

## 5.0

# Hardware Sector

Hardware comprises six sub-sectors.

These sub-sectors are Semiconductors; Computer Systems (including mainframes, servers and PCs); Data Storage; Networking Equipment (including LAN, WAN and WLAN); Handsets and Handhelds; and Video Customer Premises Equipment (CPE) such as set-top boxes and game consoles.

## Key Statistics

### 2001 Global revenue

US\$614 billion

### 2001 Australian revenue

A\$12 billion—or 1% of global revenue

### Expected global growth rate to 2005

3%

### Global market structure: varied

Less standardised markets: High concentration

—for example, in high-end servers, Top 3 hold 71% share

Standardised markets: Low concentration

—for example, in desktop computers, Top 10 hold 57%

### Multinationals (MNCs) in Australian market

MNCs account for approximately A\$8.5 billion sales

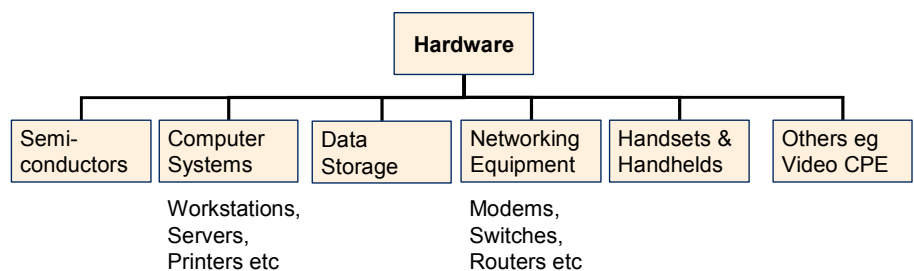
Australian companies recorded approximately A\$3.1 billion sales (mainly in distribution of computer systems and manufacture of computer system electronics with embedded software)

## Structure of Hardware Sector

This section provides a brief overview of the sector as a whole, followed by more detailed profiles of each of the six sub-sectors.

Exhibit 11

### HARDWARE SECTOR STRUCTURE



## Current State—Worldwide Hardware Sector

Hardware is a mature concentrated sector with growth rates below those for Software and IT Services. There is a high degree of standardisation, especially in low and middle-end segments such as PCs and some networking equipment. The lower growth and standardisation leads companies to engage in outsourcing and manufacturing offshore.

The market characteristics of the Hardware sector are summarised below in Exhibit 12 and then discussed in detail.

Exhibit 12

### HARDWARE SECTOR: CHARACTERISTICS

	Revenue US \$ Billions, 2001	Annual growth Percent, 2001–2005E	Market share of top 3 competitors, 2001 Percent	Enterprise share of total demand Percent
<b>Semiconductors</b>	139	9	27	100
<b>Computer Systems</b>				
Servers and workstations	57	-10*	71	60
PCs (desktops and laptops)	191	1	43	
Printers	26	2	79	
<b>Data Storage</b>				
Disk storage	24	4	56	97
Optical storage	10	9	40	
Tape storage	3	4	59	
<b>Networking Equipment</b>				
LAN (routers only)	11	6	91	100
WAN	39	8	91	
<b>Handsets &amp; Handhelds</b>				
PDAs	6	13	58	N.a.
Handsets	90	1	56	
<b>Video CPE</b>				
Set-top boxes	8	5	37	N.a.
Game consoles	10	3	96	

\* Workstations only

In 2001, global spend on this sector totalled US\$614 billion, making Hardware the largest of the three ICT sectors.<sup>5</sup>

Over the last decade, industry returns and revenue growth in the sector have outpaced returns in other industries. But with the general trend of increasing standardisation across the sector, revenues and margins are increasingly under pressure.

Of all the ICT sectors, Hardware is most affected by the global economic slowdown. For example, from now until 2005, servers are expected to experience a 10% decline due to an exceptional level of systems investment in the last few years—partly driven by Y2K concerns and early consumer and corporate enthusiasm for the Internet. PCs and printers are expected to grow at just 1% to 2%.

As a result of the high fixed costs involved in hardware manufacturing, this sector is also more concentrated than both the Software and IT Services sectors. The Top 3 companies in Hardware sub-sectors account for an average of 62% market share—against about 30% for Software, excluding Operating Systems, and about 20% for IT Services.

However, industry structure does vary across the Hardware sub-sectors.

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<sup>5</sup> Global spend on Software and IT Services amount to US\$145 billion and US\$537 billion respectively



## Australian Presence—Hardware Sector

The size of the Australian market for Hardware is estimated at A\$12 billion, which is approximately 1% of the global market. From now until 2005, Australian Hardware sector revenue is expected to grow at 4% annually. In 2001, the top MNCs captured approximately 70% of all Hardware revenue.<sup>6</sup> (A summary of Australian Hardware sector revenues is presented in Exhibit 13.)

Computer Systems account for the majority of Australian Hardware spend. In 2001, this market totalled approximately A\$8 billion, which represents about 1.6% of the total global market. This revenue is largely generated from PCs, workstations and printers, and totals over A\$6 billion. The total revenue earned from Servers is also significant, amounting to over A\$2 billion.

Exhibit 13

### AUSTRALIAN HARDWARE SECTOR: CHARACTERISTICS

	Revenue, 2001 A\$ Millions	Annual growth 2001–2005E Percent	Share of global market, 2001 Percent	Examples of MNCs	Examples of local players
• Computer Systems					
– Servers	2,185	6.1	2.0	• Dell, HP, IBM	• None
– PCs, workstations and printers	6,037	2.0	1.6	• Dell, HP, IBM	• Optima, GES International, Ipex
• Data Storage	765	7.6	1.1	• HP, EMC, IBM, Sun	• None
• Networking Equipment					
– LAN	792	4.2	3.8	• Cisco, Nortel, 3Com	• None
– WAN	856	9.5	1.1	• Alcatel, Nortel, Cisco	• Netcomm, Techniche
• Handsets & Handhelds					
– Handsets*	1000	1.5	0.6	• Nokia, Ericsson, Motorola	• Voxson, Cellnet
– Handhelds	135	40.2	1.2	• Palm, HP, Casio	• None
• Game Consoles	282	N.a.	1.2	• Sony, Microsoft Nintendo	• None

\* Based on estimates from IDC on number of handsets sold in Australia and estimates from Paul Budde on average cost of handsets in 2001

Source: IDC reports; Paul Budde Communication; McKinsey analysis

Australia's presence across each of the Hardware sub-sectors is mainly focused in local sales and distribution and to a lesser

<sup>6</sup> Our analysis of the overall size and growth of the sector is primarily based on IDC reports. This is complemented by a bottom-up analysis, covering major MNCs and 19 listed Australian firms with hardware activities

extent R&D. With the exception of a couple of firms in Computer Systems, there is little activity in manufacturing or assembly. This is because manufacturing and assembly in Hardware requires high capital investment and significant scale. Australian Hardware firms lack both capital and scale. For example, the capital required to build a new semiconductor plant approaches US\$2.5 billion.

In terms of Hardware R&D, Australia is highly regarded in a number of specialist areas—especially in Semiconductors, Networking Equipment, and Handsets and Handhelds.

Australia's R&D presence generally takes one of three forms. First, there are numerous examples of global MNCs that have established significant R&D centres in Australia—for example, Nortel Networks in Networking Equipment and Motorola in Handsets and Handhelds. Second, there are a few examples of local companies that have successfully researched and/or commercialised new hardware technologies—for example, Lake Technologies in Semiconductors and Redfern Photonics in Networking Equipment. Last, there are many examples of publicly funded research groups in Australia that have established reputations as world-class in their respective fields—for example, Special Research Centre for Quantum Computing and Australian Photonics Cooperative Research Centre.

### Trends—Hardware Sector

Three trends are common within the Hardware sector:

- **Standardisation of components and processes** across sub-segments is leading low-end vendors to enter higher-end product markets.
- **Increased outsourcing and offshore production** is leading to a proliferation of contract manufacturing from low-end to high-end products—for example, in Systems, Handsets and Semiconductors.
- **Industry consolidation and horizontal integration** is leading to greater economies of scale and scope and allowing Hardware vendors to enter IT Services markets.

## Uncertainty—Hardware Sector

There are four major areas of uncertainty that could affect the evolution of the Hardware sector:

- **Extent of continued standardisation, or commoditisation, within the manufacturing process**—for example, the standardisation of chip manufacturing and other computer components.
- **Extent of migration of services and functions to IP networks**—for example, growth in specialist network-based services, such as storage.
- **Degree of convergence leading to multi-purpose devices**—for example, handsets converging with handhelds and game consoles converging with set-top boxes.
- **Potential disruptive technology breakthroughs**—for example, nano-computing and quantum computing.



## Opportunities for Australia—Hardware Sector

Overall, the opportunities for Australia in Hardware are limited. The established manufacturing base in Asia serves as a barrier to entry because of the high levels of capital typically required in manufacturing processes and because Australia's operating costs exceed those of Asian countries such as Taiwan and China. Nevertheless, there are still likely to be opportunities for Australia in R&D and in manufacturing specialised products.

**Strengthen Australia as a research centre.** Australia already has a significant presence in R&D across a few Hardware sub-sectors—for example, in Handsets and Networking Equipment. Australia could strengthen this presence either by encouraging MNCs to broaden their R&D base and/or by helping local research companies and public funded research groups to commercialise their own research work. The main challenge in attracting further participation will be to convince MNCs that Australia's well-regarded local R&D talent pool compensates for the relatively high costs and distance from MNC head offices. In developing local cutting edge technology companies and research groups, the main challenge will be to build the necessary commercialisation capabilities, such as product development and marketing.

**Foster local manufacturers of specialised products.** A number of Australian companies have been successful in high growth product niches in Australia and globally—for example, smart cards and EFTPOS. These companies can continue to grow if they can maintain globally competitive innovation rates and cost-competitive manufacturing. They will also need to establish strong brands and obtain access to global distribution channels. Given the relatively small size of the domestic market and the difficulty of accessing global distribution, capturing these opportunities is again likely to involve significant challenges.

**Develop service providers in networking equipment and data storage.** A number of Australian telecommunication companies and ISPs/ASPs currently act as network service providers and/or storage service providers for the local market. These companies might be able to expand their service offerings to adjacent overseas markets. However, this opportunity presents three challenges. First, these companies would need to improve their local operations before pursuing opportunities in new geographies. Second, they would need to ensure that they can access the necessary network and storage infrastructure in those markets. And third, they would have to undertake extensive marketing to establish relationships with target customers in overseas markets.

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With this overview as a backdrop, the rest of this section details the global position and outlook of each of the six sub-sectors, and assesses the opportunities for Australia:

5.1 Semiconductors

5.2 Computer Systems

5.3 Data Storage

5.4 Networking Equipment

5.5 Handhelds and Handsets

5.6 Other, including Video Customer Premises Equipment (CPE).

## 5.1

# Semiconductors

Semiconductors are the fundamental building blocks inside all electronic products. This sub-sector encompasses integrated and discrete chips and opto-electronics. Integrated circuit chips include memory, microprocessors and digital signal processors (MPU/DSP), logic/microcontrollers, application-specific (ASIC) and analog chips.

Over the last 10 years, the main feature of the Semiconductors sub-sector has been the speed of technology innovation.

## Key Statistics

### 2001 Global revenue

US\$139 billion

### 2001 Australian revenue

A\$16 million<sup>7</sup>—less than 0.01% of global revenue

### Expected global growth rate to 2005

9%

### Global market structure: generally fragmented

Varies by product line

Top 3—Intel, Toshiba and Texas Instruments—have approximately 27% share combined

### Multinationals (MNCs) in Australian market

The majority of semiconductors in Australia are imported as installed components of electronics, computer systems, and networking equipment. MNC vendors such as Intel and Toshiba supply global and local manufacturers of these products

## Snapshot

The structure of the global Semiconductors industry varies by product. Market share tends to be concentrated for global integrated manufacturers in higher-end products, but more fragmented for product and functional specialists in lower-end products.

Demand in the Semiconductors sub-sector is driven by the demand for 'downstream' electronic industries. Any surge in a particular sector of the electronics industry is magnified in the semiconductor sub-sector, causing relatively high volatility in the demand for semiconductors. The nature of this demand has also made the industry particularly vulnerable to the recent global economic slowdown. Adding to the challenge of volatile demand

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<sup>7</sup> No aggregate data is available for spend on Semiconductors in Australia. The estimate of A\$16 million is based on the latest reported revenues for Lake Technology and Silex Systems. It does not include spending on imported semiconductors from global manufacturers. Inclusion of this additional spend would increase the estimated size of the local semiconductor market but it would still be extremely small relative to the global market as almost all semi-conductors are imported as installed components

are the long lead times required to build plants and the high rate of technology innovation. As a result, periods of overcapacity followed by undercapacity are typical over a 3- to 5-year industry cycle.

Looking ahead, there are three clear trends in this sub-sector: technical innovation will continue; specialist firms will continue to emerge in design and contract manufacturing; and, although the slowdown will continue, market growth will come from consumer electronics such as games and PDAs and mobile communications. The main uncertainty in the industry relates to the degree that chips in new product markets will become standardised, and the possible wider adoption of 300 mm wafer technology.

In Australia, there is only limited activity in Semiconductors. There are currently only two listed local companies in the industry, and a few publicly funded research bodies dedicated to R&D. Going forward, there may be some small opportunities to leverage this current R&D presence to either provide additional R&D for global manufacturers or develop local product specialists.

### **Current State—Semiconductors**

The structure of the Semiconductors industry varies by product—for example, a few major global manufacturers dominate the MPU/DSP chip market but the logic/ASIC chip market is more fragmented. The markets for memory chips, opto-electronics and discrete chips, on the other hand, are relatively concentrated. The analog chip market is fragmented but has specialist product manufacturers.

Firms who operate within the Semiconductors sub-sector include functional specialists and integrated manufacturers.

Functional specialists include intellectual property firms (for example, Xilinx, Broadcom, MIPS and ARM), fabless design houses (for example, Silicon Labs) and foundries (for example, Taiwan Semiconductor Manufacturing Corporation).

Integrated design and manufacturing firms (IDMs) span the value chain (for example, Intel, AMD, IBM, Texas Instruments and Micron). The current trend in the sub-sector is towards fewer IDMs and more focused specialists. This is because focused specialists have been able to exploit economies of scale

and specialisation at a specific stage of the value chain such as manufacturing and/or design. Manufacturing is becoming too expensive for all but the biggest IDMs. It costs upwards from US\$2.5 billion to build and equip a new 300 mm fab, and even some large IDMs such as Philips are using specialists (foundries) for more and more of their production.

IDMs have reacted to this trend by moving towards specialisation by product line—for example, Intel has exited memory chips to focus on microprocessors.

Demand in the Semiconductors sub-sector is driven by the demand for 'downstream' electronics industries. Any surge in a particular sector of the electronics industry is magnified in this sub-sector, causing relatively high volatility in the demand for Semiconductors. Volatility in demand varies between product lines. For example, demand for memory chips has historically been much more volatile than demand for analog chips and microprocessors. Adding to the challenge of volatile demand are scale and long lead times associated with capacity additions and the speed of technology innovation. As a result, it is typical to find periods of overcapacity followed by undercapacity over a 3- to 5-year industry cycle.

The recent global economic slowdown has also contributed to the collapse in demand, resulting in excess capacity and inventory accumulation. Demand fell by more than 20% in 2001. Worldwide capacity utilisation was estimated at 65% in the third quarter of 2001 and has possibly deteriorated since then—for example, the utilisation at Seiko Epsom plants were reported at 50% in mid 2002.

Current Australian activity in this sub-sector is minimal. There are very few local companies that focus on Semiconductors. Two listed companies are Silex Systems and Lake Technology, which focus on isotope R&D and audio chip technology respectively. Beyond these local companies, global integrated manufacturers, such as Intel and Toshiba, have only sales and distribution branch offices here. Notably, the CEO of Intel visited Australia in early 2002 and dismissed speculation that Intel might establish a manufacturing plant in Australia.

Outside the private sector, there are publicly funded research bodies dedicated to R&D. Two prominent examples are the UNSW Semiconductor Nanofabrication Facility and the Special

Research Centre for Quantum Computer Technology, which is a joint initiative between the Australian Research Council and key Australian universities. In terms of tertiary training, Victoria University has also recently introduced a Masters of Engineering in Microelectronic Engineering postgraduate degree.

### **An Australian Semiconductor Company: Silex Technology**

Silex, formerly a research subsidiary of Sonic Healthcare, is a technology development company that researches a unique, laser-based, isotope separation technology known as SILEX. This work is focused on enriching uranium for the generation of nuclear power. But the company also explores other applications in semiconductors and nuclear engineering materials.

Silex has secured the rights to patent applications for the Silicon Isotope Superlattice (SIS) technology being developed at Keio University in Tokyo. This technology aims to improve the performance of semiconductors by increasing the electron mobility, or speed, in specially fabricated layers of enriched silicon. A state-of-the-art laboratory has been established at Keio University to produce prototype SIS wafers. The first batch is expected to be available for testing in 2002.

Silex has also reached an agreement with US-based semiconductor start-up, Translucent Photonics, Inc. to fund the development of a photonic semiconductor technology known as Silicon Planar Lightwave Circuits (PLCs). This development could push low-cost silicon into the photonics arena for the first time, delivering major cost and performance benefits. If successful, Translucent PLCs are expected to have broad exposure in the growing photonics semiconductor market, currently worth around US\$11 billion per annum.

In May 2002, Silex acquired a controlling interest in Photonica Pty Ltd, an Adelaide-based photonics company with a unique suite of optical communications products and technologies. Photonica's technologies, for which several Patent applications have been filed, relate to Fibre Optic Test Equipment and Optical Communications Network Technology.

## Trends—Semiconductors

Within this sub-sector, there are three clear trends.

### **Trend 1: Technical innovation will continue.**

Semiconductors have long been equated with Moore's Law—that chip developers can almost double the number of transistors on a chip every 18 months. Some industry projections suggest that this law can be maintained through to 2010. Others predict that technical limits of current manufacturing processes will be reached sometime between 2005 and 2007.

As a result of Moore's Law, price-performance trade-offs improve dramatically over time. It is expected that by 2010 the cost of memory will be only around 5% of its present level, and that microprocessors will be many times faster.

Other technology trends include the development of multimedia chips that accelerate the processing of rich media. Leaders in this field are LSI Logic, Nvidia, ATI and Broadcom.

**Trend 2: Specialist firms are emerging in contract manufacturing and design.** As mentioned earlier, a number of contract manufacturers are emerging in production—for example, Taiwan Semiconductor and Chartered Semiconductor. Several specialist chip design firms are also becoming prominent, such as Cadence Design Systems.

Many successful contract manufacturers are located offshore. These firms include Taiwan Semiconductor Manufacturing Corporation, and United Microelectronics Corporation. Among Asian countries, China is emerging as an offshore manufacturing centre. It accounts for less than 2% of global capacity today, but is expected to triple its capacity in the next 5 years.

The rise of these specialist firms in the supply value chain has been at the expense of the market share held by integrated firms. These integrated firms have reacted by moving towards a product design focus to maximise returns.

**Trend 3: The global economic slowdown will continue, but there will be growth from consumer electronics (games, handhelds) and mobile communications.** Market commentary suggests that it could take another 2 years for the world economy to recover, depressing demand for Semiconductors for some time yet. This is a major concern for

semiconductor manufacturers because their plants are only economic if they produce and sell a certain volume within a certain time frame. As time goes by, innovation continues and those plants become increasingly obsolete.

Growth in the data processing requirements of consumer electronics (eg game consoles and PDAs), however, will continue to drive demand in microprocessors and memory chips.

Similarly, growth in mobile communications will drive demand for integrated System-On-Chip functionality as mobile devices require small sized chips and low power consumption. This will be driven mainly by the take up of next generation handsets, but is spreading into other compact electronics as well. Growth in mobile networking such as 802.11 or wireless line is also driving demand.

### **Uncertainty—Semiconductors**

The major uncertainty - the extent to which standardisation and technology evolution will affect multiple product markets and business models (such as integrated device manufacturers and functional specialists) - gives rise to three possible scenarios.

**Scenario 1: Rapid standardisation of multiple product markets (for example, mobile phone chipsets) disadvantages original equipment manufacturers (for example, handset OEMs) and favours semiconductor manufacturers.** This scenario could see any or all of the following:

- Some semiconductor manufacturers will specialise in standardising product markets such as mobile phone chipsets.
- Semiconductor firms capture value from OEMs through branding—for example, 'Intel Inside'.
- Some product specialists achieve global scale—for example, Tech Semiconductors (based in Singapore) is a global production specialist.
- Foundries expand into design and challenge integrated manufacturers.

**Scenario 2: Integrated manufacturers continue to dominate in a significant number of product markets.** This scenario could see any or all of the following:

- Microprocessors and memory and a number of other product areas continue to be vertically integrated and require intense interaction between production process and design.
- Contract manufacturing will be limited, despite currently emerging practices – for example, AMD ‘fabbing’ out some MPUs to UMC.
- Semiconductor value chains become coordinated around specific product lines led by integrated companies—for example, Intel, AMD.

**Scenario 3: Transition to 300 mm wafer technology will become an imperative for all product markets.** This scenario could see any or all of the following:

- Existing semiconductor plants in all product markets, not just microprocessors and memory manufacturers, become obsolete.
- Early adopters of 300 mm technology threaten existing semiconductor incumbents.

There is also some uncertainty around the evolution of nanotubes and quantum computing in a number of areas – such as achieving acceptable yield on nanometer technologies and the timely emergence of the next-generation lithography tools. There is a concern that investment in fundamental research is on the decline, which will make it all the more difficult to address these problems.

### **Potential Business Models—Semiconductors**

There are three potential business models in the Semiconductors sub-sector.

**Integrated manufacturers** are likely to be sustainable if there is low standardisation in manufacturing of semiconductors. Given the increasing complexity of products, only a few integrated manufacturers—perhaps just 1 or 2—are likely to participate in each product line, such as memory,

microprocessors and analog chips. In this model, successful integrated manufacturers would benefit from:

- Differentiating their products on process technology and building a reputation for product excellence—such as Intel’s reputation for its product, ‘Intel Inside’.
- Significant scale.
- Best-in-class design and short time-to-market for the latest products.
- Focused R&D to meet the needs of large market segments.
- Best-in-class supply chain management—for example, by locating near supplier facilities.

**Functional specialists** are likely to be successful if chips and applications are widely standardised. Several ‘winners’ may emerge in each functional area—for example, in technology development and intellectual property, product design, wafer fabrication, assembly and testing, sales distribution and support. In this model, successful functional specialists would benefit from:

- Strong relationships along the value chain—both upstream and downstream from their chosen specialty.
- Building an early lead as a reputable specialist that delivers functional excellence.
- Capturing economies of scope by serving different product lines.
- Leading innovation in their chosen specialty.



### **Opportunities for Australia—Semiconductors**

There are three areas of opportunity for Australia in the Semiconductors sub-sector.

**Support integrated manufacturers as an offshore R&D centre.** Australia will find it challenging to foster a fully integrated manufacturer in the local market due to the lack of existing scale. However, there may be a small opportunity to develop Australia as an offshore R&D centre in partnership with

global integrated manufacturers. Pursuing this opportunity is likely to be challenging and would require Australia to do the following:

- **Develop world-class R&D talent in Semiconductors.** A Semiconductor Nanofabrication Facility has been established at the University of NSW, there may be an opportunity to leverage this position.
- **Develop commercialisation capabilities.** Australia would need to foster local companies or attract overseas companies that can provide the capital and skills to commercialise new technologies—for example, venture capital companies.
- **Develop global product specialists.** Although there are few, if any, product specialists in the Australian market, there could still be a small opportunity to develop such manufacturers. To be successful in this area, Australian manufacturers would need to do the following:
  - **Identify specialty product areas.** Local companies would need to conduct market research to identify market requirements that are not currently addressed by global integrated manufacturers. For example, Lake Technology found a niche by originating the chip technology behind the Dolby Headphone system.
  - **Access global distribution networks.** This can be achieved by establishing branch offices around the world or by partnering with overseas distributors.

## 5.2

# Computer Systems

Computer Systems are found in almost every home and office throughout the world's developed countries. So it is not surprising that it is the largest of all Hardware sub-sectors—but it is also one of the slowest growing.

Computer Systems encompasses high-end servers and mainframes; low and mid-range servers, including workstations; desktop and laptop computers; and printers.

## Key Statistics

### **2001 Global revenue**

US\$274 billion

### **2001 Australian revenue**

A\$8.2 billion—or 1.6% of global revenue

### **Expected global growth rate to 2005**

Servers—10% decline

PCs and Printers—1 to 2% growth

### **Global market structure: varied**

Servers—concentrated: HP, IBM and Sun Microsystems hold 71% share combined

Desktops and laptops—fragmented: HP, Dell and IBM hold 43% share combined

Printers—concentrated: HP, Epson and Canon hold 79% share combined

### **Multinationals (MNCs) in Australian market**

Servers—concentrated: HP, IBM, Sun Microsystems and Dell hold 95% share combined

Desktops and laptops—fragmented: HP, Dell, IBM, Toshiba, Apple and NEC hold 55% share combined

Printers—concentrated: HP, Canon, Epson, Lexmark and Xerox hold 89% share combined

Examples of Australian companies include Optima and TPG

## Snapshot

The Australian market for Computer Systems generally reflects similar characteristics to the global market and is dominated by imports from major global manufacturers.

Technical advances and the standardisation of components and processes are influencing how, and where, companies design and manufacture their products. These trends are also increasing the entry of low-end manufacturers into high-end and adjacent products.

But there is uncertainty around the degree and pace of standardisation and the assembly process, which could result in structural changes. These changes include entry by firms in adjacent sub-sectors and increased outsourcing.

Against this background, there are three possible business models—high-end differentiated manufacturers; best-in-class manufacturers; and contract manufacturers.

Australian opportunities are likely to be linked to encouraging further on-shore manufacturing and assembly, both for global and local computer system companies. These opportunities, however, are likely to be limited to meeting the needs of the established local market and not overseas demand.

### **Current State—Computer Systems**

Computer Systems have been, and will continue to be, affected by the economic slowdown. The decline in production between 2000 and 2001 is estimated at 10 to 20%. With this, there is intensifying price competition—for example, in 2002, Dell is marketing a PowerEdge server for A\$1,599 with a 'beat the competition' price promise.

Australian revenues in this sub-sector, however, are expected to grow. Revenues for PCs and Printers are expected to grow by 1% to 2%, which is similar to global forecasts. Revenues for Servers are forecast by IDC to grow positively at around 6%, which is counter to global predicted trends.

In line with the global market, IBM, Sun Microsystems and HP led in the Australian markets for high-end and low-end servers. These manufacturers hold approximately 80% share in both markets. Similarly, the top vendors in the Australian market for desktops and laptops are the same as in the global market—HP, IBM and Dell. Together they hold approximately 46% market share.

In terms of Australian presence, most global manufacturers only have sales and distribution offices. The two exceptions to this are Acer and Lexmark. Acer, a major vendor of desktops and servers, has invested A\$15 million in a build-to-order assembly facility in Sydney. Its manufacturing facility delivers customised systems such as high-end multimedia desktops, notebooks and servers directly to local customers. All the original equipment manufacturing, however, is located overseas in Taiwan, the Philippines, Malaysia, China, Mexico and the UK.

Lexmark, a major vendor of printing hardware, has a manufacturing facility in Sydney, together with sales and service offices in the other capital cities. This facility is part of a Fixed

Term Agreement between Lexmark and the Australian Government, under which Lexmark is committed to invest in local manufacturing and export activities.

A number of Australian companies also have local manufacturing operations—for example, Optima, Ipex and TPG. In 2001, these companies were estimated to hold 2.4% and 1.7% share of the Australian market, respectively. Even though this is a very small share of the market, these companies have achieved rapid growth. Optima grew 114% from 2000 to 2001 in terms of unit shipment, and in the last 3 years Ipex has grown its sales turnover by 200%.

### **An Australian Manufacturer: Optima**

Based in Sydney, with offices around the country, Optima is the largest Australian manufacturer of personal computers, notebooks and servers. It offers comprehensive manufacturing, sales and systems integration of its own brand of PCs and has partnerships with technology providers around the world, including Microsoft, Intel and Seagate.

As well as supplying major retail outlets, Optima has now received the status of preferred supplier to the Australian Government and Education sectors. Optima's growth has been achieved through strong growth in PC sales to the education sector and strong retail sales through the Dick Smith electronic stores.

But it is in after-sales support and services where the company believes it will achieve further growth.

*'Everyone understands that PC hardware is a tight market, but . . . eventually the customer is willing to pay a premium for the service work rather than just hardware . . . Optima's service business could outstrip revenues from its hardware business within the next 3 to 5 years.'*—Optima's CEO, Cornell Ung

Beyond these traditional computer system manufacturers, a number of Australian companies specialise in high-end electronic products with embedded software. For example, ERG, Keycorp and Innovonics specialise in smartcards and ticketing systems; Retail Technology and Services specialise in retail scanning systems; Vision Systems and Alpha Technologies specialise in biotech monitoring and measurement instruments; and Intellect Holdings specialises in e-commerce and payments systems.

In addition, several local companies specialise in the sales and distribution of PC systems and related products such as handsets. These companies act as contractors for global original equipment manufacturers. Cellnet is the largest of these contractors, generating A\$247 million revenue in 2001. It operates in Australia and New Zealand and serves most of the major global manufacturers. In handsets, for example, Cellnet serves Nokia, Motorola, Sony Ericsson and Siemens.

## Trends—Computer Systems

There are four major trends impacting the global Computer Systems sub-sector.

**Trend 1: Technical innovation is leading to smaller, higher performance and more energy efficient units.** There has been a gradual increase in the performance of low-end computer processing units. Miniaturisation and energy efficiency are areas of constant innovation. For example, the laptop market is demanding an extended battery life through energy conservation, and continuous-use equipment buyers are demanding lower electricity consumption.

**Trend 2: Greater standardisation of Computer Systems has led to outsourcing of design and manufacturing, often offshore.** This trend is most prevalent in PCs—HP and Toshiba outsource design and production, but continue to control research and sales and marketing. Outsourcing is less common in more sophisticated products. High-end servers remain vertically integrated—for example, Sun outsources assembly of low-end products but assembles high-end products in-house.

Standardisation also drives regional specialisation. Production is relocated to countries with lower costs—for example, Quanta of Taiwan manufactures 20% of the worldwide supply of notebooks and Sun has located assembly in Scotland because it has lower costs than US locations.

**Trend 3: There is an increasing use of low-cost sales channels and a trend towards just-in-time production.** Direct service is most prominent in laptops and desktops but is now gaining in low-end servers. It could also be adopted in the printer market. Dell Computer champions the direct model with a rigorous approach to cost elimination. Sales are confirmed via Dell's website, thus eliminating the margins of the retailer. Sales

are filled to order, again eliminating the more costly alternative of production forecasts. Volume discounts on components are achieved through buying power. And suppliers are encouraged to co-locate to enable just-in-time supply-chain management.

**Trend 4: Low-end manufacturers are increasingly offering high-end and adjacent products.** Growing standardisation has improved price-performance characteristics of certain product lines, for example, servers versus mainframes and laptops versus desktops. Growing standardisation has also enabled offshore manufacturers of low end product lines and companies with 'best-in-class' supply chain management and outsourcing skills to enter high-end products. For example, Dell, traditionally a desktop manufacturer, has entered servers and printers.

### Uncertainty—Computer Systems

The uncertainty around the degree to which computer components and systems will become standardised gives rise to two possible scenarios.

**Scenario 1: Rapid and complete standardisation will drive disaggregation of the value chain and favour functional specialists.** This scenario could see any or all of the following:

- Most product lines are standardised—for example, the high-end server market becomes less differentiated.
- Many new competitors enter—for example, a best-in-class supply chain manager (say, from consumer electronics) enters all product lines, or an offshore contract manufacturer challenges manufacturers.
- The value chain disaggregates into functional specialists in R&D, design, production and sales and marketing.
- Offshore contract manufacturers become global manufacturers.
- R&D and design also move offshore.

**Scenario 2: Slow and incomplete standardisation will support the position of original equipment manufacturers and limit opportunities for functional specialists.** This scenario could see any or all of the following:

- Performance differentiation in high-end products persists and the market for high-end devices grows.
- Cross-sector entry is limited.
- Outsourcing, especially offshore, is limited to the design and manufacture of low-end products and manufacturers continue to capture most of their value through sales and marketing.

### Potential Business Models—Computer Systems

Depending on how the uncertainty in Computer Systems unfolds, there are three business models that could prevail.

**Best-in-class original equipment manufacturer** is likely to be the most sustainable business model if there is a high level of standardisation in Computer Systems products. In this model, successful manufacturers benefit from:

- Scale in individual products that allows them to capture economies of scope—for example, using one ordering system and purchaser/supplier network for multiple product lines.
- Outsourcing or moving design and production offshore.
- Strong supply chain management skills
- Strong brand and sales and marketing.

**High-end differentiated product manufacturers** are likely to be the most sustainable business model if there is a low level of standardisation in Computer Systems products. Key product lines are likely to have their own winners—for example, there would be different manufacturers for printers and for laptop markets. In this model, successful manufacturers would benefit from:

- Product differentiation through continuous innovation.
- Cost advantages through experience in managing specific product lines—for example, by removing functionality that is not valued by consumers.
- Limited outsourcing, both locally and offshore, of low-end products. For those products, they will continue to capture value through sales and marketing.

**Contract manufacturers** are likely to be sustainable in either scenario, but they will be better positioned in the 'high level of standardisation' scenario. In this model, there would be lower costs for successful contract manufacturers because of labour cost advantages and strong relationships with leading manufacturers.



### **Opportunities for Australia—Computer Systems**

Several potential opportunities exist to grow Australia's involvement in the Computer Systems sector. The most attractive of these opportunities is to develop global manufacturers in specialty high-end systems.

**Develop global manufacturers in specialty high-end systems.** As noted, there are a number of Australian companies with global presence in several high-end product areas. These include smartcards and ticketing systems, retail scanning systems, biotech monitoring and measurement instruments, and e-commerce and payments systems. These types of Australian companies could become global leaders in their respective products by focusing on several important attributes and capabilities:

- Talent, either locally or from overseas, in each of the identified product areas.
- R&D to maintain product innovation and differentiation in each area.
- Target markets for each of the product areas and global distribution networks in those markets established through partnerships and alliances.

**Support best-in-class global original equipment manufacturers.** There are opportunities to encourage more global companies to perform their assembly in Australia. However, these opportunities are likely to be limited to supplying the local Australian and New Zealand markets, not broader overseas markets.

As discussed, Acer and Lexmark have both made major investments in assembly operations in Australia. The strategic rationale driving these investments has been to provide superior service and customised solutions to local customers in the

Australian market. This strategy has proven successful for these companies, especially for Acer, which was the fastest growing PC brand in Australia in 2002. A similar proposition could be emphasised to other global manufacturers to encourage them to locate their assembly facilities in Australia. However, the proposition for establishing an assembly plant that is close to customers is, by definition, limited to proximate markets. Therefore, the opportunity to attract global manufacturers to perform assembly processes in Australia is likely to be limited to supplying the Australian and New Zealand markets – and attractiveness of this is unclear given assembly for the local market is likely to be sub-scale for most providers.

To encourage global manufacturers to locate assembly plants in Australia would require Australia to demonstrate the following:

- Local demand for customised solutions and after-sales service.
- Strong local talent in assembly, especially in delivering customised solutions.

### **Develop best-in-class local original equipment**

**manufacturers.** The presence of Optima and Ipex suggests that there may be an opportunity to develop local equipment manufacturers. While these companies currently only capture 4% share of the market, they have grown strongly in the last few years—Optima, for example, grew 114% from 2000 to 2001 in terms of unit shipments. This suggests that these companies could develop into more significant manufacturers in the local Australian market. However, given the scale difference between these companies and the global manufacturers, it would be challenging for these companies to penetrate overseas markets.

To develop a strong local manufacturing presence, local companies would need to do the following:

- Develop local talent in both design and manufacturing as well as in after-sales and service of PCs and related products.
- Maximise scale in their existing manufacturing processes to reach and maintain cost competitiveness and continue to invest in R&D to develop superior manufacturing processes.
- Strengthen their relationships with important customer segments, such as the government and education sectors.

They could also broaden their distribution networks to include a greater number of retailers.

**Develop local contract manufacturers.** Although this opportunity exists, it is unlikely that local contract manufacturing companies could support major global manufacturers. First, there is currently no significant contract manufacturing operation in Australia. Second, establishing a manufacturing plant would require a great deal of capital investment. Last, Australia is unlikely to be cost competitive with several other Asia-Pacific countries such as China and Taiwan, which benefit from much lower labour rates.

## 5.3 Data Storage

Data Storage includes three different types of storage equipment—disk storage, optical storage and tape storage.

Disk storage comprises DAS (Direct Attached Storage), SAN (Storage Area Networking) and NAS (Network Attached Storage).

Optical storage comprises CD/DVD-ROM, CD/DVD-Recordable drives, MO-Removable drives, optical drives and low-end magnetic drives.

Tape storage comprises a suite of products lines, from low to enterprise level.

## Key Statistics

### **2001 Global revenue**

US\$37 billion

### **2001 Australian revenue**

A\$765 million—or 1.1% of global revenue

### **Expected global growth rate to 2005**

Disk and Tape Storage: 4%

Optical storage: 9%

### **Global market structure: concentrated**

Disk storage—concentrated: HP, EMC and IBM hold 56% share

Optical storage—concentrated: Hitachi-La, Samsung and Lite-on hold 40% share

Tape storage—concentrated: Quantum, Storage Tek and Sony hold 59% share

### **Multinationals (MNCs) in Australian market**

Concentrated—HP, EMC, IBM, Sun Microsystems, XSI Technology and HDS hold at least 75% share

## Snapshot

Data Storage is a relatively concentrated sub-sector that is undergoing a shift in structure as storage architecture changes from server-attached to network-based.

The market is characterised by increasing standardisation in equipment and related software, which is leading to greater outsourcing, especially offshore. In addition, the economic slowdown has triggered horizontal integration and Hardware firms are moving into Software and IT Services.

The largest uncertainty in this sub-sector is the degree and pace of the shift towards network-based storage architectures.

Against this background, three business models are likely to evolve. Scale equipment vendors will prevail if network-based storage architectures dominate and become highly standardised. Product specialists will prevail if no storage architecture emerges as dominant and products become more differentiated. Contract manufacturers can perform well in either of these scenarios.

At present, Australia is not involved in any significant development or manufacturing of storage equipment. However, local telecommunication companies and ISPs/ASPs have partnered with MNCs to become storage service providers for the local market.

### **Current State—Data Storage**

To date, Data Storage manufacturers have enjoyed high margins because of the relatively concentrated market. For example, disk systems have enjoyed up to 40% gross margins where the Top 3 firms hold 56% share. EMC leads the market in server-attached external disk storage and SAN. Network Appliance leads in Network Attached Storage (NAS) and HP leads in server-attached internal architecture. Following the recent entry of new competitors—for example, Dell's entry—margins have declined to around 20%.

Growth in long-term Data Storage will be influenced by growth in the following areas:

- Existing enterprise applications—for example, Supply Chain Management (SCM), Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM).
- New applications—for example, video on demand.
- Networked applications—for example, email and Internet usage.
- Infrastructure applications.
- Data warehousing—for example, data copied via replication, mirroring, backup or caching.

Near-term demand may suffer from enterprise IT organisations imposing restrictions on data growth. The mid-term demand for disk storage could be restricted until bandwidth-on-demand is available and until enterprises commit to offsite data management. Despite these restrictions, the demand for storage capacity is still predicted to grow at more than 70% per annum, with the average cost per gigabyte declining at 38% annually.

The market for Data Storage varies by type of equipment. Disk Storage is sold primarily to enterprise customers. This has resulted in vendors using a dedicated sales team approach with

account managers. Optical and Tape Storage are sold to both enterprise and consumer segments as low unit costs have driven sales through wholesale and retail outlets.

In terms of market structure, the Data Storage sub-sector is largely vertically integrated with only limited outsourcing of production. Market leaders EMC and Network Appliance, for example, remain largely vertically integrated although EMC does have a sales and marketing alliance with Dell. This vertical integration may remain viable in disk systems where the hardware is highly differentiated. In low-end tape and optical storage, however, the increasing standardisation of the equipment is likely to lead to a disaggregation of the value chain and increased outsourcing by the major companies.

### **World's Leading Storage Equipment Manufacturer—EMC**

EMC Corporation is the leader in networked information storage and information management software. EMC's customers include the world's largest banks and financial services firms, manufacturers, telecommunications providers, airlines, transportation companies, Internet providers, retailers, educational institutions, pharmaceutical companies and regional and national government agencies.

EMC began its rapid rise in the worldwide information storage market in 1989, when the company revised its strategy to address the world's growing reliance on vast amounts of electronic data. Key achievements in recent years include its development of Storage Area Networks (SAN) and its combination of Network Attached Storage (NAS) and SAN technology. In 2001, EMC led in a number of major systems category, including external SAN, NAS and networked storage (NAS and SAN combined).

Over 2000/01, EMC's revenues from network information storage grew 26%, reaching US\$2.7 billion. The most recent projections from IDC indicate that EMC's 2001 market share in networked information storage (SAN and NAS) was 37%, exceeding the combined revenues of the next three vendors. Revenue from information storage software grew 9% in 2001 compared with 2000, reaching a record US\$1.6 billion. Service revenues for EMC also grew 59% between 2000 and 2001, reaching US\$972 million.

There are no significant local manufacturers listed in the Australian market, either in low-end or high-end equipment. HP, EMC, IBM and Sun are entrenched as major providers, accounting for a total of 61% market share. Their Australian presence in Data Storage, however, is limited to branch office sales and distribution. They do not conduct manufacturing or R&D in Australia.

There are, however, local telecommunication companies and ISPs/ASPs who currently act as storage service providers in the Australian market. These companies are partnered with global vendors to access storage equipment. An example of this is the partnership between Telstra and EMC.

## Trends—Data Storage

In the Data Storage sub-sector, there are five trends.

**Trend 1: An explosion in network traffic is driving growth in network-attached storage (NAS).** This represents a move beyond internal enterprise networks towards external options that, in addition to Network Attached Storage (NAS), include Storage Area Networking (SAN). Currently, network-based storage comprises about 30% of the market and this figure is expected to rise to 35% by 2004/5. Despite this movement, server-attached internal storage is likely to remain the main storage architecture until at least 2005.

**Trend 2: There is increasing standardisation across, and within, storage segments.** CDs and DVDs are replacing traditional low-end tape storage products such as cassettes and floppy disks and are themselves now considered low-end storage products. Prices for all of these products are falling while their performance and functionality are increasing. This trend has resulted in the curtailment of further development of low-end tape systems by major manufacturers including HP, Sony and Seagate. Mid- to high-end tape technologies are also moving away from proprietary formats to open standards. For example, in 2001, HP, IBM and Seagate jointly developed and launched Linear Tape Open (LTO) technology.

**Trend 3: Outsourcing, especially offshore, is being used to protect margins.** One example of this is EMC's recent discussions with Dell about outsourcing production of EMC's mid-range products to Dell's Latin America facilities. This trend is likely to continue for more standardised products. This includes most Tape and Optical Storage products and increasingly some low-end Disk Storage products.

**Trend 4: A number of hardware manufacturers are moving into Data Storage, leading to a more contested market.** Dell already co-brands its low-end products with EMC. And, in August 2002, Cisco acquired Andiamo Systems, a maker of storage switches. Although they have yet to move, IBM & HP have committed additional resources to storage and it is said that because of the generally low valuation of storage manufacturers they could even look to acquire EMC.

**Trend 5. Data Storage manufacturers are moving into Software and IT Services.** The shift to NAS and SAN may

herald a change in the focus of the value chain. Until now, competition has focused within R&D and product capability. There is now an opportunity for Data Storage manufacturers to move towards service provision and whole-of-system storage management solutions. For example, EMC now has divisions in Software and Services.

### Uncertainty—Data Storage

The uncertainty around the degree and pace of the shift towards network-based storage architectures gives rise to two possible scenarios.

**Scenario 1: High take-up of networked-based storage architecture and equipment, creating opportunities for network-based storage service providers.** This scenario could see any or all of the following:

- One open standard disk storage architecture prevails—for example, SAN, NAS or its future derivative.
- Disk storage systems and related network equipment and communication software are standardised.
- There are several 'winners' who have global scale in standardised product lines.

**Scenario 2: Low take-up of network-based storage leading to the continuation of existing market dynamics.** This scenario could see any or all of the following:

- Competing storage architectures co-exist.
- Disk storage hardware, and other related network hardware, remains differentiated between vendors. Communication software also remains discrete.
- A number of winners by product co-exist, competing on scale within a chosen storage architecture.
- Reference clients are more important.

### Potential Business Models—Data Storage

**Scale vendors** are likely to prevail if network-based storage architecture emerges as the dominant technology and leads to

high product standardisation. In this model, successful manufacturers benefit from:

- Economies of scale.
- Excellent production management and outsourcing.
- A strong brand.
- Experience managing indirect service providers, such as local technicians who provide maintenance.

Incumbent vendors may be well placed to pursue this opportunity.

**Product specialists** are likely to prevail if storage architectures continue to compete. In this model, successful manufacturers would benefit from:

- Scale within the chosen storage architecture.
- Moving offshore to achieve lower production costs.
- A strong brand.
- Relationships with reference clients.
- Skills to manage differentiated product lines.

**Contract manufacturers** will be sustainable in most outcomes. In this model, successful manufacturers would benefit from:

- Relationships with market leaders.
- Low cost base.
- A reputation for excellence.



## Opportunities for Australia—Data Storage

Given the lack of storage equipment manufacturing or R&D in the Australian market, it would be difficult to foster any such activity in the future. Developing local companies or persuading global manufacturers to undertake additional activities here beyond sales and marketing does not appear to be promising.

Australia could, however, have a small opportunity to develop the local telecommunication companies and ISPs/ASPs—who currently act as storage service providers in the local Australian market—into regional service providers. This would be a significant challenge given that these local service providers have had only modest success in storage services in the Australian market to date. Naturally, these providers must improve their local operations before rolling out their business models into new geographies. Moreover, these service providers would need to do the following:

- **Develop relationships with customers in other geographic locations.** Although the local telecommunication companies and ISPs/ASPs have relationships with customers within Australia (such as large corporates and government agencies), they do not have a significant portfolio of overseas customers.
- **Access quality storage equipment and network infrastructure in new markets at a competitive cost.** Currently, the local service providers have partnerships with global vendors to offer storage services in the Australian market—for example, the partnership between Telstra and EMC. These service providers would need to extend their partnership agreements with global manufacturers before expanding their service offerings overseas. They would also need to ensure they have access to other required network infrastructure in the target market, which would be critical to their ability to offer acceptable SLAs to customers.

## 5.4

# Networking Equipment

The Networking Equipment sub-sector comprises Local Area Network (LAN) devices and Wide Area Network (WAN) devices. The main products are routers, optical switches and data switches.

## Key Statistics

### **2001 Global revenue**

US\$50 billion

### **2001 Australian revenue**

A\$1.6 billion—or 1.7% of global revenue

### **Expected global growth rate to 2005**

6 to 8%

### **Global market structure: concentrated, especially in high-end product lines**

Top 3—Cisco, 3Com and Nortel Networks—hold over 60% share. In some high-end product lines, market concentration is even higher—for example, Routers where Cisco, Juniper and Nortel Networks hold 91% share

### **Multinationals (MNCs) in Australian market**

LAN Hardware—concentrated: Cisco, Nortel and 3Com hold 72% share combined

WAN Hardware—concentrated: Alcatel, Nortel and Cisco

Australian companies include Netcom (modems), CTAM (ATM Security modules), Redfern Photonics

## Snapshot

The global market for Networking Equipment is highly concentrated. Large integrated vendors have historically been strong in the market, although there is evidence that contract manufacturing and distribution alliances are becoming prevalent.

The Australian market is dominated by global integrated vendors. Some of these vendors have established significant R&D centres in Australia. These R&D centres are complemented by a number of local Australian publicly funded research groups. Photonics is an area where Australia is regarded as world class.

Looking forward, there are five clear trends—lower end technology and products are increasingly standardised; manufacturing is increasingly being outsourced and/or relocated to low cost geographies; horizontal integration is increasing as firms enter from adjacent markets; growth in the market is

being driven by the WAN take-up; and equipment vendors are increasingly moving into Software and IT Services.

The main uncertainty in the market relates to the extent of migration to IP Networks and the distribution of functionality between LAN and WAN. The outcome of this uncertainty will shape how value is shared between networking equipment, computing equipment and communications equipment vendors.

Opportunities for Australia in Networking Equipment are likely to be in expanding the existing R&D base for MNCs and supporting local companies to commercialise their own R&D.

### **Current State—Networking Equipment**

There are high fixed R&D costs in Networking Equipment. And the concentrated market structure in this sub-sector is a result of the scale required to offset that investment. To date, this situation has allowed the top manufacturers to maintain high margins. However, these margins could come under threat as products mature and entry from adjacent markets becomes more feasible.

At present, demand in this sub-sector is driven by carriers and the broader corporate segment. This makes relationships with large MNC customers a key success factor for Networking Equipment firms. Growth in demand broadly follows the economic cycle but it is also influenced by technology. Individual network purchases are typically very costly and are therefore dependent on enterprise capital expenditure and IT budgets. This exposure to economic cycles has led most vendors to offer after-sales service to maintain revenue streams when demand for primary purchases slows down.

While the Networking Equipment market has traditionally been vertically integrated, contract manufacturing and distribution alliances are now widely used—except in those cases when specialised skills are still required.

In 2001, the Australian market spend comprised A\$792 million in LAN Hardware and A\$856 million in WAN Hardware—and is forecast to grow by an average annual rate of 7% until 2005.

Major global manufacturers dominate the local markets for both LAN Hardware and WAN Hardware. In LAN Hardware, Cisco is the leading vendor in Australia and New Zealand with 69%

market share. Nortel and 3Com are the second and third largest manufacturers, holding approximately 8% and 5% market share respectively. In WAN Hardware, Alcatel, Nortel and Cisco are the leading vendors in Australia and New Zealand.<sup>8</sup> Global manufacturers, such as Nortel Networks, NEC Australia, Lucent Technologies and Alcatel, have established sales and distribution in Australia and have invested to establish engineering and R&D centres.

Complementing these private R&D centres are a number of publicly funded research groups that specialise in Networking Equipment technology. Some of these research groups have relationships with the offshore R&D centres of global manufacturers.

One particular area where Australia has a global reputation for world-leading research is the photonics sector. The Australian Photonics Cooperative Research Centre leads this work, with a research staff of over 60 full-time equivalents and over 230 members associated with its 28 participants. In a venture that involves Australia's major universities and industry, the Australian Photonics Cooperative Research Centre coordinates over 90% of Australia's research and development in optical fibre and photonic technology.

Notably, an Australian company, Redfern Photonics, has also emerged in recent years. And other examples of prominent research groups in the area of Networking Equipment include the Australian Telecommunications CRC and the Australian Partnership for Advanced Computing (which has partnered with Cisco to research Grid and Next Generation Networking).

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<sup>8</sup> Market shares of these manufacturers are not available

### **From Australia's 'Science and Technology Hothouse'— Redfern Photonics**

Established in November 1998, Redfern Photonics invests in, and commercialises, Australian research and development outcomes in photonics. Its ability to draw on the resources of the country's finest research and academic institutions has allowed it to advance the development of photonics networks for the global service provider, access and enterprise markets.

Redfern Photonics is unique in its breadth of photonics technology. It develops, manufactures and distributes a range of components and systems for this burgeoning market. The Group is supported by numerous separate subsidiary and investee companies—and each has its own product and business focus, including a range of vertically integrated products in the high speed, high bandwidth networking and communications segment.

These products range from Application Specific Optical Fibre, passive and active photonic components for the Dense Wavelength Division Multiplexer (DWDM) market, integrated optical devices (planar lightwave circuits), Polymer Microstructured Optical Fibre and terabit networking platforms for Metropolitan Area Networks.

Redfern Photonics is located in the centre of Australia's 'science and technology hothouse'—the Australian Technology Park at Redfern, Sydney.

## Trends—Networking Equipment

There are five trends at work in the Networking Equipment sub-sector.

**Trend 1: 'Lower-end' technology and products are becoming increasingly standardised.** Hubs, NICs, bridges and modems are already regarded as commodity products, and routers and some switches are also becoming standardised. This trend will continue to create opportunities for scale manufacturers, such as PC manufacturers, to enter from adjacent markets.

**Trend 2: Manufacturing is increasingly outsourced, frequently to contract manufacturers in low cost countries.** For example, Juniper Networks outsources most of its production to contract manufacturers. Furthermore, large network equipment contract manufacturers have emerged in lower cost countries such as Taiwan—manufacturers such as Accton Technology Group, D-Link Corp and GVC Corp. As a result, OEMs are refocusing their business models on either R&D or after-sales service. In addition, successful OEMs will need to develop the skills required in managing production in low-cost countries or risk losing business to contract manufacturers and specialist sales and distribution firms.

**Trend 3: There is an increase in horizontal integration as companies enter from adjacent markets.** This trend is driven by the commoditisation of low-end products and companies looking for additional growth. One example of this trend is Dell's move into selling switches, which it sources from Networking Equipment vendors. Computing equipment vendors are also pursuing low-end Networking Equipment markets, such as NICs, hubs and low-end routers. This will likely lower overall margins as manufacturers from adjacent markets capture value from Networking Equipment manufacturers. Entry by 'best-in-class' value chain managers is most likely for highly standardised products.

**Trend 4: The uptake of WAN equipment is driving overall market growth.** The WAN equipment market is growing at 15% per annum and is being led by switches and WAN routers, which are growing at 19% and 17% respectively.

By contrast, annual growth in LAN equipment has slowed to 1%, with revenues in NIC and hubs declining by 1% and 8% respectively, and revenues in switches and LAN routers growing by 6% and 8% respectively. If this trend continues, there will be increasing pressure on manufacturers in low-end LAN markets to operate as best-in-class manufacturers of standardised products.

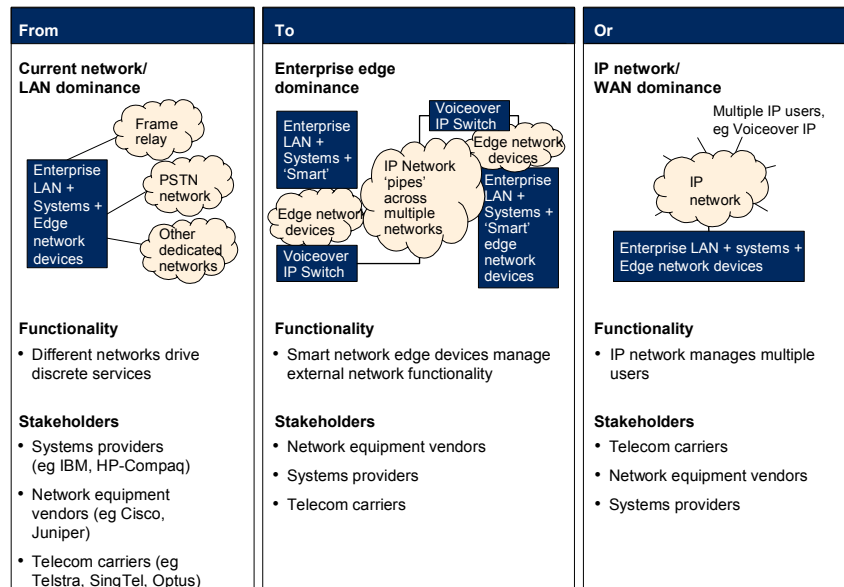
**Trend 5: Increasing pressure on margins is leading Networking Equipment vendors to move into Software and IT Services.** A clear example of this trend is Cisco’s move into network services to generate further revenue. In the same way, Nortel Networks is moving into network services and helping customers to upgrade legacy equipment.

### Uncertainty—Networking Equipment

There is uncertainty around the extent of migration to IP Networks and how carriers and corporates will choose to distribute functionality between LAN and WAN. The outcome of this uncertainty will shape how value is shared between networking equipment, computing equipment and communications equipment vendors (Exhibit 14).

Exhibit 14

#### NETWORK EVOLUTION POSSIBILITIES



This uncertainty gives rise to three possible scenarios.

**Scenario 1: There is significant migration to IP networks, which is accompanied by a concentration of functionality in WANs.** This scenario could see any or all of the following:

- Ubiquitous IP networks.
- High level of outsourced network services.
- Extensive low cost, shared connectivity across public Internet and service provider IP networks.
- New opportunities in the development and management of the carrier-class service provider equipment markets. There could also be opportunities in standardised low end product lines.

**Scenario 2: There is a high migration to IP networks, but only limited migration of functionality to WAN and most functionality residing in 'Edge' technology.**<sup>9</sup> This scenario could see any or all of the following:

- Ubiquitous IP networks in use by enterprises.
- Significant functionality resides in the enterprise LAN and 'Edge'.
- Opportunities in the development and provision of Edge services as firms compete in the Edge environment.
- Decreasing costs and increasing product standardisation encourage outsourcing of production.

**Scenario 3: There is limited migration to IP networks and most functionality is located in LANs.** This effectively represents a mild evolution beyond the present industry landscape. This scenario could see any or all of the following:

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<sup>9</sup> In this context, the Edge refers to the technology linking backbone providers with end users. Edge providers include hosting companies and content delivery network service providers, who have the potential to disintermediate the value chain of network services between backbone providers and end users. This would occur if there is sufficient build up of legacy equipment and significant switching costs to WAN

- Functionality is primarily accessible within LAN.
- WAN connectivity and leasing are high cost.
- Networking Equipment investment is driven by existing trends and applications. For example, investment opportunities focus on improving LAN connectivity for PCs, email use, Internet access, websites, web hosting, and remote access and mobile computing.
- Little market disruption to the existing market definitions in Edge and enterprise network equipment, systems and communications equipment.

### Potential Business Models—Networking Equipment

Depending on how the uncertainty in Networking Equipment unfolds, there are three business models that could prevail.

**High-end equipment vendors** are likely to be sustainable if there is a significant migration to IP networks accompanied by a shift of functionality to the WAN. In this model, successful manufacturers would benefit from:

- Capability in carrier-class technology, IP fax and telephony servers.
- Hardware expertise that they can leverage via bundled service offerings—for example, in VPN management—and use to drive greater outsourcing—for example, where a network manager administers a security server.

Other likely manufacturers will succeed by building IT Service companies around new WAN-based functionality—for example, offsite security storage.

**Low-end equipment vendors** are likely to be sustainable if there is significant migration to all-IP networks but only limited migration of functionality to WAN and with most functionality residing in the 'Edge'. In this model, successful manufacturers would benefit from:

- Control over Edge technology and equipment.
- Brands that embody reliability and quality

- Showcase reference clients
- Low-cost after-sales service and maintenance capabilities.
- Loyal customers by building a large installed base with contracted options to upgrade their equipment.

Other successful manufacturers will win by partnering with lead vendors to provide service and/or maintenance or distribution. Alternatively, they will seek to become low-cost contract manufacturers for low-end product outsourcers.

**Functional specialists either in low-end production or service provision** will be well positioned if there is low migration to IP networks with most functionality located within LANs. In this model, successful manufacturers would benefit from:

- Quickly building installed bases in key hardware products. For Networking Equipment vendors, this would include LAN hubs, switches, routers, remote access servers and modems. For systems manufacturers, this would mean web-hosting servers.
- Exposure to higher growth sub-sectors, such as WAN equipment, while being wary of over-investment and volatile customer demand.

Other manufacturers can also win in low-end product lines—for example, NICS and modems—by leveraging production management skills to achieve a low-cost base.



### **Opportunities for Australia—Networking Equipment**

Against this background, there are three opportunities that Australia could pursue.

**Support major global low-end and high-end equipment vendors by strengthening Australia’s position as an offshore centre for R&D.** As discussed, there are already a number of global manufacturers that have local R&D centres. Australia could work to either encourage these MNCs to further invest in these centres or encourage more MNCs to establish R&D centres. Their presence could help build critical mass and momentum in local R&D and transfer key skills to the local workforce. However, the major risk is that these MNCs could

close their R&D centres in Australia at their discretion. A recent example is Ericsson, which had its major regional R&D centre located in Australia but has now closed the centre as part of the company's global reduction in R&D operations.

To capture this opportunity, Australia would need to do the following:

- **Maintain or build distinctive local R&D skills.** Australia already has a world-class local pool of R&D talent in Networking Equipment, especially in Photonics. Given this strong base in R&D, Australia could further promote itself to other global manufacturers as an attractive location to locate R&D.
- **Foster demand for innovative Networking Equipment.** Most MNCs initially established R&D centres in Australia in response to a unique demand requirement from local customers. For example, Ericsson first established its R&D presence in Australia because Telstra needed switches with higher performance than was available at the time. Therefore, the encouragement of local enterprises and carriers to demand more innovative equipment could act as a stimulus for attracting MNCs to conduct more R&D in Australia.

**Develop local companies through distinctive local R&D.** As discussed earlier, there are a few existing Australian companies commercialising R&D in network technologies. Australia could support these companies with a view to developing Australia into a centre of innovation and incubation. The most likely model for these companies would be to sell to MNCs after commercialisation as it would be difficult for them to develop into full global scale manufacturers.

An often-cited successful example of this model is Radiata, which researched and developed chipset technology for high-speed wireless networks, commercialised the technology, and was then acquired by Cisco for US\$295 million in November 2000. The benefits of pursuing this opportunity, therefore, are that shareholder wealth would be generated by local companies and retained in Australia. However, the risk is that a number of these companies could fail.

To be successful, Australia would need to strengthen its commercialisation capabilities in a broader set of network

technologies. Outside Photonics, there are few examples of joint government-venture capital incubators. And even the Australian Photonics CRC now only offers limited support to its start ups in low level accounting—it had previously helped incubate its start-ups by offering infrastructure, HR, accounting and mentoring. One solution could be to focus the ICT Centre of Excellence on helping local companies to access commercialisation capabilities.

**Develop local telcos and ASPs/ISPs to become regional network service providers.** Australia might have an opportunity to develop local telcos and ISPs/ASPs into regional service providers. However, this is a significantly lower priority opportunity because it requires building the following attributes and capabilities:

- **Develop relationships with customers in overseas markets.** Although the local telcos and ISPs/ASPs have relationships with customers within Australia, such as large corporates and government agencies, they do not yet have a portfolio of overseas customers. To build this portfolio, service providers would need to build dedicated sales forces for each target market.
- **Access Networking Equipment in new markets at a competitive cost.** Before expanding their service offerings overseas, local network service providers will need to ensure that they can access quality network infrastructure in the target markets at a competitive cost. This could be difficult in a number of Asian markets, which still have generally under-developed infrastructure—for example, China. Without access to quality network infrastructure, local service providers will not be able to offer acceptable SLAs to their prospective customers.

## 5.5

# Handsets and Handhelds

Handsets and Handhelds are becoming increasingly commonplace in most developed countries, reflecting the growing importance of wireless technology in everyday life. Approximately 400 million handsets were produced in 2000.

Mobile telephone handsets and handheld personal digital assistants (PDAs), such as the 'Palm Pilot', are some of the devices included in the scope of this Hardware sub-sector.

## Key Statistics

### 2001 Global revenue

US\$96 billion

### 2001 Australian revenue

A\$1.1 billion—or 0.6% of global revenue

### Expected global growth rate to 2005

Handsets: approximately 1%

PDAs: approximately 13%

### Global market structure: concentrated

Handsets—concentrated: Nokia, Motorola and Ericsson hold 56% share

PDAs—concentrated: Palm, HP and Handspring hold 58% share

### Multinationals (MNCs) in Australian market

Handsets—concentrated: Nokia, Motorola and Ericsson hold 78% share

Handhelds—concentrated: Palm, HP and Casio hold 93% share

Examples of Australian companies include QPSX (IP mobile technology) and Voxson (GPRS modules for mobiles)

## Snapshot

The market for handheld mobile phones is relatively concentrated, with the Top 3 firms holding 56% of total market share. The market for handheld PDAs is similarly concentrated.

In telecom handsets, the intense competition for share and penetration has resulted in downward price pressure. To be cost competitive, manufacturers require economies of scale in production, efficient supply chain management and global distribution.

There is no direct measure available for the total spend on handsets in the Australian market, but the IDC estimates that approximately 5 million units were sold in 2001. Consistent with other developed markets, the Australian handset market is starting to show signs of saturation, with limited growth in demand. In contrast to handsets, the handheld market is smaller and less developed.

There are three global trends in this sub-sector—the fast pace of technology innovation; manufacturers are outsourcing or

locating their own production offshore; and the handset and handheld PDA markets are continuing to grow.

The uncertainty in Handsets and Handhelds surrounds the degree of convergence between handheld PDAs and mobile handsets and the extent to which functionality will increase. Depending on how this uncertainty unfolds, there are three business models that could prevail—Handset/Handheld OEMs, converged device OEMs, and functional specialists.

The existing Australian presence in Handsets and Handhelds is predominantly in R&D and sales and distribution. Looking ahead, Australia could broaden its existing R&D base and increase its support of global handset manufacturers as an offshore R&D centre. Capturing this opportunity, however, is likely to be challenging.

### **Current State—Handsets and Handhelds**

The market for handheld mobile phones is relatively concentrated, with the Top 3 firms holding 56% of total market share (and the Top 10 manufacturers hold 86%). Leaders by shipment are Nokia, Motorola and Ericsson with 31%, 15% and 10% share respectively.

Similarly, the market for handheld PDAs is relatively concentrated, with the Top 3 producers—Palm, Handspring and HP—comprising 58% of the market by shipments. Palm's leading market share was eroded in 2001 from 45% to 34%, and HP and Handspring increased their market shares to 13% and 11% respectively. Another new player is Blackberry, which has developed a wireless email solution.

In telecom handsets, vendors have invested heavily in both R&D and marketing. They have sought to capture market share to spread their development and marketing costs across a broad user base. Intense competition for share and efforts to drive penetration have resulted in downward price pressure. To be cost competitive, manufacturers require economies of scale in production, efficient supply chain management and global distribution. They are also beginning to selectively outsource and move manufacturing offshore for their standard lines. Vendors work jointly with content and application developers to offer compelling functionality and user-services.

In handheld devices, vendors have focused on aggressive marketing to establish market share and on R&D to develop distinctive functionality. Manufacturers have also focused on Operating System software as a critical factor in establishing market leadership. Relative to handsets, the handheld market is still smaller and less developed and handheld manufacturers are predominantly vertically integrated.

There is no direct measure available of the total spend on handsets in the Australian market, but IDC estimates that approximately 5 million units were sold in 2001. Given the average cost of handsets in Australia in 2001 was estimated to be A\$200,<sup>10</sup> this suggests that the total 2001 Australian spend was approximately A\$1.0 billion. This estimate represents 0.6% of the current global market for handsets.

For handhelds, the IDC estimates that the total Australian market for PC Companions and Personal Companions in 2001 was approximately A\$135 million. This estimate represents 1.2% of the current global market for handhelds.

Consistent with other developed markets, the Australian handset market is starting to show signs of saturation with limited growth in new demand. New subscribers at this point in the product cycle tend to have lower usage levels than average. They also tend to be less affluent, making them more likely to purchase lower priced handsets. Most of the demand for handsets is generated from handset renewal among existing users.

Nokia, Ericsson and Motorola dominate the local Handset market, accounting for approximately 52%, 14% and 9% of the market respectively. Each of these manufacturers has local branch offices for sales, distribution and technical support, but, more importantly, Nokia and Motorola currently have R&D centres in Australia. NEC Australia is another example of a global vendor that conducts a significant amount of R&D in Handsets in Australia. Until recently, Ericsson had its major regional R&D centre located in Australia (the 'Ericsson AsiaPacificLab') but it has closed the centre as part of the company's global reduction in R&D operations.

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<sup>10</sup> Estimated by Paul Budde Communication, 2002

### **Motorola Australia Research Centre (MARC)**

MARC is part of the Motorola Technology Centre, located in Botany, NSW. The centre was created in 1995 to develop innovative technologies that will drive the company's future business growth. The majority of the researchers employed at MARC hold PhD degrees from Australian universities. The focus of its work is on technologies for speech, image and video processing, networks and communications systems.

MARC takes a leading role in global standardisation efforts, including the ISO and the IETF. It also collaborates closely with other Motorola organisations to transfer its technologies, and those developed through its university partnerships, into new products. MARC develops algorithms and proof-of-concept implementations in speech recognition, speech coding, communications and networking, image coding and video coding.

In addition to the private R&D centres run by global manufacturers, there are several research groups in Australia that focus on wireless technology that is relevant to Handsets and Handhelds. Examples of these groups include CSIRO, the Defence Science and Technology Organisation, Telstra, the Australian Telecommunications Cooperative Research Centre and a number of universities. Locally listed companies involved in handsets include Cellnet which provides contract distribution of Handsets and Handhelds in Australia and New Zealand, and Voxson which develops and manufactures GSM and GPRS modular components and sells them to major handset manufacturers.

Palm is the dominant vendor in the local Handheld market, holding 58% share. Casio and HP are the next two largest vendors with 25% and 11% share respectively. Handspring entered the market in 2001, but there is no information available yet on how much market share they have captured. Sony also has plans to enter the market in the near future. However, there is no evidence that any of these global manufacturers have any presence in Australia beyond sales and distribution. Moreover, there are no significant local companies involved in developing or manufacturing Handhelds.

## Trends—Handsets and Handhelds

There are three trends in this sub-sector.

### **Trend 1: The fast pace of technology innovation continues.**

The major development currently influencing the mobiles market is the rollout of 2.5G and 3G, technologies that allow high-speed data transmission over mobile phones. 2.5G is being rolled out in a number of markets, particularly by operators with CDMA networks for which a 2.5G upgrade (via 1XRTT) delivers significant increases in data speeds as well as 'always on' functionality. High levels of investment in licences for the technology, and the prospect of high rollout costs, have prompted many telecommunication companies to scale back their original 3G plans. Nevertheless, the migration to 2.5G will likely drive handset upgrades irrespective of 3G outcomes.

### **Trend 2: Manufacturers are outsourcing or locating their own production offshore.**

Value chain disaggregation and regional specialisation are emerging trends. Many mobile handset vendors now outsource manufacturing to countries with low-cost labour such as Taiwan. An example is Palm, which used Casio to develop and produce its PDA hardware. In addition, manufacturers are increasingly locating their own production offshore, especially in Asia. As well as allowing them to lower labour costs, this has the added benefit that many Handset component suppliers are based in that region—for example, TSMC.

### **Trend 3: The Handset and Handheld markets continue to grow.**

The demand for mobiles has matured in developed markets—for example, demand in Western Europe, Japan and Korea is now primarily generated by upgrades to smaller, lighter units and next-generation networks. However, there are still faster growing, emerging markets in China, India and Latin America. In handheld PDAs, the main customers have been business professionals. Producers of handheld PDAs are now targeting business professionals in an increasing number of markets, such as Asia, and are also seeking to increase their penetration into a broader demographic.

## Uncertainty—Handsets and Handhelds

The uncertainty in Handsets and Handhelds surrounds the degree of convergence between handheld PDAs and mobile

handsets and the extent to which functionality will increase. There is evidence of some convergence with the emergence of multi-purpose devices. A prominent example is the handset released by Sony and Ericsson that has a built-in camera and personal area network functionality. Another example is the Blackberry device, which is a PDA that uses GPRS technology to enable it to always be connected to a user's PC.

It is unclear, however, to what extent this convergence between PDA handhelds and mobile handsets will be supported by consumer demand. What is clear is that in the event of high convergence, manufacturers will race for control of a dominant design. This uncertainty gives rise to two potential scenarios.

**Scenario 1: There is high technology convergence that results in single multipurpose devices.** This scenario could see any or all of the following:

- Market acceptance of a dominant multi-function device.
- A single, or relatively few, equipment vendors or syndicates capture the majority of market share. These vendors also lead the development of the dominant design.
- Niche firms specialise in peripheral products such as keyboards that are compatible with the dominant design—or in functional devices such as small screen resolution that are integrated into the dominant design.

**Scenario 2: There is low technology convergence that leads to discrete product lines remaining.** This scenario could see any or all of the following:

- Co-existence of discrete product lines.
- OEMs diverge in their strategies and different manufacturers dominate different markets—for example, Nokia in mobile handsets, Palm in PDA handhelds.
- Niche firms exist, but they partner with a chosen major OEM.

### **Potential Business Models—Handsets and Handhelds**

Depending on how the uncertainty in Handsets and Handhelds unfolds, there are three business models that could prevail.

**Independent handset or handheld OEMs** are likely to be sustainable in the 'low convergence' scenario. In this model, successful manufacturers would benefit from:

- Quickly responding to changing customer tastes for functionality thus attracting and retaining a loyal customer base in their target market segments.
- Developing devices that easily link to other platforms—for example, Palm Pilot to PC, mobile handsets to email.
- Building and maintaining brand status around their product lines.
- Demonstrating high innovation and low-cost manufacturing.
- Access to global distribution.

**Converged device OEMs** are likely to be sustainable in the 'high convergence' scenario. Handset manufacturers are likely to dominate due to their superior scale relative to handheld manufacturers. In this model, successful manufacturers would benefit from:

- Brokering partnerships to access complementary device technologies—for example, handset vendor partnering with a PDA vendor to access pen-based character recognition capabilities.
- Access to a competitive embedded operating system for the device.
- Access to product-oriented semiconductors—for example, graphics chips for display control.
- Access to production facilities that are sufficiently low cost/high scale despite the high complexity and initially high cost of the device.

**Functional specialists**—for example, R&D, testing, contract manufacturers and distribution centres—are likely to be sustainable in either scenario but are likely to benefit more if there is high convergence and greater product standardisation. If there is limited standardisation, manufacturers are more likely to seek to control all functions.



## Opportunities for Australia—Handsets and Handhelds

Australia's existing presence in Handsets and Handhelds is predominantly in R&D, making this the most natural area of opportunity.

**Support global handset manufacturers as an offshore R&D centre.** As discussed above, two of the top three global handset manufacturers—Nokia and Motorola—have R&D centres located in Australia. These R&D centres are complemented by a number of local research groups. There are, however, very few examples of Australian institutions or companies that have managed to successfully commercialise their R&D into profitable products. Given this existing R&D base, Australia could establish itself as an attractive R&D centre for global manufacturers. The major risk in pursuing this opportunity is that global manufacturers could close their R&D centres in Australia at their discretion. This risk has been clearly demonstrated by Ericsson's recent closure of its Australian R&D centre.

The benefit of pursuing the opportunity, however, is that it does not require Australia to close any significant capability gaps. Australia already has a strong pool of R&D talent in wireless technology for handsets, as evidenced by the number of local research institutions and the substantial R&D presence of global manufacturers.

It is less clear if Australia has the necessary capabilities to successfully commercialise wireless R&D into profitable products. Australia must either build the necessary commercialisation, sales and marketing capabilities locally—for example, by fostering venture capital firms that focus on this technology—or access them through stronger relationships with global manufacturers.

## 5.6 Video CPE

The Video Customer Premises Equipment (Video CPE) market is wholly focused on consumers.

The markets considered in this sub-sector include video game consoles and set-top boxes. The discussion refers primarily to the hardware in these markets and not the content or software, such as games development, which are addressed in our discussion of Consumer Applications.

## Key Statistics

### 2001 Global revenue

US\$18 billion (excludes games software)

### 2001 Australian revenue

A\$245million—or 0.7% of global revenue

### Expected global growth rate to 2005

Game consoles—approx 5%

Set-top boxes—approx 3%

### Global market structure: Varied by product and geography

Game consoles—Concentrated: Nintendo, Sony, Microsoft and Sega hold virtually 100% share

Set-top boxes (US)—Concentrated: RCA, Echostar and Motorola hold 72% share

Set-top boxes (Europe, Middle East, Africa)—Fragmented: Phillips, PMT and Sagem hold 47% share

### Multinationals (MNCs) in Australian market

Sony, Nintendo, Microsoft and Sega hold virtually 100%

## Snapshot

Unlike the other Hardware sub-sectors, the Video Customer Premises Equipment (Video CPE) market is wholly focused on consumers. This means that it is closely tied to economic cycles and follows a similar pattern to durable electrical goods.

The industry requires significant upfront investment and, as a result, has a high fixed cost structure.

Australian participation in the Video CPE sub-sector is presently limited to MNC distribution, with the market almost 100% dominated by the three largest global manufacturers—Sony, Microsoft and Nintendo.

Within this sub-sector, two trends are common—the rising cost of technology and the increase in market penetration.

As in other Hardware sub-sectors, the uncertainty in Video CPE is the degree of convergence between digital video devices and the extent to which they will offer increased functionality.

This uncertainty will likely result in two potential business models—converged device OEMs and game console, or set-top box, OEMs.

Converged device OEMs are likely to be sustainable if there is high convergence and several major producers compete globally for market share. Game console, or set-top box, OEMs are likely to be sustainable if there is low convergence, in which case several winners would continue to dominate each discrete product line.

### **Current State—Video CPE**

The Video CPE market is relatively consolidated. In set-top boxes, the Top 3 manufacturers in the US hold 72% of the market—RCA has 38%, EchoStar has 19%, and Motorola has 15%. The Top 3 manufacturers in the Europe, Middle East and Africa (EMEA) region hold 47% of the market—Phillips has 21%, PMT has 16% and Sagem has 10%.

In game consoles, four manufacturers dominate the market—Sony, Nintendo, Microsoft and Sega. And the largest markets for game consoles and set-top boxes are the US, Europe and Japan.

Overall, the Video CPE sub-sector contributed US\$18 billion of revenue in 2001—US\$10 billion in game consoles and US\$8 billion in set-top boxes. This excludes games software, which, during the same period, earned a further US\$11 billion.

Video CPE hardware generally requires significant upfront investment and, as a result, has a high fixed cost structure. It involves significant R&D investments as manufacturers pursue new hardware products for both game consoles and set-top boxes. Rather than use hardware sales to recover these high fixed costs, vendors typically sell game consoles and set-top boxes as loss leaders. They then achieve higher margins through software sales (the average margins are between 20% and 40%).

Unlike other Hardware markets, the Video CPE market is wholly focused on consumers. Over the last 5 years, however, manufacturers have begun to target consumer groups beyond children and games enthusiasts. In line with these efforts, the average age of game users has steadily increased.

The focus of the Video CPE market on consumer groups also means that the market is closely tied to economic cycles and follows a similar pattern to durable electrical goods.

Today, this market is characterised by a high degree of vertical integration. Firms such as Sony and Nintendo are involved right across the value chain—from hardware manufacturing through to game development, publishing and wholesaling. This is possible because the market size is still limited. As the product cycle matures and the market grows, it is predicted that outsourcing will become more economic.

### **A Digital Convergence Strategy: Sony Playstation 2**

In 2000, Sony unveiled its much-anticipated PlayStation2 (PS2). The PS2 includes a DVD-ROM drive that, as well as PlayStation software, accepts standard audio CDs and video DVDs. The PS2 has no built-in modem. Sony preferred to leave modem options open to include cable and digital subscriber line modems.

Hoping to make its game technology an industry standard, Sony Computer Entertainment (SCE) started selling the microprocessors and graphics chips used in the PS2 console on the merchant market. The move reflects Sony's commitment to implement its digital convergence strategy. That is, the PS2 console can also be used as a broadband Internet entertainment hub that connects to other consumer electronics appliances. Eventually, Sony expects the PS2 will allow consumers the option of using the box for gaming, DVD movie playing, and eventually for web surfing. Consumers will be able to use AOL's email, instant messaging and chat online. Sony also plans to distribute the PS2 software electronically.

According to the Australian Film Commission, the value of Australian spend on game consoles was A\$245 million (US\$127 million) in 2001.<sup>11</sup> This total represents 1.2% of global sales for game consoles. Australian participation in the game consoles market is currently limited to MNC distribution. Similar to the global market, the local market is almost 100% dominated by imports from the three largest global manufacturers—Sony, Microsoft and Nintendo. There are no Australian companies

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<sup>11</sup> Excludes games, which account for a further A\$318 million

involved in either the design or manufacture of game consoles.<sup>12</sup>

The market for set-top boxes in Australia is currently in its infancy, with very limited sales. A major roadblock to the development of this local market is the current negotiation between Telstra/Foxtel, Optus and other television networks to agree on a common standard. Until an open set-top box solution emerges, which can provide access to both the pay TV platform and the free-to-air digital cable and satellite TV platform, there is unlikely to be significant local growth in this market.

### **Trends—Video CPE**

Two trends are common in this sub-sector.

**Trend 1: The cost of technology is rising.** As the capabilities of the devices are becoming increasingly advanced, so too R&D costs, and the capital investments required to produce next generation Video CPE products, are rising. For example, and not surprisingly, the current options to deploy advanced set-top boxes require greater investment than the original light boxes. Similarly, upgrades in game consoles have required increasing R&D investment with each generation.

**Trend 2: There is an increase in market penetration.**

The user base for Video CPE devices is broadening beyond the traditional market of children and enthusiasts. This extended user base has in turn encouraged manufacturers to expand the functionality of their products. As the user base for Video CPE broadens, it will become increasingly important for manufacturers to understand the different market segments when developing software and content offerings.

### **Uncertainty—Video CPE**

The uncertainty in the Video CPE sub-sector centres on the degree of convergence between digital video devices and the extent to which they will offer increased functionality.

From a technology standpoint, the outcome of this uncertainty hinges on whether a common middleware standard will prevail

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<sup>12</sup> Some Australian companies are involved in games development

among the current competing standards such as Open TV, which is a proprietary standard, and Multimedia Home Platform, which is an open standard. From a market standpoint, the outcome will also depend on the extent to which there is consumer demand for convergent devices.

There is already some evidence of convergence as manufacturers increase the functionality of game consoles. Depending on consumer demand for these multi-functional devices, vendors could market the consoles as an entry point for other products—for example, as an entry point for DVD manufacturers.

The uncertainty within this market could result in one of two possible scenarios.

**Scenario 1: High convergence results in 'single box' functionality.** This scenario could see any or all of the following:

- A dominant design that combines set-top box and game console devices.
- As devices merge and the product cycle becomes more mature, increased market penetration drives volume. This leads to opportunities to capture scale economies by outsourcing production and the transferring manufacturing capacity to low cost countries.

**Scenario 2: Low convergence ensures that discrete product lines remain.** This scenario arises if consumers ultimately prefer single application devices. This preference could be the result of different product upgrade cycles for different devices, the existence of legacy installed bases or, quite simply, differing consumer needs. This scenario could see any or all of the following:

- There is no dominant design and products continue to be differentiated.
- Manufacturers continue to grow their share of individual sub-segments through specific device advances and segment the market to reduce competition and maintain margins.
- Scale economies and a low-cost base are important but less critical than in the high convergence scenario.

## Potential Business Models—Video CPE

Depending on how the uncertainty in Video CPE unfolds, two business models could prevail.

**Converged device OEMs** are likely to be sustainable if there is high convergence. Several major producers will compete globally for market share and the winning manufacturers would benefit from:

- Economies of scale that allow them to achieve a low-cost base.
- Strong relationships with software and content providers.
- A rapidly growing an installed base that creates a valuable legacy.
- Partnerships with retail outlets for consumer sales.

Opportunities will also exist for firms to partner with these manufacturers to provide production, software, content and sales/distribution.

**Game console, or set-top box, OEMs** are likely to be sustainable if there is low convergence. Several winners will continue to dominate each discrete product line. In this model, successful manufacturers will benefit from:

- Ongoing R&D to continually differentiate their products.
- A variety of products that are attractive to contrasting market segments.
- Modular product offerings so they can create an initial installed base and maintain ongoing demand by creating 'versions' of the hardware to encourage user upgrades.

Again, opportunities will exist for firms to partner with these lead device manufacturers to provide production, software, content and sales/distribution.



## Opportunities for Australia—Video CPE

Australian participation in the Video CPE sub-sector is presently limited to MNC distribution and there are unlikely to be major growth opportunities.

In order to compete, manufacturers require an innovation base, low-cost manufacturing and global distribution. Today, Australia lacks these resources and capabilities.