Semiconductor Outlook: Embedded Intelligence From the Cloud to the Edge

*Silicon suppliers must reinvent business model to realize the new wave of growth*

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Agenda

- Key takeaways
- ICT and OT Market Context: Systems to Silicon Size
- How large are the volumes at the edge? Why does it matter?
- Industrial and Automotive: What problems should technology suppliers focus on to capitalize on these two growth sectors?
- Semiconductor revenue growth over the next 5 years
- How must semi suppliers and OEMs identify the right markets and ecosystem requirements to unlock value beyond silicon and HW?
Key Takeaways

1. Deep Intimacy with customers and partners essential for scale
   IoT Semiconductor market is less than $1 billion today

2. 1 out of 4 devices connected (only 13% for OT segments)

3. Most computation and data reside at the edge - need for edge business strategy

4. Moore’s law and new architectures drive computer vision and machine learning
ICT and OT Market Context, 2015

Semi Industry Revenue Growth Shifts from IT to OT

2015

- IT 81%
- OT 19%

2020

- IT 73%
- OT 27%

5-Year CAGR

- OT: 7.6%
- IT: -2.5%
- Total Market: 1.5%

Source: IDC Semiconductor Application Forecaster, June 2016
IT: Computing, Consumer (except Other Consumer), Communications
OT: Automotive, Other Consumer, Industrial & Military Aero

$97.5 Billion OT Semiconductor Market by 2020
Semiconductor Revenue by Key Market Segments, 2015-2020

- MPU / MCU / DSP
- Memory
- Application Specific
- Other

2015-2020 CAGR:
- MPU / MCU / DSP: -0.9%
- Memory: -0.7%
- Application Specific: 4.7%
- Other: 8.0%
- 2015-2020 CAGR: 3.1%
- 2015-2020 CAGR: -0.2%

Source: Semiconductor Application Forecaster, IDC, June 2016
(1) Industrial includes Retail, Energy, Medical, LED Lighting, Military, Aero
From the Edge to the Cloud: Where Does The Intelligence Reside?

*95%

From the Edge to the Cloud: Where Does The Intelligence Reside?

* % of 2016 System Volumes
Industrial and Automotive Sectors—What problems should technology suppliers be looking to solve?

- Uptime, cost, and asset life fundamental requirements
- Large installed base
- High level of service
- Supply chain critical to margin sustainability for ecosystem
- Computer vision, cloud-based analytics, and AI investment in need of guidance
- Electrification, increasing energy demand
- Autonomous-safety, regulation, compute
What’s next? Computer vision and machine learning, make autonomous systems a reality

- Computing and sensors link the physical and digital world-just at the start of the journey
- Systems will begin to learn and drive natural user interfaces like our mobile and CE devices do today
  - natural language processing
  - Image recognition, videos evolving to do the same
- Ubiquitous connectivity with ultra low latency will be essential (5G)
- Still a long journey toward intelligence and AI
  - Extending intelligence from the Cloud to personal mobile devices, wearables, and into our home (Echo, Google Home) is just beginning it will take time in OT environment
Computer Vision Key Area for Silicon Over The Next Five Years

**Wearables**
Ship 242 CAGR 28%

**Video Surveillance**
Ship 98 CAGR 18%
MPU 58% MCU 42%

**Ship 98 CAGR 18%**
MPU 100% MCU 0%

**ADAS**
Ship 196 CAGR 25%
MPU 8% MCU 92%

**Smart Home Security**
Ship 1,527 CAGR 13%

**Retail/Kiosk**
Ship 6 CAGR 12%
MPU 99% MCU 1%

**Drone**
Ship 83 CAGR 54%
MPU 100% MCU 0%
Sensor/System 7

**Medical Imaging**
Ship 2 CAGR 7%
MPU 96% MCU 4%

**Industrial Automation**
Ship 49 CAGR 3%
MPU 93% MCU 6%

**Gaming**
Ship 43 CAGR 0%
MPU 100% MCU 0%

**Smart Building**
Ship 8 CAGR 5%
MPU 34% MCU 66%
Sensor/System 35

**Industrial Robots**
Ship <1 CAGR 9%
MPU 30% MCU 70%

Note: 2020 Systems shipments are in millions of units, CAGR is for 2015-20 systems shipments. MPU and MCU as share of governing intelligence for systems.

Note: Data from June 2016 IDC Enabling Tech Embedded & Intelligent Systems Market Model.
Autonomous Driving Requiring Technology, Compliance, and Deep Ecosystem Partnerships

- Ultrasonic
- Short/Medium-range Radar
- Camera
- Long-Range Radar
- Ultrasonic
- Adaptive Cruise Control
- Emergency Braking
- Pedestrian Detection
- Collision Avoidance
- Lane Departure Warning
- Traffic Sign Recognition
- Cross Traffic Alert
- Park Assist
- Surround View
- Digital Side Mirror
- Environment Mapping
- Blind Spot Detection
- Park Assistance
- Rear View Mirror
- Rear View
- Environment Mapping
- Digital Side Mirror
- Surround View
- Rear Collision Warning
- Emergency Mapping
Ecosystem Partnerships Necessary for Market Development

- OEM and New Entrants
  - OEMs challenged to stay ahead of new entrants
  - View technology as differentiation
  - Change in development model

- Tier Ones & Tech Suppliers
  - Value add being challenged
  - Rapid decrease in technology cost
  - New technologies and business models

- Semiconductor Companies
  - Large players consolidating
  - New entrants have good traction, but will need scale to remain sustainable
Automotive Semiconductor Growth – Three Drivers

- Electrification
  - Lowering greenhouse emissions
  - Enabling transportation paradigm shifts (car services)
  - Lower operating costs

- Infotainment and connectivity
  - Connected Life extension
  - Diagnostics / OTA Updates
  - Generational expectation

- Advanced Driver Assist
  - Safety requirements / Governmental mandates
  - Brand Differentiation
  - Road to autonomy

$43 Billion Semiconductor market by 2020

Source: IDC Semiconductor Application Forecaster, June 2016
Suppliers Target Auto and OT Growth Areas, More Consolidation Expected

Source: IDC WW Semiconductor Application Forecaster, June 2016
Fastest Growing Semi Suppliers-What Should Taiwan Do?

- Half of the semiconductor companies on this list are focused on intelligent systems and computer vision, smart home, wearables, autonomous systems
- MCU and leading CPU companies have launched go-to-market strategies targeting OT and Auto OEMs and ecosystem
- Contractor manufacturers and ODMs pivoting to support new opportunities in OT and Auto
- **Taiwan Ecosystem needs to move from a fast follower strategy to an enabler and leader in the faster growing segments of the market**

Note: Data from 2016 IDC Semiconductor Application Forecaster

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