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FINANCIAL HIGHLIGHTS

At the Heart of Mobile Innovation

- Exynos SOCs for Premium and Volume Zone Smartphones
- Key Image Sensor for High Resolution Single/Dual Mobile Cameras
- Core Display Driver IC for OLED Displays of Rigid, Flexible and Full-front Types

1/3 Global Smartphones Used ISOCELL Image Sensors
4.6 Out of 10 Chinese Smartphones Used ISOCELL Image Sensors
4.6 Out of 10 Global Mobile Displays Used System LSI's Driver ICs

Revenue Growth
ISOCELL IMAGE SENSOR

SAMSUNG ISOCELL
Technologies that Redefine Mobile Camera

3-stack Fast Readout Sensor
960 frame Super Slow Motion with integrated LPDDR4

Sub-micron Small Pixel
0.9um 24Mega Pixel Small but High Resolution Sensor

Hybrid Pixel Conversion
Tetracell – Remosaic Technology Clear and Bright Images Any Time

Dual Camera Solution
Total Solution for Out-focus, Low Light Shooting

Tetracell – Remosaic Technology
Clear and Bright Images Any Time
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MARKET OPPORTUNITIES
SAMSUNG STRATEGY
KEY TAKEAWAYS
AI/Deep Learning for Wide Industries
Realized by Semiconductor Technologies

Technologies
- Intelligent Image Processing
- Face/Voice Recognition
- Natural Language Processing
- Personal Assistance
- Pedestrian/Object Detection & Recognition
- Autonomous Operation based on Deep Learning

Requirement
- Huge Data Processing
- High Speed, Low Latency
- Low Power Consumption
- Optimized Learning Algorithm
- High Resolution Sensors

Human-like Processing with NPU
- Human Brain: 1,000,000 GFLOPS
- NPU: 3,200 GFLOPS
- CPU: 120 GFLOPS
- GPU: 490 GFLOPS
- NPU: 47 GFLOPS
- CPU: 17 GFLOPS
- GPU: 27 GFLOPS

2018
The Mass Connected Era
Inspires creativity to all connected dots

2018
3GPP 5G NR Phase 1 Standard Release
2019
Commercial Device & Service Release
2020
5G NR Commercialization

Enhanced Mobile Broadband
Ultra Reliable & Low Latency
Massive Machine Type Communication

5G Mobile Subscriptions to Reach 1 Billion by 2023
(Ericsson Mobility Report, Nov.2017)
AUTOMONOUS MOBILITY

The Future Mobility is Near

Powerful Processing

- \( < 10 \text{TOPS} \)
  - ADAS Level 2
  - Simple Driving Support
- \( 100 \text{TOPS} + \)
  - ADAS Level 5
  - Autonomous Driving

Low Latency with 5G Connection

- \( < 50 \text{ms} \)
  - 4G LTE
- \( 1 \text{ms} \)
  - 5G NR

Higher Level Security

- Biometric Authentication and Data Encryption
- Systems and Supply Chain Data Protection

Level 3 Autonomous Vehicles on the Road from 2021

Autonomous Vehicle Market (K units)

2017 ... 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030

- 390
- 640
- 820
- 2,140
- 3,020
- 5,920
- 10,250
- 13,120
- 16,810

Level 0-2
Partial Automation for Specific Situation

Level 3
Conditional Automation

Level 4
Defined Use-Cases

Level 5
Driverless

Experts interview, BCG analysis
Cameras, Displays and Security Systems for the Future Autonomous Mobility

Cameras for ADAS/Autonomous Driving

Displays and Security Systems for Driving, System Control and In-vehicle Entertainment
STRATEGY FOR GROWTH

Innovation to Bring Ideas to Life

Total Solution
Integrated and Extended Portfolio

Technical Leadership
Advanced Technologies for Components & Platform

Leading Market
Collaboration with Ecosystem

- R&D Investment
- Leading-edge Process
- Reference Platform
- System Design

- Close Partnership
- Future Market & Technical Research
Samsung’s advanced component solutions for mobile innovation

- Exynos SOC
- OLED Display Driver IC
- Touch Controller
- Envelope Tracker
- Power Management IC

- Front Camera
- ISOCELL Bright
- ISOCELL Slim

- Main Camera
- ISOCELL Fast
- ISOCELL Dual

- Iris Recognition
- NFC
**Brainy Unit that Makes a Difference**

**Vision Image Processing**
- Enhanced Low Light Sensitivity
- De-hazing / Super Resolution
- Single Image Bokeh / Depth Sensing

**Detection and Recognition**
- Objects/Face/Voice
- Humans and Animals

**Autonomous Driving**
- Pedestrian/Object Recognition
- Navigation, Driving Control

**IoT with Machine Learning**

**Augmented Reality**
- Mixed Reality

* NNE (Neural Network Engine)
EXYNOS FOR 5G ERA

Making 5G NR a Reality

Compatibility | Global Bands | C-V2X | Legacy RATs
--- | --- | --- | ---
3GPP 5G NR Standard | Sub-6GHz mmWave | 4G | 3G/2G

* C-V2X (Cellular Vehicle-to-Everything), RAT (Radio Access Technologies)
MOBILE CAMERA SOLUTIONS

SAMSUNG ISOCELL
Image Sensors Capturing Moments
Anytime and Anywhere through Unique Pixel Technologies

- Bright
  - Tetracell Smart WDR
  - DUAL PIXEL Fast Readout Sensor

- Fast
  - Sub-micron Small Pixel
  - Dual Camera Solutions for Zoom, Depth Sensing, LLS

- Slim

- Dual

* WDR (Wide Dynamic Range), LLS (Low Light Shooting)
Stunning Mobile Images with ISOCELL

Advanced Node
28nm based Image Sensors

ISOCELL Pixel Technology
Superior Image Quality with Small Pixel Unique Pixel Technologies

Design Service
Hardware and Software Integrated Solution
Custom Sensor Design
Transforming the Driving Experience with IC Technologies
ADAS, Infotainment System, Telematics and Autonomous Driving Solutions

ExynosAuto
Processors and NPUs for IVI, Cluster, ADAS System
Modems for Telematics System

ISOCELL
High Sensitive and High Resolution Image Sensors with Embedded Security

Security
Safe and Reliable Security Solutions for Automotive Systems and Personal Information

Display
Display Driver ICs, Touch Controllers

* C-V2X : Cellular Vehicle-to-Everything
SOLUTION FOR IOT

IoT Platforms with Enhanced Performance and Security

Exynos i
IoT Processors with On-chip Security Solution and Connectivity

ISOCELL
Image Sensor Solution for Sensing and Recognition
Dynamic Vision Sensor

Security
NFCs, Secure Elements for Data Protection of IoT Systems
Secure Storage of Key & Credentials, Authentication and Crypto Operation

Exynos i T200
WiFi Integrated IoT Processors
On-chip Security Sub-System and PUF

Secure Element
Embedded Crypto Engine and
Hacking Protection Circuit with Security Software

* PUF: Physically Unclonable Functions
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MARKET OPPORTUNITIES
SAMSUNG STRATEGY
KEY TAKEAWAYS
Samsung has maintained the position as a key supplier of mobile processors, image sensors and display driver ICs.

Innovations in semiconductor technologies will be the key driver in various new applications that adopts AI/Deep Learning, 5G NR network, and smart mobility.

Samsung System LSI is a provider of integrated total solution for mobile. On top of that, System LSI is now on the path to be a key player for 5G and autonomous mobility, and is investing for future device intelligence.
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KEY TAKEAWAYS
Samsung Foundry

Started as a new business unit in 2017 for better customer support

The Most Trusted Foundry
providing creative solutions for customers' innovation needs

Technology  Operation  Service
Business Milestones

- **Business Start**
  - S1-Line Construction
  - 2005

- **Foundry 1st HKMG Mass Production**
  - S2-Line Ramp up
  - 2011

- **Foundry 1st FinFET Mass Production**
  - 2015

- **Industry 1st 10nm Mass Production**
  - 8-inch Business Start
  - 2016

- **New Business Unit**
  - 2017

- **S3-Line Ramp up**
  - 2017

- **EUV Line Construction Started**
  - 2018

*High-K Metal Gate
14LPE
Global Manufacturing Sites

Advanced 300mm Fabs, Matured 200mm Fab, Test/Package Facilities

in 3 Locations in Korea and US

in Korea

in Korea and China

SESS (Test/Package)
Suzhou, China

S1-Line
(65nm~8nm)

Line-6
(180nm~65nm)

S3-Line
(10nm-)

EUV Line
(Under Construction)

Test/Package Center

Giheung, Korea

Hwaseong, Korea

Inyang, Korea

S2-Line
(65nm~14nm)

S3-Line
(10nm-)

EUV Line
(Under Construction)

Test/Package Center

Hwaseong, Korea

Inyang, Korea

Austin, Texas, USA

S1-Line
(65nm~8nm)

Line-6
(180nm~65nm)

S3-Line
(10nm-)

EUV Line
(Under Construction)

Test/Package Center

Giheung, Korea

Hwaseong, Korea

Inyang, Korea

Austin, Texas, USA
Market Opportunities

Foundry Market by Node

Expected to grow more than 5% in 2018

# of Foundry Providers by Node

Now only 3 companies, including Samsung, provide leading-edge foundry services

![Graphs showing the foundry market by node and the number of foundry providers by node.](image-url)
Samsung in Foundry Industry

Company Revenue 2017

Samsung is aiming to be a strong no. 2 player in the foundry market

<table>
<thead>
<tr>
<th>Company</th>
<th>Revenue 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSMC</td>
<td></td>
</tr>
<tr>
<td>Samsung</td>
<td>$9.8B</td>
</tr>
<tr>
<td>GF</td>
<td></td>
</tr>
<tr>
<td>UMC</td>
<td></td>
</tr>
<tr>
<td>SMIC</td>
<td></td>
</tr>
</tbody>
</table>

Firm Technology Leadership at Advanced Nodes

Samsung is ready to support a wide variety of customers and applications

- **1st Foundry Deployment**: 32/28nm HKMG
- **1st Foundry Deployment**: 14nm FinFET
- **1st Foundry Deployment**: 10nm FinFET
- **EUV**: 7nm FinFET
- **EUV**: 4nm GAA

* HKMG: High-K Metal Gate
* GAA: Gate All Around
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BUSINESS UPDATE

MARKET OPPORTUNITIES

SAMSUNG STRATEGY

KEY TAKEAWAYS
Continuous Evolution to Provide Even More Benefits for a Long Lifetime
- Multiple derivative performance and cost variations for a wide range of applications
- Most competitive process nodes before full EUV adoption

Competitive in Power and Performance, Scaling with EUV Lithography Technology
* Extreme Ultraviolet

Adopting New Architecture, GAA
* Gate All Around
Differentiated Platform, FD-SOI

28/18FDS, Samsung's Differentiated Solution for IoT and Automotive

- RF: Supports 100GHz and mmWave
- eMRAM: Extremely small bitcell, superior write speed and endurance time

### FDS Technology Offering

<table>
<thead>
<tr>
<th></th>
<th>Logic</th>
<th>RF</th>
<th>eMRAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>28FDS</td>
<td>⚫</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>18FDS</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

○ Available  ⚫ Under Development

### Next Generation FDS Strategy

- 14FinFET: Matured Back-end Process
- 18FDS: Same Ground Rule with Same Back-end Process
- 28Bulk: Performance Improvement
- 28FDS: New Technology Offering
8-inch Value Added Offerings

Expanding Portfolio from eFlash, Power, DDI, CIS to RF/IoT and Fingerprint Sensor

- Technologies extensively optimized through many years of product manufacturing
Value Added Package Solutions

Advanced Package Technology Drives System Level Performance Improvement by Enabling More Integration and Better Performance

<table>
<thead>
<tr>
<th>Application</th>
<th>Fingerprint Sensor</th>
<th>Mobile</th>
<th>Server &amp; Network</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Features</strong></td>
<td>Fan-out type</td>
<td>Fan-out type</td>
<td>I-Cube™</td>
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<tr>
<td>for Fingerprint Sensor</td>
<td>Package on Package</td>
<td></td>
<td>HBM and interposer solutions</td>
</tr>
<tr>
<td>Shorter sensing distance</td>
<td>For thinner chip</td>
<td></td>
<td>addressing higher bandwidth needs</td>
</tr>
<tr>
<td>supporting higher</td>
<td>and better</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sensitivity</td>
<td>performance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*HBM: High Bandwidth Memory
Foundry One-Stop-Shop

Offering Complete Turn-key Foundry Solution, Simplifying Customers' Supply Chain

Flexible Design Service
Assurance of Capacity and Quality
Advanced Package Solution
Fast TAT Test Infrastructure

Efficient Supply Chain Management is Possible at Samsung
'SAFE', the Ecosystem that Samsung Foundry has Built with its Partners, is Always SAFE
Key Takeaways

☑️ Maintain firm leadership in cutting-edge technology
☑️ Provide various technology offerings and solutions to serve as a "one-stop-shop"
☑️ Maintain state-of-the-art operations to satisfy customers' needs
☑️ Provide best products and services to enable customers' success
To be the most trusted foundry,
providing creative solutions for customers' innovation needs

**Technology**
- Unrivaled process Technology
- Customer-friendly design infrastructure
- Semiconductor 'One-stop-shop'

**Operation**
- Flawless supply chain management
- Unparalleled execution to deliver our commitment
- Highest level of visibility and flexibility

**Service**
- Service beyond expectation
- Deep knowledge and expertise to solve customer challenges
- Agile collaboration for customers' success

SAMSUNG FOUNDRY