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BUSINESS UPDATE

MARKET OPPORTUNITIES

SAMSUNG STRATEGY

KEY TAKEAWAYS
Financial Highlights

At the Heart of Mobile Innovation

- 1/3 Global Smartphones Powered by ISOCELL Image Sensors
  * TSR, Dec. '19
- 5G Leading Provider of 5G Modem & 5G Mobile SOC
- 1/2 60% of Global Mobile Displays Featured with System LSI's OLED Driver ICs
  * IHS, 2019

Revenue Growth 2.6X

- 2011
- 2014
- 2019
Technologies for the Next Decade

- 5G Network
- On-device Intelligence
- Mobile Camera
- Smart Mobility

toward

Intelligent Connectivity
5G Network

5G for Everyone

5G Phase 1
- Commercial service rollout
- Non standalone network
- Combination of 4G LTE and 5G NR

5G Phase 2
- Mass Market 5G devices with various 5G chipsets
- Standalone network deployment
- Global adoption of mmWave
- NR-V2X, Industrial IoT

3GPP Rel-15
- NSA Freeze
- NSA/SA Freeze

3GPP Rel-16
- Study
- Development
- Freeze

3GPP Rel-17
- Study
- Development
- Freeze
Intelligence on the Devices

Smarter Future Powered by AI

Artificial Intelligence (AI) is playing an increasingly prominent role in our day to day lives and it promises to transform the technological landscape. Complex algorithms and processes, such as machine learning and deep learning, are driving the transformation, boosting the need for more powerful on-device AI solutions.
Mobile Camera

**Ultra-high Resolution**
64 and 108Mp mobile image sensors

**Small and Slim**
Packs in ultrafine ~0.7um sized pixels

**Intelligent Camera**
Scene-Adaptive HDR Processing, Face Detection/Recognition, Fast AF

**Multiple Cameras**
More front and rear facing cameras

**DSLR-like Performance**
High light sensitivity, super zoom, slow-mo

**3D Depth Sensing**
DVS, ToF for Game/VR/AR

*DVS : Dynamic Vision Sensor
ToF : Time-of-Flight*
Smart Mobility with IC Technology

Innovation in Automotive Industry

Engine

Semiconductor

AI

Intelligent Driving

Mechanical

Digital Cockpit

5G NR

ADAS

Electronic

Various semiconductor components including processor, connectivity, image sensor and memory power future driving experience
Enriched Systems in Future Mobility

Cameras, Displays and Security Systems for the Future Mobility

Cameras for ADAS/Autonomous Driving

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

In-vehicle Systems
- Data Protection
- Driver Authentication

ADAS System
- Device Authentication
- System Attack Protection
- Data Security

Supply Chain
- Copy Protection
Strategy for the Growth

Innovation to Bring Ideas to Life

Total Solution
Integrated, extended portfolio
Hardware & software capability

Technical Leadership
Leading technologies for 5G/AI/Sensor
Technology on leading-edge process

Market Shaper
Close collaboration with ecosystem partners
Pioneering future market
Solutions for Mobile Devices

Advanced IC Portfolio for Mobile Innovation

- **ISOCELL Image Sensor**: Super resolution, sub-micron sensors for front / rear cameras, Motion & depth sensor
- **Exynos Processor**: Mobile processors, LTE/5G modems & RF ICs, Connectivity, Supply modulator
- **Power Management IC**: PMIC for mobile processor, UFS memory, OLED display, Wireless charger, USB Type-C PDIC
- **NFC / Secure Element**: Mobile payment, Data security solution
- **Touch Controller**: Low power, high sensitive
- **OLED Display Driver IC**: Bezel-less full screen
- **Fingerprint Sensor**: Fingerprint sensor on display
- **Reference Designs**: Optimized platform design
Transforming the Driving Experience with IC Technologies

**Exynos Auto**
Processors and modem solution for infotainment, telematics and ADAS system

**ISOCELL Auto**
High sensitive, high resolution image sensors with embedded security

**Security**
Safe and highly reliable security solutions to protect personal data and privacy

**Display**
Display driver ICs, Touch Controllers for integrated cockpit system

*SAMSUNG

*SAMSUNG

* C-V2X: Cellular Vehicle-to-Everything
Exynos Processor

Path of the Innovation

- Exynos 4 Series
  - 2009: Dual/Quad Core CPU
  - 2011: Octa Core CPU
  - 2013: CMC220, World's 1st Commercial LTE Modem

- Exynos 5 Series
  - 2011: Exynos 5410/5420
  - 2013: Exynos 5430
  - 2014: Exynos 7420

- Exynos 7 Series
  - 2015: Exynos 8890
  - 2016: Exynos 7872
  - 2017: Exynos 8895

- Exynos 8 Series
  - 2018: Exynos 9810
  - 2019: Exynos 9820/9825
  - 2020: Exynos 990

- Exynos Modem
  - 2011: LTE-A 300Mbps
  - 2012: LTE-A 600Mbps 3CA
  - 2013: LTE-A 1.2Gbps, Cat.20 8CA
  - 2014: LTE-A Pro 2Gbps, Cat.20 8CA
  - 2015: LTE-A 600Mbps, Cat.19 4CA
  - 2016: LTE-A 1.2Gbps, Cat.20 8CA
  - 2017: LTE-A 2Gbps, Cat.20 8CA
  - 2019: LTE-A 5G NR, Multi-mode 5G NR FR1 5Gbps, FR2 7.5Gbps, SA/NSA, EN-DC

5G

- Exynos 9810
  - 3GPP Rel-15 5G NR
  - Multi-mode single modem
  - FR1 26Gbps, FR2 6Gbps

- Exynos 9820/9825
  - 3GPP Rel-15 5G NR
  - Multi-mode (2G-5G) modem
  - FR1 3Gbps, FR2 7.5Gbps, SA/NSA, EN-DC

- Exynos 990
  - 7nm EUV Dual Core NPU 15 TOPS
  - 15 TOPS

- Path of the Innovation
  - 2019: 5G
  - 2020: 7nm EUV Dual Core NPU 15 TOPS
Exynos 5G Processor

Unlocking the future of 5G with Exynos

Hyper-fast
Up to 7.35Gbps*
* Based on FR2 (mmWave)

Compliant with 3GPP 5G NR Rel-15

Global spectrum covers FR1 & FR2

Ready for 5G Phase 2 supporting NSA & SA

Technologies for speed
256 QAM, 4x4 MIMO, EN-DC

Full 5G chipset
Modem, RF IC, ET, PMIC
Making 5G into a Reality

5G Smartphones powered by Exynos

Dec. 2018
5G Mobile Hot Spot Smartphone Prototype

Feb. 2019
Galaxy S10 5G

Aug. 2019
Galaxy Note10+

Dec. 2019
Vivo X30/Pro

Feb. 2020
Galaxy S20
Exynos for Device Intelligence

An Intelligent Powerhouse

Powerful hardware architecture
Integrated hardware & software design
Efficient deep learning algorithms

Neural Processing SDK
Deep learning frameworks
TensorFlow | Caffe | Caffe2 | PyTorch | Android NN API | ONNX

Software architecture & tools
Compiler | Conversion tools | Pre-trained models | Library
Exynos Auto for Mobility

Driving the Future of Mobility

In-vehicle Infotainment
Exynos Auto V
- Powerful Processor for Intelligent Multi-screen Infotainment Platform

ADAS System
Exynos Auto A
- Intelligent Processor for ADAS System

Telematics
Exynos Auto T
- LTE & 5G Modems for Telematics System
- Low Latency, C-V2X

Exynos Auto V9
- A Processor to Power the Next Generation In-vehicle Infotainment System
- Supports 6 Displays & 12 Cameras in 1 Chip
- Embedded NPU
- Tri-cluster GPU
- Safety System
ISOCELL Image Sensor

SAMSUNG ISOCELL

Image sensors to redefine mobile photography

ISOCELL Plus
Upgraded Pixel Isolation Technology
Better Low Light Sensitivity, Higher Color Fidelity
Fit for Realizing High-resolution with Sub-micron Pixel

Super Resolution
Sub-micron Pixel
0.7um & 0.8um Fine Pixels
to Integrate up to 108 Megapixel

Hybrid Pixel Algorithm
Tetracell / Nonacell Technology
Hybrid pixel algorithms to enable
clear and bright photos at any time

Smart ISO
Intelligent ISO level selections
depending on light environment
Remarkable color accuracy and balance

An advanced pixel isolation technology that minimizes optical loss and cross-talk by placing a barrier around each pixel.

ISOCELL Plus Pixel Technology

[Diagram showing the structure of ISOCELL Plus technology]
Advanced Image Sensor Technologies

Super Resolution, Sub-micron Pixel

Super resolution in a tiny sensor enabled by ISOCELL Plus pixel technology

ISOCELL

World's 1st Mass Production

ISOCELL PLUS

World's 1st Mass Production

1.12um
2013
8Mpx

1.0um
2014
16Mpx

0.9um
2017
24Mpx

0.8um
2019
48Mpx

0.7um
2020
64Mpx
108Mpx
Advanced Image Sensor Technologies

Small pixels for detail
big pixels for brightness

Tetracell and Nonacell technologies
Hybrid pixel merging and remosaic solutions
that enable bright photos in low-light
and detailed photos in day light.
Smart-ISO
Intelligent ISO caters to variable environments

Low ISO in bright environments

High ISO for low-lit settings
Stunning Mobile Images with ISOCELL

**Advanced Node**
28nm based Image Sensors

**Unique Pixel Technology**
Various Pixel Technologies and Algorithm for Superior Image Quality with Small Pixel

**Design Service**
Hardware and Software Integrated Solution
Custom Sensor Design
Contents

BUSINESS UPDATE
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’s System LSI business provides integrated total solutions for mobile, and is now on the path to be a key player in the field of 5G, autonomous mobility, and device intelligence.
Possibilities Beyond Components

Meet Samsung System LSI

www.samsung.com/semiconductor
www.samsung.com/Exynos
www.samsung.com/ISOCELL

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WeChat – Exynos, ISOCELL