The Conspirators

• Make sure your device uses Samsung Memory
Memory Business

Dong Soo Jun
President of Memory Business
The materials in this report include forward-looking statements which can generally be identified by phrases such as Samsung Electronics (SEC) or its management "believes," "expects," "anticipates," "foresees," "forecasts," "estimates" or other words or phrases of similar implications. Similarly, such statements that describe the company's business strategy, outlook, objectives, plans, intentions or goals are also forward-looking statements. All such statements are subject to certain risks and uncertainties that could cause actual results to differ materially from those in the presentation files above.

For us, particular uncertainties which could adversely or positively affect our future results include:

- The behavior of financial markets including fluctuations in exchange rates, interest rates and commodity prices
- Strategic actions including dispositions and acquisitions
- Unanticipated dramatic developments in our major businesses including CE (Consumer Electronics), IM (IT & Mobile communications), DS (Device Solutions)
- Numerous other matters at the national and international levels which could affect our future results

These uncertainties may cause our actual results to be materially different from those expressed in this report.
1. Paradigm Shift
   - Transition from PC’s to Mobile

2. Strategic Direction
   - Stay “One Step Ahead” as Ecosystem Leader
   - Exploit Breakthroughs in Technology
   - Extend Core Competencies
Paradigm Shift
Memory Market Evolution

W/W Memory rev. ($B)

(Source: isuppli, Samsung)
• Business cycle accelerates in mobile era

**3-4 year product cycles**

- **PC CPU & OS**
  - Pentium Pro
  - Pentium4
  - Win95
  - Win98
  - WinXP
  - Win7
  - Win8
  - Lynnfield

- **Mobile OS**
  - iOS 1
  - iOS 2
  - iOS 3
  - iOS 4
  - iOS 5
  - iOS 6
  - iOS 7

**Annual product cycles**

- **PC DRAM**
  - SDR
  - DDR
  - DDR2
  - DDR3
  - DDR4

- **Mobile DRAM**
  - LP3
  - LP4

**Faster standardization, development and enabling**
Product Compatibility

• Interchangeable $\rightarrow$ Customized

Pin-to-pin compatible
= Simple SCM*

Non-interchangeable
= Complicated SCM*

More difficult in managing raw material and work-in-process

* SCM: Supply Chain Management
Value Chain

• The mobile value chain is more horizontal
  - Value more evenly distributed amongst key players

PC: Vertical Ecosystem

<table>
<thead>
<tr>
<th>Component</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>Rule setter</td>
</tr>
<tr>
<td>OS</td>
<td>Rule follower</td>
</tr>
<tr>
<td>Memory</td>
<td></td>
</tr>
<tr>
<td>Set</td>
<td></td>
</tr>
</tbody>
</table>

Mobile: Horizontal Ecosystem

De facto standard by leading players

Shared Value

More opportunities for value capture
Selective Relationship

- Supply interruptions possible during memory shortages

PC Makers

- Tier1
  - Spot market
  - Alternative supply under shortage

Handset Makers

- Tier1
  - No alternative under shortage
  - Spot market

Danger of production halt under shortage
“Tapered Pricing” for visible and predictable memory supply

Volatile Pricing (PC DRAM)
- Price ↑ means Density ↓
- Maintain BOM

Tapered Pricing (Mobile DRAM)
- Price ↑ does not mean Density ↓
- Increase BOM

Predictable price and continued cost innovation required
• Design-in at each vendor, 1st mover takes all

Memory vendors’ share for PC maker ‘A’
- No.1: 40~50%
- No.2: 20~30%
- No.3
- Others

Memory vendors’ share for handset maker ‘B’
- No.1: 70~80%
- No.2 (~10%)
- No.3

Need to be a first mover, Not just fast follower
Technology & Capex

• Technology complexity driving greater CapEx

Need to improve ROI
- Minimum input maximum output
Product Quality

- PC memory is modular, but Mobile memory is embedded
- Product quality becomes more important

Module type

$00 for DRAM module only
$000 for entire board

Embedded type

High risk of RMA* cost and lost business

* Return Material Authorization
• Paradigm shift is reflected in memory market

Memory market gets more stable due to diminished players and PC DRAM portion
Paradigm Shift

• Radical change of business paradigm

**Product Characteristics**
- **PC era**
  - Longer lifetime
  - Commodity
  - Number One
- **Mobile era**
  - Shorter lifetime
  - Customization
  - Only One

**Biz Model**
- **PC era**
  - Make-to-stock
  - Volatile market pricing
  - 2nd mover has opportunity
- **Mobile era**
  - Make-to-order
  - Tapered pricing
  - Winner takes all

**Technology**
- **PC era**
  - Continuous scaling
  - Manageable CapEx
  - Reasonable quality
- **Mobile era**
  - Scaling limitations
  - Lower ROI
  - Higher RMA cost
Strategic Direction

- Stay “One Step Ahead” as Eco-system Leader
• **Green Memory**
  - Value maximizing solution for datacenters

**5th Generation**

- **DRAM**
  - 20nm class DDR4

- **SSD**
  - 10nm class PCIe SSD
Green Memory Benefits

- Combined benefits of Green Memories provide up to 105% greater operational efficiency
Creating Shared Value

- Creating $3 Billion value

3.1 Billion Dollars

800M Trees (Singapore Area x4.6)

The World Population can use handset within 1.8 years

100% Green

45TWh Reduction*

Solar Heat Power Station (Area of Hawaii x2)

Thermoelectric power plant 7.7 units Reduction

* Assumes ’14 W/W Server & high-end storage change to 100% Green Memory
• Continue to secure price premium via tech leadership
• Continue to secure price premium via tech leadership

- **High Density Mobile DRAM**
  - **World’s 1st**
  - Competition
  - **World’s 1st**

- **Value**
  - **Samsung**
  - **Premium**
  - **2GB**
  - **3GB**
  - **2GB**
  - **Competitor**

- **3GB**
  - **4Gb x 6ea = 3GB**
  - **6Gb x 4ea = 3GB**

- **Chipset validation complete**
- **Handset evaluation finished**
- **Mass production ready**
• Cultivate de facto standard via ecosystem leadership

Mobile DRAM
- 20nm class 4Gb LPDDR3
- De facto standard
- Open standard
- LPDDR3

Mobile CPU
- Memory
- Handset

Mobile OS
- Handset

NAND Storage Solution
- 20nm class 4Gb LPDDR3
- De facto standard
- Open standard
- eMMC 5.0

- eMMC 4.5
- UFS*

*Universal Flash Storage
Enabling Tech for One Step Ahead

• World’s first 3-bit NAND flash SSD
  - Comparable performance at a value price

Overcome Trade-off

Higher
Performance

1-bit NAND

2-bit

3-bit

Lower Cost

with superior solution technology

840 ('12)
840 EVO ('13)

“I’m continually amazed by Samsung's rise to power in the SSD space.” - Anandtech -

“The performance increase is profound. Writes shoot up, while the read results shoot up as well.” - Tom's Hardware -
Strategic Direction

- Exploit Technology Breakthroughs
Technology Paradigm Shift

• Memory process technology no longer lithography dependent

Tech. Limit?

EUV?

V-NAND

New Structure

Litho contribution to CapEx:
Planar 45% → V-NAND 15%
Value Proposition of V-NAND

- High Endurance: x10 Program/Erase cycle
- High Performance: x2 Write speed
- Low Power Consumption: 40% less power consumption

Shipping to datacenter customers and receiving positive feedback
V-NAND in Enterprise SSD

- V-NAND will change the server storage industry

Enterprise SSD bit shipments

- **V-NAND**
- **Planar**

2013 2014 2015 2016 2017

CAGR 105%
Multi-bit V-Solution

• V-NAND can be the most cost effective solution

V-NAND
Premium Quality

Samsung’s Multi-Bit Solution Technology

2-bit → 3-bit → • • •

SSD Price

50%↓

Current
V-NAND (Multi-bit)

Multi-bit V-Solution
Most Cost Competitive Solution
Creating new demand with V-NAND

- V-NAND will boost NAND demand

In mass production in Korea and to be expanded to Xi’an, China next year

NAND bit Shipment

Enterprise SSD

PC SSD

Mobile

V-NAND

Premium Application

Planar

2013 2014 2015 2016 2017
How to Sustain DRAM Growth?

- Leading technologies will be applied to mobile first as necessitated by increased scale

**EDP**: Electronic Data Processing

* EDP : Electronic Data Processing

---

**EDP-centric develop.**: Mobile Cost > EDP

Economy of Scale, EDP < Mobile ▲
Cost, EDP > Mobile ▼
Three-pronged approach to sub 20nm breakthrough

- **3D TSV-based**
  - *Through-Silicon Vias*
  - high density solution

- **Solution DRAM**
  - Error management algorithm
  - Server-class memory sub-system

- **New Memory**
  - MRAM, ReRAM, PRAM, etc...

Limit?

Sub-20nm?
Strategic Direction
- Extend Core Competencies
What to Do

• To extend core competencies...

Core Competencies

Organization
More customer and market-oriented Reinforcing solution engineers

Capabilities
System knowledge Competitive SCM, Quality

Collaboration
Open innovation
Establish application/market-oriented organization
Excellent Quality

- Samsung’s Server DRAM, Top-notch quality

Low Server DRAM fraction defective

- Statistical methodology, Big data mining
- Root-cause finding through cross-functional collaboration

x10 lower defective rate

Top-notch quality
→ Leverage for competitive mobile DRAM
Improve SCM

- Right product, time and place through improved SCM
  - Transformation into manufacturing service provider

Inbound SCM: Increased Complexity
- Raw materials

Outbound SCM: Differentiated, Dedicated
- Memory
- Customer

“Samsung is truly differentiating
... obviously providing more detail than even foundries
... proactive approach to improve the level of service of which is already great”
• Smart online service & support

**Information**
Smartphone trend

**Customize**
Smart architecture design tool

**Recommend**
Alignment with memory solution

**Sample Request**
Sample order and feedback
Global R&D Network

• Improve solution development capability

Israel
Flash Management S/W

Xi’an, China
Storage S/W

Bangalore, India
Mobile S/W

San Jose, USA
S/W Architecture Research & Enterprise SSD S/W
New Tech. Sensing & Product Enabling

Expanding Global R&D Personnel

Expand 2004 2013 2015

0 500 700
More Values via Open Innovation

• System, Solution and Software to unlock value

System Knowledge
→ Identify opportunities

Solution Engineering
→ Create opportunities

Software Capability
→ Maximize opportunities

M&A
- Nvelo (SSD S/W), etc.

Equity Investment
- Storage system start-ups

Overseas R&D Center
- Tech. sensing, Product enabling

Academia Collaboration
- Memory system architecture
To align with the paradigm shift...

**Strategy**

*Stay ‘One Step Ahead’ as an Ecosystem Leader*
- De facto standard

*Exploit Technology Breakthroughs*
- Sustainable memory demand growth

*Extend Core Competencies*
- Organization, Open innovation, System knowledge, SCM, Quality
Transformation in progress...

Unpredictable & Fluctuating Biz

Stable & Steady Growth
Thank You