Divestment by telecoms system makers and bankruptcy of opto start-ups is leading to consolidation of complementary manufacturing capabilities into more cost-efficient 'one-stop shop' suppliers of not just opto components, but also modules and subsystems for both telecom and non-telecom applications.

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The one-stop shop

The near-50% growth in the optical communications system market during the telecoms 'bubble' of 2000 led to frenzied acquisition of opto component suppliers by equipment makers, funded by their inflated stock values, eg ADC of tunable laser maker Altitun for $872m; Nortel Networks of tunable VCSEL maker CoreTek and Lucent Technologies of Ortel for $2.95bn. After the $6.1bn merger of JDS FITEL and Uniphase (makers of passive and active components, respectively, with combined annual sales of $587.9m), JDS Uniphase acquired more than a dozen opto suppliers, culminating with the $41bn for SDL Inc, and invested $125m to expand manufacturing and staffing to over 17,000.

But since the bubble burst and system sales fell by 60% in 2002, the components sector has contracted as large, diversified manufacturers of systems (Marconi, Nortel, Ericsson, Alcatel, Corning, ADC), modules (Finisar) and ICs (Agere, Vitesse) have divested or closed their opto components operations to focus on core business.

When the market recovers, equipment makers will therefore be in need of large component suppliers that can deliver broad product portfolios at low prices through economies of scale. This can be achieved fastest through acquisition, driving consolidation, as surviving supplier pick up divested businesses at bargain prices and subsequent streamlining of facilities yields cost efficiencies.

Components to modules

JDSU's sales fell from $3.2bn in fiscal 2001 to $1.1bn in 2002 to $676m in fiscal 2003 (to end-September). But, says CEO Kevin Kennedy, "Progress on reducing losses has been steady [$934m (down from $8.7bn for fiscal '02)], driven by our imperative to be well poised for a stabilising market."

'Figure 1. Bookham's InP laser wafer fab and dry etching at Caswell.'

JDSU has shifted its focus from capacity expansion to maximising efficiency. The goal is to reorganise and consolidate manufacturing into the facilities best suited to particular products. However, it continues to "pursue opportunities to invest in, acquire and develop strategic relationships with other businesses." In the downturn, system makers cut engineering resources, so there is a need for suppliers to both manufacture and design, not just discrete components, but also value added products such as highly integrated modules and subsystems. So JDSU acquired IBM's optical transceiver business in January '02 and OptronX's transceiver/transponder unit in September '02.

At March's OFC 2003 event, JDSU launched new components and modules that reflect a re-focusing from building new systems to reducing costs for network operation, utilisation and upgrade of existing systems, and from long-haul telecoms to short-haul datacoms. September-quarter sales of $147.4m showed a continued decline in thin film business, but a bottoming in communications business, while net loss was $28.1m, down from $520.5m a year ago.

Management buy-backs

In October 2002 Sunnyvale, CA-based Finisar Corp, which supplies Gigabit transceivers for datacoms, sold Sensors Unlimited (acquired two years previously for $700m) to its former management for $6.1m.

This May it sold Germany-based laser-making subsidiary Finisar Europe, acquired in February 2002 for $2.3m, to a management buy-out, led by original CEO Claus-Georg Müller, under its former name AIFOtec. A license agreement gives Finisar a cut of any revenues from its FBG-stabilised laser technology.

In April Finisar acquired Fremont, CA-based Genoa Inc, a developer of linear semiconductor optical amplifiers and 1310/1550nm VCSELs, founded in 1998 with $95m in venture funding, for $5.5m in stock. It also said it was closing its Demeter Technologies Inc Fabry-Perot/DFB laser and PIN/avalanche photodetector division in El Monte, CA (founded August 2000 but acquired that November for $146m) and consolidating it into the Genoa plant. But in August Finisar sold Demeter's assets and IP rights to new company, DMG Technologies, to make subassemblies at its 11,000ft^2 plant in City of Industry CA. DMG has a new product roadmap for sensors, biomedicine, spectroscopy, and government, as well as data- and telecoms, including 2.5 and 10Gbit/s APD-TIA receivers and DFB TOSAs. In November DMG and Adtech Technologies co-founded the LA-based foundry Netchip.

In May subsystem supplier Stratos Lightwave sold its epi and opto device foundry subsidiary Bandwidth Semiconductor back to Spire Corp of Bedford, MA. Bandwidth was formed in December '99 when Spire's Optoelectronics division was bought by Methode Electronics, which in 2000 spun off its optical products business as Stratos Lightwave.

Bandwidth has expanded into its own high-volume plant in Hudson, NH and supplies Spire Biomedical. "Bandwidth can continue to grow its underlying defence and telecoms business, while providing key opto-electronic device building blocks to allow Spire and other manufacturers to take proprietary positions in the life sciences instrument market," says Spire president and CEO Roger Little. "We intend to expand Bandwidth's biophotonics activities to support Spire's important Life Sciences initiative."

Such buy-backs from shrinking telecom system makers can therefore enable 'restarts' to address new, expanding markets.

JDSU's $1.2bn Global Realignment Program (to be completed by end-2003) has cut staffing to 5,200 and annual costs by $1.3bn, enabling breakeven on December quarter-sales of $200m and September 2004 quarter sales of $170m. December-quarter sales should be $140-150m.

Like JDSU a few years ago, Bookham Technology has been buying companies with the intention of amassing a 'one-stop shop.' Founded in 1988, Milton, UK-based Bookham Technology's active silicon integrated optical circuit (ASOC) technology allowed hybrid integration of optical and electronic functions on a single silicon chip. An initial public offering in April 2000 led to major expansion. However, the targeted fibre-to-the-home market stalled. A 17% drop in sales from 2000 to £22m in '01, led to staff being cut by 150 from 850, and in October 2002, by closure of a fab in Maryland, US and an assembly facility in Swindon, UK.

Bookham has therefore diversified by acquisition:

•In February 2002 it swapped 9% of its stock (worth £16.4m) for Marconi Optical Components (MOC) in Caswell, UK, plus a supply agreement with Marconi, buying £30m of products over the following 18 months. MOC was developed in 2000 from Caswell's 6" GaAs MMIC manufacturing (re-launched by Bookham in 2003 for commercial foundry). Such 6" capability boosts opto integration both monolithically (eg. of large GaAs modulators with variable optical attenuators and power monitors) and by hybrid co-packaging in a single module (eg. of InP tunable DBR lasers) yielding lower cost and increased functionality in, for example, compact 10Gbit/s transmitters.

• In November 2002 Bookham swapped 29.8% of its stock (worth $44m) for Nortel Networks' Optical Components (after closure of its Coretek tunable laser business), plus a supply agreement, with Nortel buying 50-80% on a product-by-product basis of its opto component needs over the following three years (a minimum of $120m over the first six quarters). Bookham gained 1,300 staff in:
- Ottawa, Canada, for InP chip fabrication for lasers, modulators, and receiver chip fabrication (with a capacity of 1,000 3" InP wafers per week);
- Paignton, UK, for design, assembly and test of components and modules;
- Zurich, Switzerland (ex-IBM Research, bought from JDSU for $3bn in F2001) for GaAs 980nm and InP1480nm pump lasers and optical amplifiers.

Bookham can now provide a portfolio of optical components (active transmitters, receivers, lasers, 980nm pump modules and passives as well as optical amplifiers), highly integrated components and modules, enabling it to capture "new business from major customers looking for a single, more cost-effective alternative to their existing suppliers," it says.

Compared to first-half '02, due to NNOC, first-half '03 sales rose 231% to £42.1m,

but operating expenses rose 27% and net loss was £43.1m. However, compared to Q2, sales rose 10% in Q3 to £23.1m. Though still reliant on supply agreements, "We are beginning gradually to expand our customer base," said president and CEO, Giorgio Anania, with Nortel down from 62% of sales to 57% (and Marconi 14%; Huawei Technologies 10%). Operating expenses fell 7% and net loss fell from £18.1m to £14.6m.

From reserves of £137m at end-Q3/ '02, cash burn was £31.6m in Q4, £17.7m in Q1/ '03 and £16.9m in Q2, but up 36% to £22.9m in Q3 (due to restructuring), leaving just £47.9m. To cut costs, the Ottawa fab has been closed (laying off 200 but relocating 70 mainly R&D staff to a smaller facility); its 3" InP line (including automation and process control) moved to Caswell, and designs and manufacturing processes transferred by September, four months up on schedule.

A further 70 have been laid off by consolidating Zurich's optical amplifier manufacturing and Caswell's assembly and test into Paignton, where staffing is now 1,000. Also, with ASOC sales falling, in September Bookham discontinued the line, closing the Milton fab and cutting 160-180 staff.

Datacoms & non-telecoms

In July Bookham swapped £2.25m in shares to acquire Santa Rosa-based Cierra Photonics Inc, whose 40 staff make thin-film filters, allowing cost cutting through internal sourcing of components for its optical amplifiers. Then in October to enter the growing datacom market, Bookham issued $15.5m worth of new shares to acquire San Jose-based Ignis Optics Inc, whose 40 staff design and make small form-factor pluggable (SFP and XFP) optical transceiver modules. In Q4 Bookham expects total staffing of 1,500 (down from 1,945), cash burn of less than £10m, quarterly revenue breakeven point cut to £30-35m and sales up 3 -10% to £24- £26m

Also to diversify its customer base, Bookham expects by January to close a deal (announced in September) to issue £117.6m worth of new shares (27% of its stock) to acquire San Jose-based New Focus Inc, whose 200 staff supply non-telecom photonics and microwave products (eg. to semiconductor equipment manufacturers and defence contractors).

If the two businesses had been combined in first-half '03, Bookham's non-telecom sales would have been 20% rather than 6%. New Focus should add £65m to cash reserves removing liquidity concerns, while its plant in Shenzhen, China, should lower manufacturing costs.

Agere's opto goes to TriQuint and Emcore

In August 2002 Agere said it would exit opto to focus on electronic components. So, in January it sold its West Coast cable TV, telecom access and satellite communications opto component business Ortel (acquired by Lucent in April 2000 for $2.95bn) for just $26.2m to Emcore, which is complementing its data- and telecom opto products to "realise the full potential of the 'triple play' in voice, data and video" and "assist deployment of fibre to the home and office".

As Emcore's Ortel division, 215 of its 230 staff have been consolidated into the Alhambra facility (leased by Emcore); Agere exited the Irwindale facility at the end of March. After fiscal-2002 sales of $56m, $30-40m is expected for fiscal 2003 (to end-September).

Emcore's March-quarter sales of $27.7m included 'materials-related' sales up 80% sequentially to $16.9m, due to $7.1m from Ortel (though increased operating expenses raised net loss from $2.9m to $12.5m). In contrast, the 'systems-related' MOCVD business (for which sales fell from $131.1m in fiscal 2001 to $52.7m in fiscal 2003) was sold in November to Veeco Instruments for $80m, while "retaining the process technology base to continue to improve both production efficiency and device design". This allows a focus on communications products as part of a "strategic realignment into higher-revenue-growth opportunities," said president and CEO Reuben F. Richards Jr.

In October Emcore added to its Fiber Optics division by acquiring Molex Inc's 10 Gigabit Ethernet transceiver business (with 17 staff), addressing a market forecast by Strategies Unlimited to grow 66% per year to $380m by 2007. Emcore now expects December-quarter sales from continuing operations up 25% to $21-$23m and positive operating income in fiscal 2004.

In January Agere sold its remaining opto business (lasers, detectors, modulators, passives, arrayed waveguide-based components, amplifiers, and MEMS) to TriQuint Semiconductor (which makes ICs for optical networks) for $40m. Revenues were $198m in Agere's fiscal year to end-September 2002. This consolidates 215 staff in the Breinigsville, PA fab plus 125 at a leased component-module assembly and test plant in Matamoros, Mexico.

At March's OFC 2003 event TriQuint announced an expansion in Matamoros as well as new 10Gbit/s components, the completion of the Netlight small-form-factor/small-form-factor-pluggable (SFF/SFP) transceiver line, and 10Gbit/s transmit and receive engines for XFP transceiver and X2 transponder modules, "examples of the advantage of our flexible manufacturing platforms", said TriQuint Optoelectronics GM Glen Riley. As a vertically integrated manufacturer, "We are leveraging our ability to make our own optical components, chips, and transceiver modules."

In June, TriQuint sold its undersea 980nm pump-laser product line to JDSU for $6.6m and plans to sell its interests in EDFAs, silica waveguides and lithium niobate modulators. Consolidation will greatly reduce costs compared to Agere's, it says. With its September-quarter opto sales up 7.6%, TriQuint forecasts 2003 sales of $50-75m.

New avenue for Alcatel and Corning

Sales for Alcatel's optical components subsidiary Alcatel Optronics fell 82% from 2001's €470.4m to 2002's €84.1m while net loss rose from €144.3m to €418.8m. Staff was therefore cut from

1,800 to 1,000, aiming for less than 500 by end-'03.

With complementary products to hard-hit fibre-manufacturer Corning's photonic technologies business, Alcatel and Corning jointly sought a partner for the two businesses.

Fremont, CA-based Avanex Corp makes photonic processing subsystems and modules (thin-film passives and optical add/drop multiplexers), but slumped from a net loss of $77.8m on sales of $33.7m for fiscal 2002, to $102.9m on sales of $21.4m for fiscal 2003 (to end-June). But, since it is listed, in a combined transaction in July it exchanged:

•28% of its stock (worth $38.5m) for Alcatel Optronics, including two plants in Nozay, France for actives (InP and GaAs chips for lasers, detectors, pumps and optical amplifiers) and the ex-Kymata plant in Livingston, Scotland (bought in '01 for $119m) for passives (arrayed waveguide gratings, fibre Bragg grating and filter-based wavelength multiplexers, and planar lightwave circuits), together with a three-year supply agreement. March-quarter sales were just €7.3m. Staffing was 950, but the Lannion long-haul and submarine component plant is being closed by end-2003.

• 17% of its stock (worth $25m) for Corning's photonic technologies business (which had March-quarter sales of $11m), includes 400 staff in Erwin, NY (dispersion compensation modules and optical fibre amplifiers) and at its ex-Pirelli plant in Milan, Italy (lithium niobate and electro-absorption modulators). Corning Lasertron's pump plant in Bedford, MA is being closed by end-03, cutting 150 jobs.

•Although the customer base of Alcatel Optonics (Huawei and ZTE in China and CIENA in the US) and Corning (Lucent) is complementary to Avanex's (Cisco), combined staffing of 1,600 may be cut to 1,000 at the five plants by end '03.

In August Avanex acquired, for $6m in stock, the assets and half the 62 staff of Vitesse Semiconductor's San Jose-based Optical Systems Division (formerly Versatile Optical Networks Inc, acquired in 2001 for $150m in stock). Though it debuted 10Gbit/s transponders at OFC '02, Vitesse is re-focusing on silicon. Over the next three years it will buy up to $2m in products from Vitesse, while co-developing transponder products.

Vertical integration via the four companies enables "a consolidated supplier base and a one-stop shop for advanced and reliable optical subsystems, modules and components," says sales & product marketing VP, Jaime Reloj.

"During the past year, we improved the fiscal foundation through cost saving initiatives, and increased our use of outsourced manufacturing, reducing operating expenses," said chairman, president and CEO Walter Alessandrini.

September-quarter sales (including two months Alcatel/Corning sales and one from Vitesse) were $18.1m, up from the June quarter's $5.5m. Net loss was $27.9m (up from $6.6m, but down from $70m a year ago). However, Avanex expects December-quarter sales of $25m and has over $250m in cash reserves (including $110m from Alcatel and $20m from Corning), ie. 8-10 quarters at a burn rate of $25m expected for two years.

Relocation to Asia

In January '01 JDSU opened a 320,000ft^2 plant in Shenzhen, China for passive and active components and modules. Much of JDSU's manufacturing is now in China.

This July Agilent cut 200 jobs by closing its Fabry-Perot/DFB laser and detector fab in Ipswich, UK, acquired by former parent Hewlett-Packard in '93 from a British Telecom-DuPont joint venture, BT&D Technologies. Over $150m was invested, including a $20m, 80,000ft^2 building completed in early '02, and staffing peaked at 1,100. The 50 remaining R&D and marketing staff have been relocated to a smaller facility.

Production has been transferred to its $92m plant in Yishun, Singapore (opened in February), where most devices, including optocouplers, standard-brightness LEDs, and emitters for IR transceivers, were already being fabricated.

Agilent has moved all opto manufacturing out of the US, mostly to Singapore (including its California-based VCSEL unit).

Agilent retains R&D in Turin, Italy (from Telecom Italia in early 2000); Lumileds Lighting, the joint venture with Philips Lighting, still make high-brightness LEDs in San Jose, CA.

In October Infineon Technologies set up a $12m, 56%:44% JV to make fibre-optic chips in the Hsinchu plant of Taiwanese epi and device manufacturer United Epitaxy Co, from Q4/2004. Both license their respective technologies to the JV and assemble and package components and modules. Full capacity up to 100 wafer starts per week, will employ 120.

Substrate maker AXT's Q1/2003 opto sales (high-brightness LEDs and lasers from its plants in California and China) were $4.1m (32.6% of total revenues). But a sharp drop in May led to a two-week US shutdown and Q2/2003 net loss of $13.8m (up from Q1's $1.8m). In June AXT laid off 165 staff at the Monterey Park plant and in September sold its opto business to Lumei Opto-electronics Corp for $9.6m.

So, in combination with emerging, consolidated 'one-stop shops', the relocation of manufacturing to lower-cost regions may now provide the required cost efficiencies that are needed to kick-start the opto sector back into profitability.

Signs of growth

According to Velocity Industry Research and Consulting, the Optical Component and Module Manufacturers had revenues of $340m in Q1/2003 (55% down on Q1/2002), led by JDSU, Agilent, Bookham, and Finisar. End-2003 will see signs of growth. After dropping 43% in 2001 and 66% in 2002, the market will drop 'just' 30-40% in 2003.