerging as an important technology asset, as evidenced by certain recent acquisitions. The characteristics of these optical vendor and component categories are summarized in the excerpt below.

Excerpt 2: Optical Integration Company Landscape

<table>
<thead>
<tr>
<th>SEGMENT</th>
<th>OPTICAL COMPONENTS PLAYERS</th>
<th>SYSTEM VENDORS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GENERALISTS</td>
<td>SPECIALISTS</td>
</tr>
<tr>
<td>Strengths</td>
<td>Scale and vertical integration</td>
<td>Focus</td>
</tr>
<tr>
<td>Weaknesses</td>
<td>Limited ability to differentiate products</td>
<td>Focus; limited scale; ability to fund investment</td>
</tr>
<tr>
<td>Opportunities</td>
<td>Through execution the promise of greater profitability</td>
<td>Fewer specialists, this is both an opportunity and a threat</td>
</tr>
<tr>
<td>Threats</td>
<td>Consolidation; many generalists impacting profitability</td>
<td>Acquisition targets, limited ability to adapt</td>
</tr>
</tbody>
</table>

Source: Heavy Reading
Report Scope & Structure

Photonic Integration, Super Channels & the March to Terabit Networks is structured as follows:

Section I is an introduction to the report, with complete report key findings.

Section II provides an introduction to the topic of optical integration and includes definitions and technologies as well as an overview of the benefits of photonic integration.

Section III provides a market overview, detailing the company landscape and discussing the main market opportunities and challenges for photonic integration.

Section IV focuses in depth on the current and future role of photonic integration in both the line-side and client-side modules.

Section V discusses other applications for photonic integration, including short-reach optical interconnects, passive optical networking, and ROADMs and switches.

Section VI profiles the four main DWDM systems suppliers with in-house photonic integration expertise.

Section VII profiles 16 leading optical components suppliers active in photonic integration.

Photonic Integration, Super Channels & the March to Terabit Networks is published in PDF format.