

More Than Moore: Trends in Wafer-Level Packaging

March 2017

Agenda

- Amkor at a glance
- Wafer Level Packaging (WLP) market drivers
- What is WLP ?
- NANIUM
- Key success factors

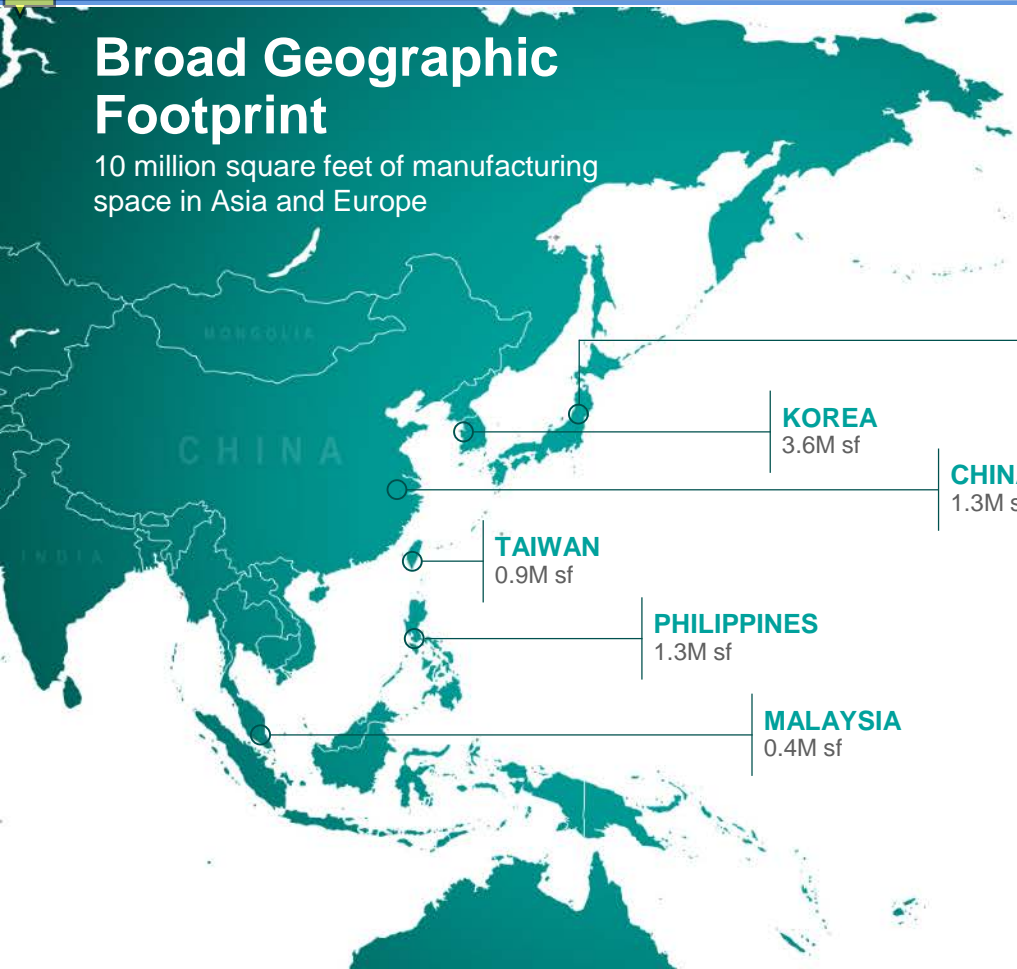
Amkor at a Glance

Amkor

- Trusted OSAT partner since 1968
- Leader in advanced packaging
- 10 million sq. ft. of manufacturing space
- \$3.9 billion revenue in 2016
- Recent acquisitions: J-Devices and NANIUM

Broad Geographic Footprint

10 million square feet of manufacturing space in Asia and Europe



**JAPAN/
J-DEVICES**
2.6M sf

KOREA
3.6M sf

CHINA
1.3M sf

TAIWAN
0.9M sf

PHILIPPINES
1.3M sf

MALAYSIA
0.4M sf

PORTUGAL
0.5M sf



Balanced Growth Strategy

- Increase revenues in markets other than smartphone (e.g. Automotive)
- Expand smartphone customer base
 - Greater China
 - Multiple tiers
- Gain share with advanced technology
 - WLP
 - Advanced SiP
 - MEMS



2016 End Markets



44%

COMMUNICATIONS

Smartphone
Tablet
Handheld Device



25%

**AUTOMOTIVE &
INDUSTRIAL**

Infotainment
Safety
Performance



14%

CONSUMER

Television
Set-Top Box
Personal Electronics



10%

NETWORKING

Server
Router
Switch



7%

COMPUTING

PC/Laptop
Hard Disk Drive
Peripherals

WLP Market Drivers

Smartphones Drive Wafer-Level Packaging



Source: TechSearch International, Inc.

WLP has migrated into other markets



WLP Market TAM

WLP Demand in 200mm Equivalent Wafers

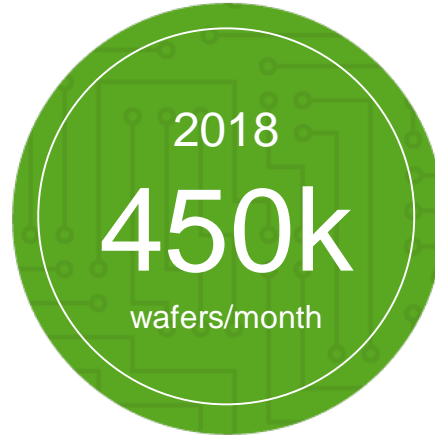


Source: TechSearch International, Inc.

\$8B
Market
in 2016

- 10% CAGR WLP Fan-in
- 140% CAGR WLP Fan-out

Amkor WLP Capabilities



200mm equivalent wafers

- 200mm and 300mm capacity
- \$550 million revenue in 2016
- Over 100 customers
- More than 10 years in the business

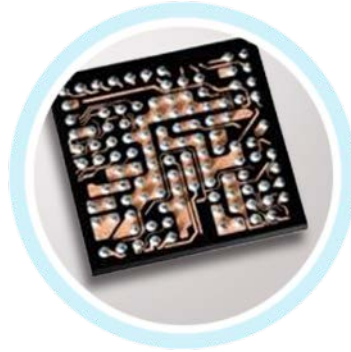
What is WLP?

WLP Platforms



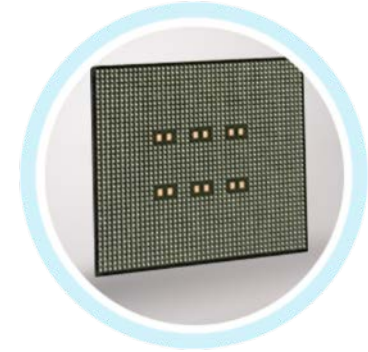
WLCSP
Wafer-level Chip Scale
Package
(Fan-In)

No substrate



WLFO
Wafer-level Fan-out
(Low density fan out)

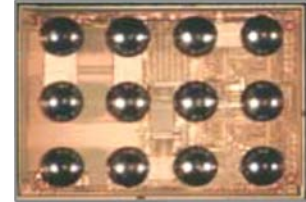
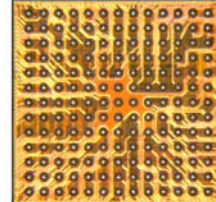
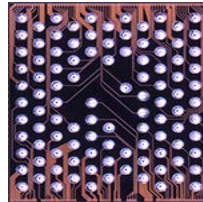
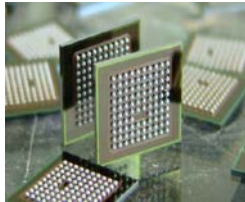
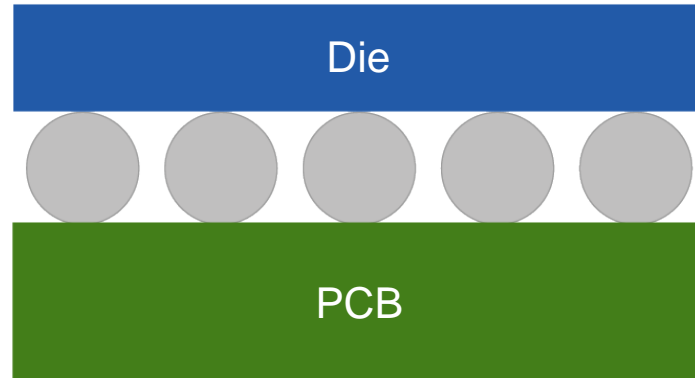
“Stretch” small die to
accommodate bond pads



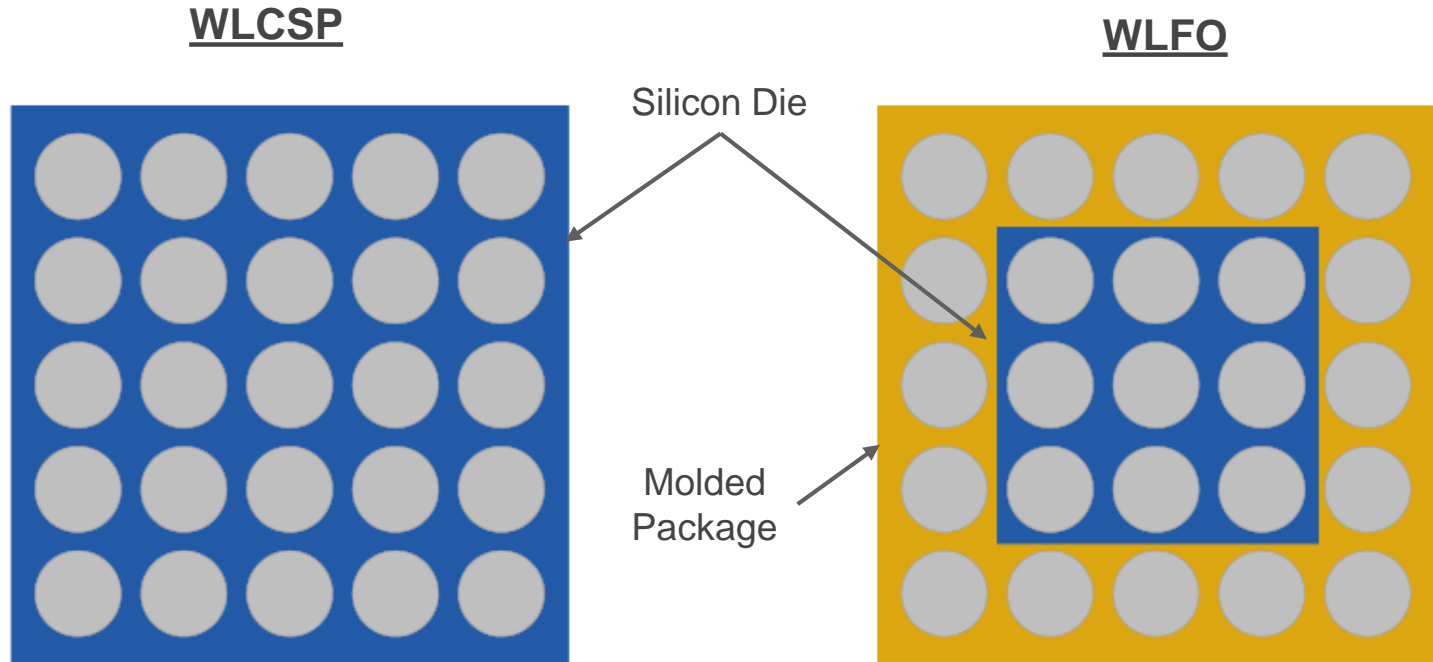
SWIFT
Silicon Wafer Integrated
Fan-out Technology
(High density fan-out)

Ideal for high pin count and SiP
applications

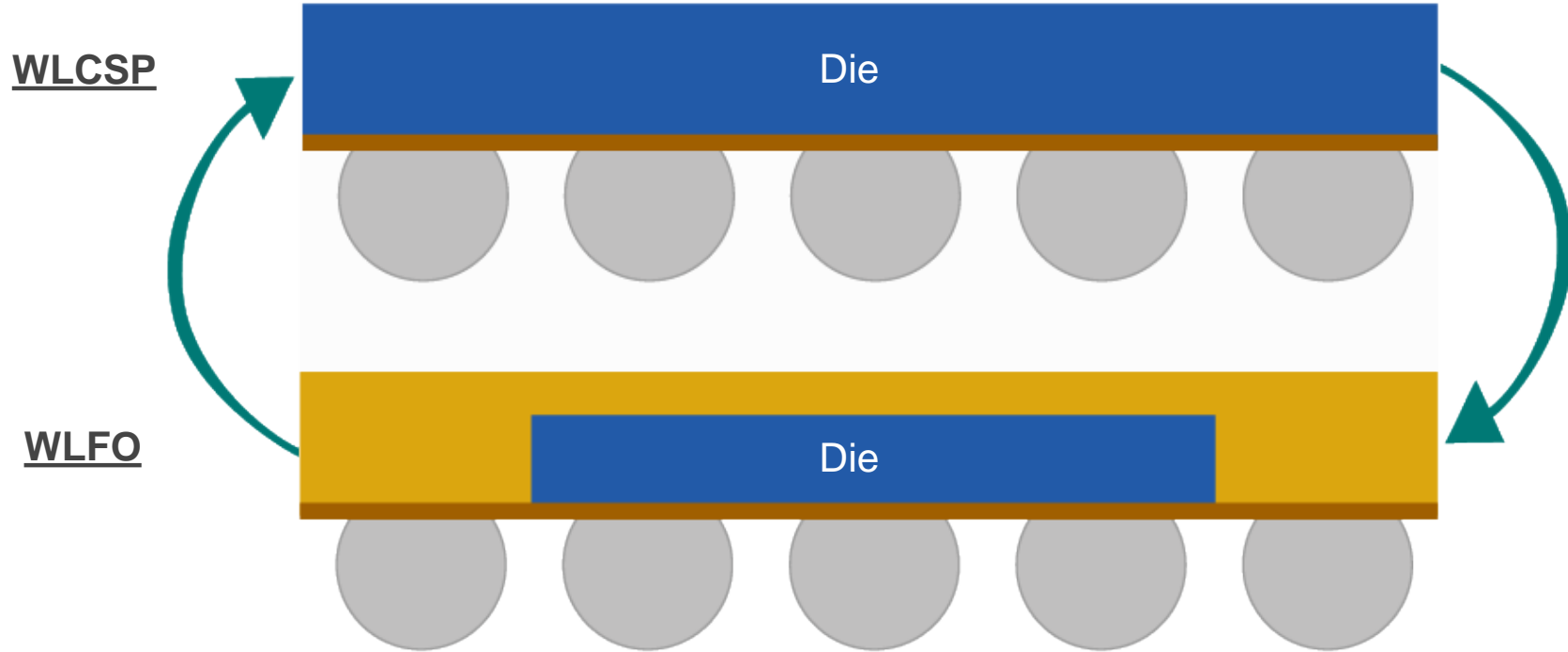
Wafer-Level Chip Scale Package (WLCSP, Fan-In)



Wafer-Level Fan-Out (WLFO)

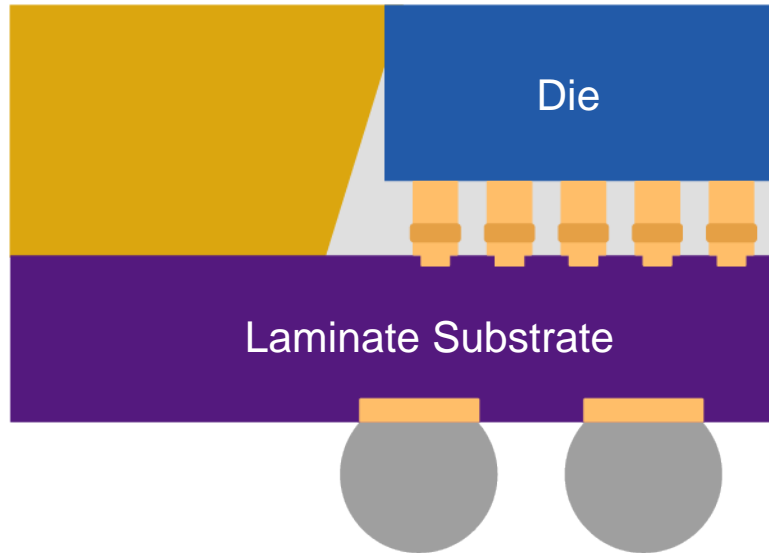


WLCSP and WLFO are Complementary

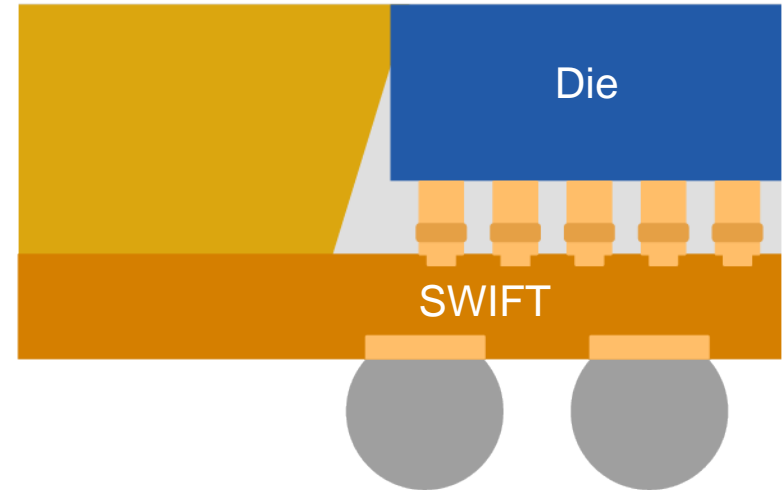


SWIFT: 40% Thinner Than Laminate Substrate

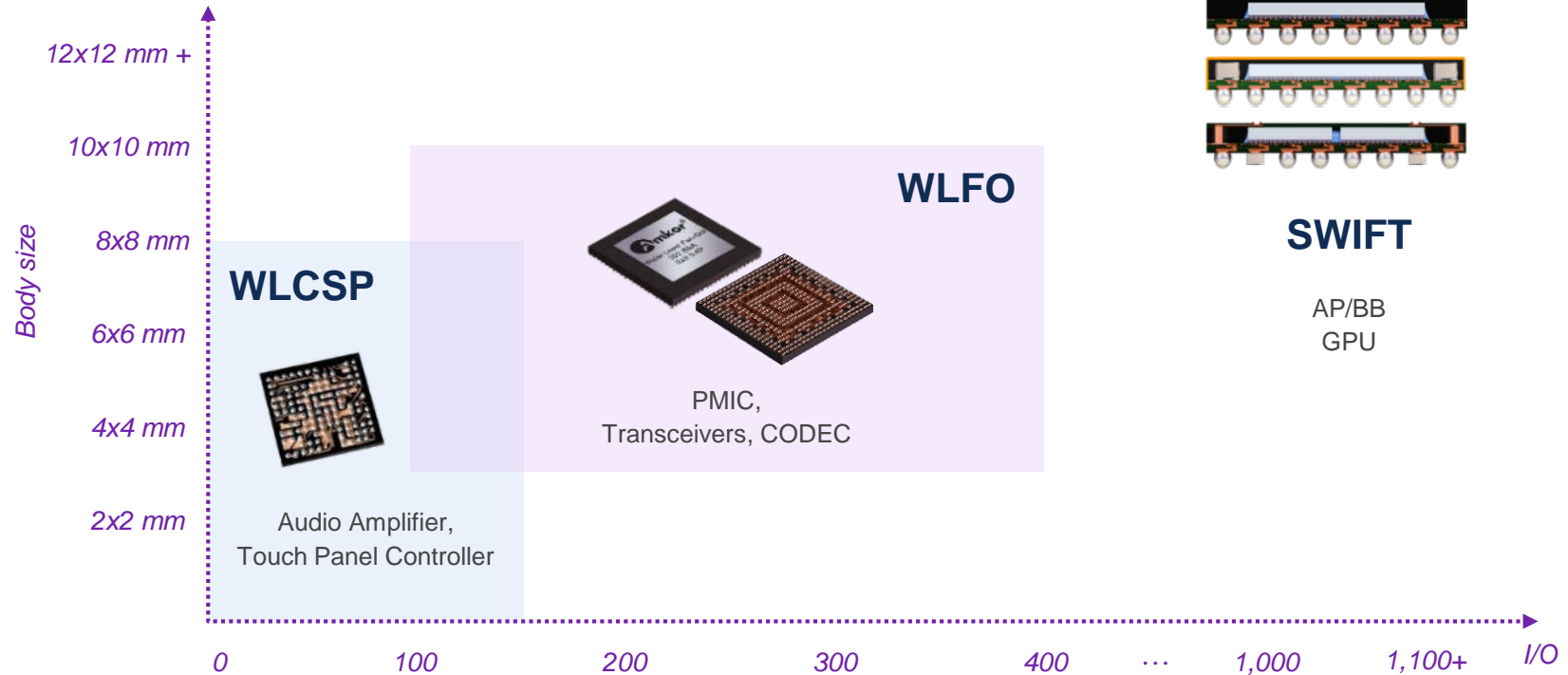
Flip Chip



SWIFT



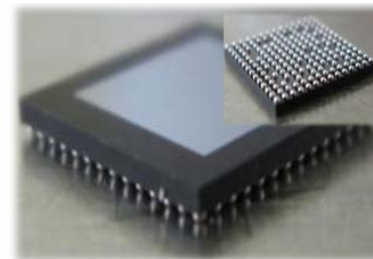
Wafer-level Package Platforms



NANIUM

NANIUM

- Best-in-class, high-yield WLFO technology
- Technology accepted by major smartphone IC makers
- Nearly 1BU shipped
- Generated ~ \$40M in profitable revenue in 2016



NANIUM

- Amkor will expand WLFO capacity in Portugal
- Amkor will also build WLFO production capacity in Asia



Key Success Factors

Key Success Factors

- Portfolio of key technologies
- Capital investment
- Engineering expertise
- Service infrastructure



Summary

- Wafer-level Packaging is a large and fast growing market, driven by the needs of smartphone applications.
- WLCSP, WLFO and SWIFT are the three key WLP technologies.
- Only Tier 1 OSATs have the money and expertise to compete effectively in WLP
- Amkor continues to invest and make acquisitions to support our WLP leadership position

