Transformational and disruptive memory storage

Development update - February 2016

4DS Memory
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4DS Memory

- Silicon Valley memory technology developer
- US$10m invested in development over 8 years
- Wholly owned, in-house developed, intellectual property (IP) anchored by 15 US patents granted and 8 US patents pending
- Non-filamentary resistive random access memory (ReRAM)
- For next generation mobile and cloud silicon storage
- Demonstrated a critical milestone of ReRAM cell size at a 50 nanometre (nm) lithography, a breakthrough in ReRAM technology
### Board of Directors - significant IPO and M&A experience

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Experience and Achievements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Dorrian</td>
<td>Chairman</td>
<td>Served as CEO and director of several Silicon Valley companies with in-depth experience in M&amp;A and IPOs gained through founding and managing successful technology exits. Partner at Crosspoint Venture Partners, an early stage venture capital firm.</td>
</tr>
<tr>
<td>Dr Guido Arnout</td>
<td>CEO and Managing Director</td>
<td>Specific expertise over 30 years in commercialising electronics technology from concept to product including Power-Escape, CoWare, CrossCheck Technology and Silvar-Lisco.</td>
</tr>
<tr>
<td>Howard Digby</td>
<td>Non-Executive Director</td>
<td>Former senior roles at IBM, Adobe, Gartner and the Economist Group. Director of Estrella Resources (ASX:ESR).</td>
</tr>
<tr>
<td>David McAuliffe</td>
<td>Non-Executive Director</td>
<td>Experienced company director, has been involved in numerous capital raisings and in-licensing of technologies and founder of several companies in Australia, France and the UK, many of which are now publicly listed.</td>
</tr>
</tbody>
</table>
Guido Arnout
Chief Engineering Officer

Refer to previous slide.

Michael Van Buskirk
Refer to previous slide.

Executive roles with a number of leading memory companies in
Silicon Valley including Adesto Technologies Corporation,
Innovative Silicon Inc, Spansion Inc (the flash memory JV
between Advanced Micro Devices (AMD) and Fujitsu).

Melanie Buffier
Director, Corporate Strategy and
Investor Relations

Over 15 years’ experience in investor relations, communications
and financial reporting gained at some of Australia’s leading
public companies including Scentre Group, Westfield Retail Trust,
Mirvac Group and Westfield Group.
## Capital structure

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>ASX Code</strong></td>
<td>4DS</td>
</tr>
<tr>
<td><strong>Last traded closing price</strong></td>
<td>$0.035</td>
</tr>
<tr>
<td><strong>Market capitalisation</strong></td>
<td>$23.1 million</td>
</tr>
<tr>
<td><strong>Ordinary shares on issue</strong></td>
<td>659.2 million</td>
</tr>
<tr>
<td><strong>Escrowed performance shares</strong></td>
<td>67.6 million</td>
</tr>
<tr>
<td><strong>Unlisted options</strong></td>
<td>106.1 million</td>
</tr>
<tr>
<td><strong>Top 20 Shareholders</strong></td>
<td>50.4%</td>
</tr>
<tr>
<td><strong>Cash (at 31 December 2015)</strong></td>
<td>$2.4 million</td>
</tr>
</tbody>
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1. At 29 January 2015.
2. Including 114.6 million escrowed shares on issue.
3. Including 66.5 million escrowed unlisted options.
Today, the majority of non-volatile memory (NVM) storage is NAND Flash (Flash), used in billions of mobile phones, tablets and laptops.

Memory storage use is growing exponentially:
- Increasing use of cloud storage
- Continued proliferation of mobile devices
- The Internet of Things, connected devices

The opportunity?
- To replace existing Flash technology which has a diminishing ability to scale further, while still remaining fast and reliable, and meet the future need for more storage in less physical space
4DS opportunity: the perfect storm

- Staggering growth has seen 90% of data stored today created in the last 2 years
- Cloud storage is moving to silicon storage
- Flash is exhausted

1. MEDIA REDEF: Age of Abundance: How the Content Explosion will Invert the Media Industry, January 2016
Hard drives v solid state storage (SSD)

• Hard drives in the Cloud
  – Great retention and recovery, but:
    • Power hungry
    • Heat producing
    • Inferior latency

• Cloud players are moving to silicon storage
Flash is exhausted

NAND Flash currently dominates the US$40bn GB silicon storage market

2D Flash
16nm to 20nm cell size
Limits are # of electrons

3D Flash
40nm to 50nm cell size
Limits are structural
The solution = 4DS ReRAM

- 4DS next generation memory:
  - higher density / potential for better scalability
  - cooler / consumes less power
  - faster
  - better reliability; retention and endurance

- Why is 4DS ReRAM the solution?
  - Changes resistance of switching material
  - Operates without filaments
Two approaches to ReRAM

<table>
<thead>
<tr>
<th></th>
<th>ALL FILAMENTARY ReRAM</th>
<th>4DS NON-FILAMENTARY ReRAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATA RETENTION</td>
<td>Switching current high</td>
<td>Switching current low*</td>
</tr>
<tr>
<td>SWITCHING CURRENT</td>
<td>Constant</td>
<td>Scales with cell size</td>
</tr>
<tr>
<td>EFFECTIVE CELL SIZE</td>
<td>Switching current determines size</td>
<td>Lower current allows smaller cells</td>
</tr>
<tr>
<td>MARKET SWEET SPOT</td>
<td>Low density: Connected devices</td>
<td>High density: Mobile and Cloud</td>
</tr>
</tbody>
</table>

The 4DS memory cell uses no filament to switch= no scaling and retention issues
Memory hierarchy

- **CPU**
- **GPU**
- **REG**
- **ISTER**
- **L1**
- **L2**
- **L3 Cache**
- **Embedded memory**
- **Processor**
- **Mobile/Tablet/PC**
- **DRAM**
  - Where apps & data are running
- **SSD (HDD)**
  - Where apps & data are stored
- **The Cloud**
- **HDD (SSD)**
Memory hierarchy

- **CPU**
- **GPU**
- **L1**
- **L2**
- **L3 Cache**

**DRAM**

Where apps & data are running

**SSD (HDD)**

Where apps & data are stored

**The Cloud**

- **HDD (SSD)**

4DS target market

- Non volatile memory
- GB silicon storage

- speed, endurance and cost per bit
- density, size (#bits) and retention

For personal use only.
Emerging NVM applications

- Industry & transportation
- Smart Card MCU
- Cache Memory for Enterprise storage
- Mobiles Phones
- Mass storage Memory

- Industrial Automation
  - SIM Card
  - Journal Memory
  - Entry mobile phone
  - NAND Memories

- Smart Meter
- ID Card
- Other Cache Memory applications
- Smart phones

For personal use only
GB silicon storage supply chain

- **4DS memory technology**
- **Memory chip makers**
- **Silicon storage makers**
- **The Cloud**
- **Mobile products**
- **Consumer**

Cloud access
Memory development phases

**RESEARCH**
- Single cells in large geometries
- Risk: >1,000nm
- 4DS started
- Value: 15 patents

**DEVELOPMENT**
- Approach production geometries
- Goal line: 50nm
- 4DS now

**PRODUCTION**
- First product
- Value
50nm milestone achieved

Today: **4DS demonstrated ReRAM cells at 50nm lithography**
- Significant progress in scalability and yield
- This is where 3D Flash is today, Flash is an estimated US$40bn market
- Approaching production geometries
- An essential step towards viable GB silicon storage

Tomorrow: **demonstrate viable scalability below 50nm with JDA partner, HGST**
- Endurance
- Retention
- Speed
- Yield
Joint development agreement with HGST

- Strategic partnership established in 2014 with HGST
- HGST is a global storage leader that strategically invests in high growth and emerging technology segments and innovative product development
- Provides access to resources and expertise
- Accelerates our development program

1. Source: https://www.hgst.com/company/company-info
4DS strategy

- Target the fast growing GB silicon storage market
- Develop & own strong IP for GB silicon storage
- Leverage strategic partnerships
- Move technology to where only “time and money” is needed to go to market
- Create window for tremendous shareholder value creation
## Recent transactions

<table>
<thead>
<tr>
<th>Acquirer</th>
<th>Transaction</th>
<th>Date</th>
<th>Value (US$)</th>
<th>Technology</th>
<th>Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>Acquired Anobit</td>
<td>2011</td>
<td>$390m</td>
<td>Flash controllers</td>
<td>Mobile</td>
</tr>
<tr>
<td>Western Digital</td>
<td>Acquired startup Virident</td>
<td>2013</td>
<td>$685m</td>
<td>Flash controllers</td>
<td>Cloud</td>
</tr>
<tr>
<td>Western Digital</td>
<td>Acquired sTec</td>
<td>2013</td>
<td>$340m</td>
<td>Solid state drives</td>
<td>Cloud</td>
</tr>
<tr>
<td>Seagate</td>
<td>Acquired LSI</td>
<td>2014</td>
<td>$540m</td>
<td>Flash controllers</td>
<td>Mobile</td>
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<tr>
<td>Cypress</td>
<td>Merger with Spansion</td>
<td>2015</td>
<td>$5bn</td>
<td>Flash memory</td>
<td>Flash systems</td>
</tr>
<tr>
<td>Western Digital</td>
<td>Acquiring Sandisk</td>
<td></td>
<td>$19bn</td>
<td>Flash memory</td>
<td>Cloud</td>
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</tbody>
</table>
Investment summary

- 4DS is targeting a massive and fast growing segment at the right time
- Transformational and disruptive Silicon Valley memory platform
- 4DS non-filament based ReRAM, unique among other next generation players
- Developed over 8 years, US$10m invested in R&D, 15 US patents granted
- JDA with HGST, a significant player in the storage market
- Small R, Big D
- Experienced high tech management and industry respected scientists
- Complemented by a Board with significant M&A and IPO experience
- Significant progress demonstrated in scalability and yield at 50nm lithography
Synopsis

- Developer of next generation Resistive Random Access Memory (ReRAM)
- Established in 2007 in Silicon Valley with US$10m invested in R&D over last 8 years
- Listed on ASX in December 2015, $2.4m cash on hand (at 31 December 2015)
- 4DS has developed a scalable non-filamentary ReRAM memory cell at a 50nm lithography, a breakthrough in ReRAM technology
- 50nm represents significant progress towards the development of next generation mobile and cloud silicon storage
- Wholly owned, in-house developed, intellectual property (IP) with 15 US patents granted and 8 US patents pending
- Annual global memory market valued at US$79 billion annually with a CAGR of 16%
- Flash is an estimated annual US$40 billion market
- Renewal of Joint Development Agreement with HGST, a global storage leader that invests in high growth and emerging technology segments
- High tech experienced management supported by a team of industry respected scientists and developers and complemented by a Board with significant international M&A and IPO experience
- Strategy is to prove the value of technology and leverage IP through strategic alliances
Consumer and mobile trends

- Mobile lifestyle uses silicon storage: smart phones, tablets, laptops
- More power hungry HD displays & multi-core processors
- More battery for longer mobility
- Ever thinner & lighter devices
- Less physical space for silicon storage
How does filamentary ReRAM work?

Filamentary ReRAM consists of a switching material sandwiched between two electrodes.

- A voltage pulse reversibly changes resistance (typically reversing voltage polarity).
- Resistance change establishes “On” and “Off” states.
- Switching materials range from simple (binary) metal oxides to multiple element composites.
- Most ReRAM create/eliminate conductive “filaments”:
  - Either oxygen vacancy creation or metal injection into switching material.
  - Filamentary conduction independent of cell size - potential future scaling issue.
  - Poor “on” state retention if incomplete filament created.
Why is 4DS ReRAM better?

4DS ReRAM technology is non-filamentary = no filamentary scaling and retention issues

- **4DS MOHJO™**
  - Metal Oxide Hetero Junction – patented cell structure and operation
  - Oxygen exchange across hetero-junction
  - A voltage pulse reversibly changes resistance
  - Reversing voltage polarity switches resistance
  - Non-filamentary switching mechanism

- **4DS patented ReRAM**
  - Inherently scales well beyond mainstream memories
  - Ideal candidate to replace Flash as dominant future non volatile memory
Patent portfolio

- 4DS has 15 US patents granted and 8 US patents pending
- Our granted patent portfolio contains a balance between ReRAM cell structure patents and manufacturing process patents and is split evenly between patents with a broad scope and patents that specifically relate to PCMO
- Hetero junction non-filamentary switching is at the core of 4DS’ wholly owned MOHJO™ technology and materials deposition process IP portfolio, developed in house through an US$10 million R&D program over the last 8 years
Corporate directory

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