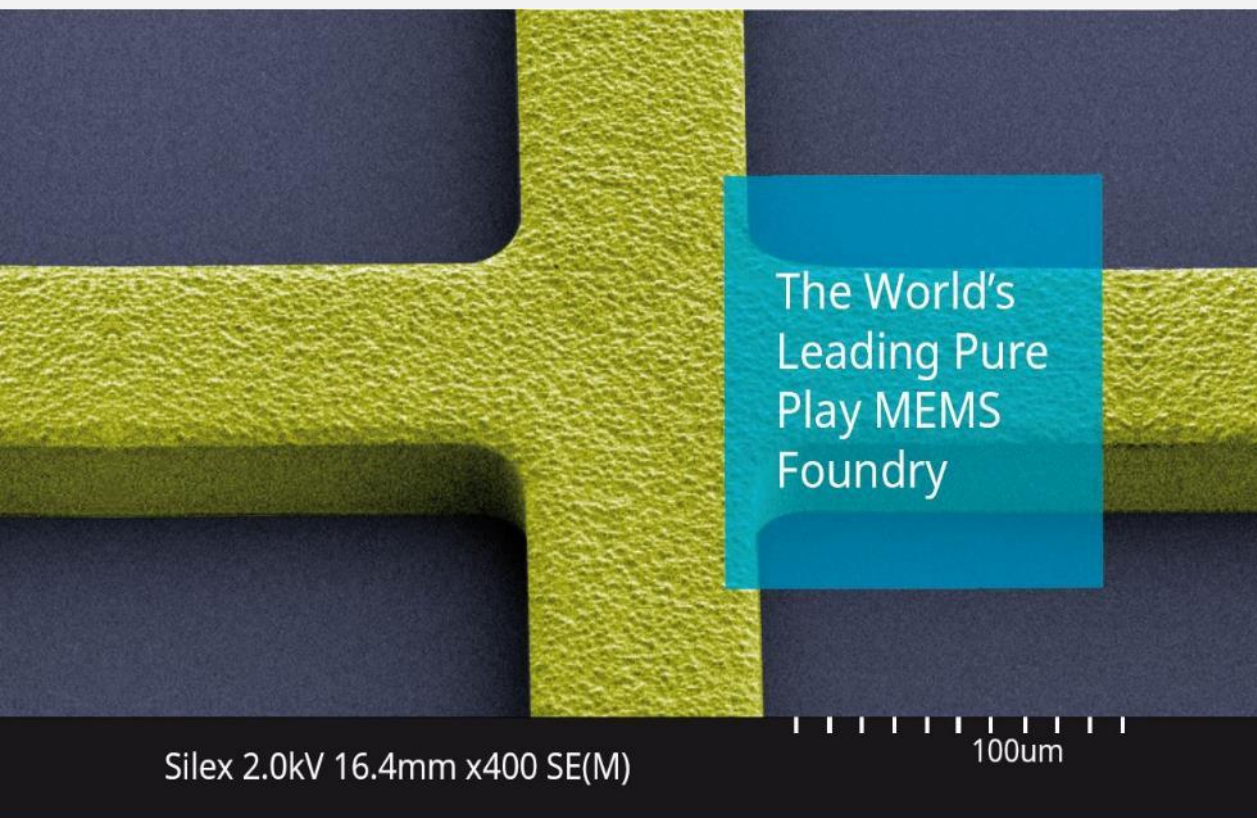


The World's Leading Pure Play MEMS Foundry





Overview of Silex Microsystems

The World's Leading Pure-Play MEMS Foundry

- Founded in year 2000
- Focus on MEMS Foundry manufacturing services
 - Silex has no products
- 170 employees, 75 of them engineers
- Revenue 2017: 50M USD
- Globally serving fabless, fab-lite and IDM customers
- From early prototype to volume production



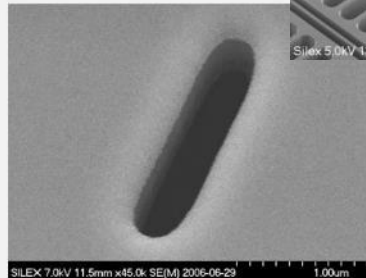
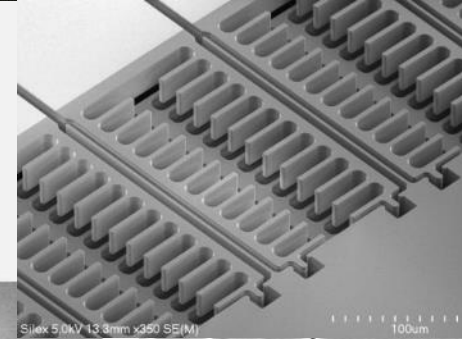
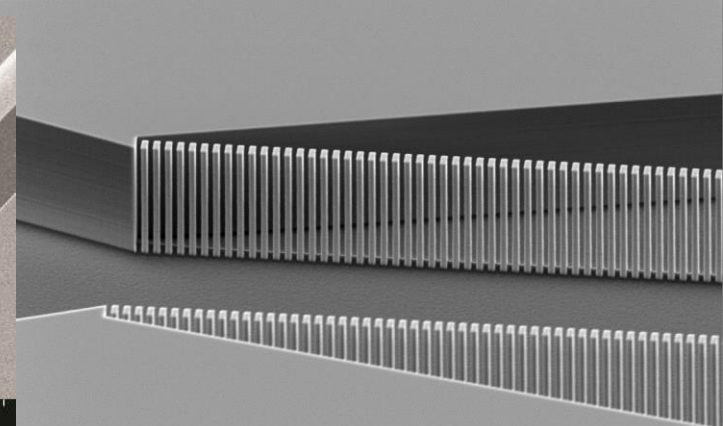
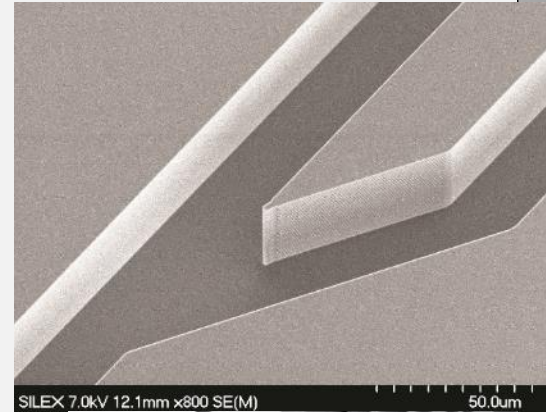
Silex Wafer Fabs

Extensive Capabilities and Capacity

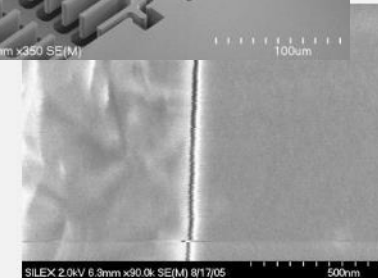
- Fab2 – 200mm wafer fab (1M+ litho layers/year) in Sweden
- Fab3 – 200mm wafer fab under construction in Beijing

Expanded Silex 200mm Fab2 in Sweden

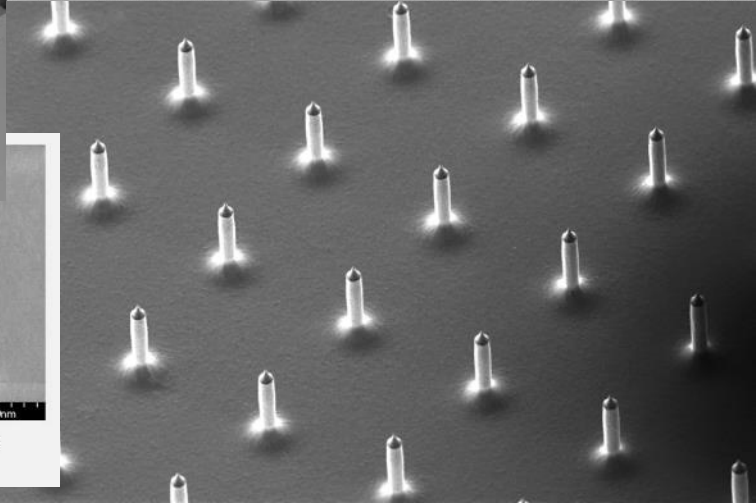
- 40M USD invested in new fab equipment since July 2015
- Sweden “Fab2” will be servicing new process integration and volume manufacturing



Re-grow etched features
(0.20 um features)



Grow vertical sacrificial layers
(20 nm features)





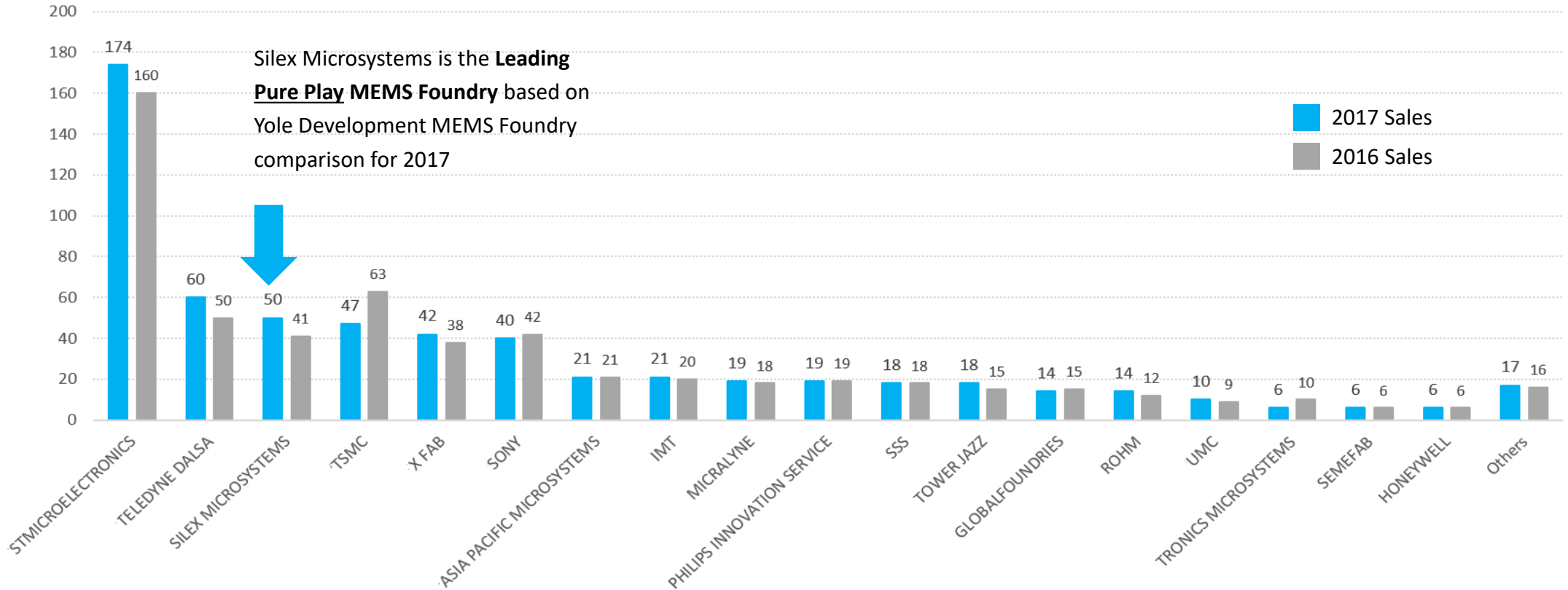
FAB3 BUILDING UNDER CONSTRUCTION





2017 TOP MEMS Foundry Revenue in Million USD

Only the MEMS foundry business is taken into account





Silex Delivers MEMS Chips to a Wide Range of Applications



Telecom

- Optical transceivers
- Optical switches
- Si Photonics



Life Science & Medical

- DNA analysis devices
- Drug delivery devices
- Medical sensors
- Implantables



Industrial & Automotive

- Timing devices
- Micro-mirror devices
- Thermal imaging



Consumer

- Inertial navigation sensors
- Microphones
- Camera autofocus



Productification of MEMS calls for a protocol quite different from IC devices

Program/Start		Development		Manufacturing				
Prospect Phase	TG 0	Concept Phase	TG 1	Prototype Phase	TG 2	Pilot Production Phase	TG 3	Production Phase
<ul style="list-style-type: none"> Program Initiating 		<ul style="list-style-type: none"> Process Feasibility Demonstrated 		<ul style="list-style-type: none"> Design Freeze Process Freeze 		<ul style="list-style-type: none"> Process Capability 		<ul style="list-style-type: none"> Major TG Milestones
<ul style="list-style-type: none"> NDA (signed) 		<ul style="list-style-type: none"> Account Management 		<ul style="list-style-type: none"> Account Management 		<ul style="list-style-type: none"> Account Management 		<ul style="list-style-type: none"> Sales
<ul style="list-style-type: none"> Statement of Work Process Flow 		<ul style="list-style-type: none"> Product Specs (initial) Build Forecast DFMEA 		<ul style="list-style-type: none"> Product Specs (updated) Build Forecast 		<ul style="list-style-type: none"> Product Specs (signed) Build Forecast (12 month) 		<ul style="list-style-type: none"> Customer inputs
<ul style="list-style-type: none"> Process Flow (initial) 		<ul style="list-style-type: none"> Process Flow (updated) Control Plan (draft) PFMEA (draft) Data Collection Check MSA/Gauge RR Plan PCM Plan Quality Plan 		<ul style="list-style-type: none"> Process Flow (updated) Control Plan (updated) PFMEA (updated) Cpk analysis MSA/Gauge RR analysis PCM review Quality Plan (signed) Process Cornering 		<ul style="list-style-type: none"> Process Flow (final) Control Plan (final) PFMEA (to TRB) Cpk analysis (to TRB) 		<ul style="list-style-type: none"> Scope of Work (CIE/Pdev/Quality)
<ul style="list-style-type: none"> Determination of Unknowns Resource Assignment 				<ul style="list-style-type: none"> Mfg Integration Plan 		<ul style="list-style-type: none"> PPAP (if applicable) 		<ul style="list-style-type: none"> Scope of Work (Mig/Quality)

Acronyms Defined

NDA – Non disclosure Agreement

DFMEA - design Failure Mode Effects Analysis

PFMEA - Process Failure Mode Effects Analysis

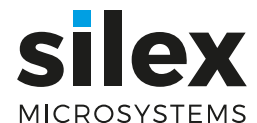
MSA - Measurement Systems Analysis

PCM- Process Control Monitors

PPAP – Production Part approval Process

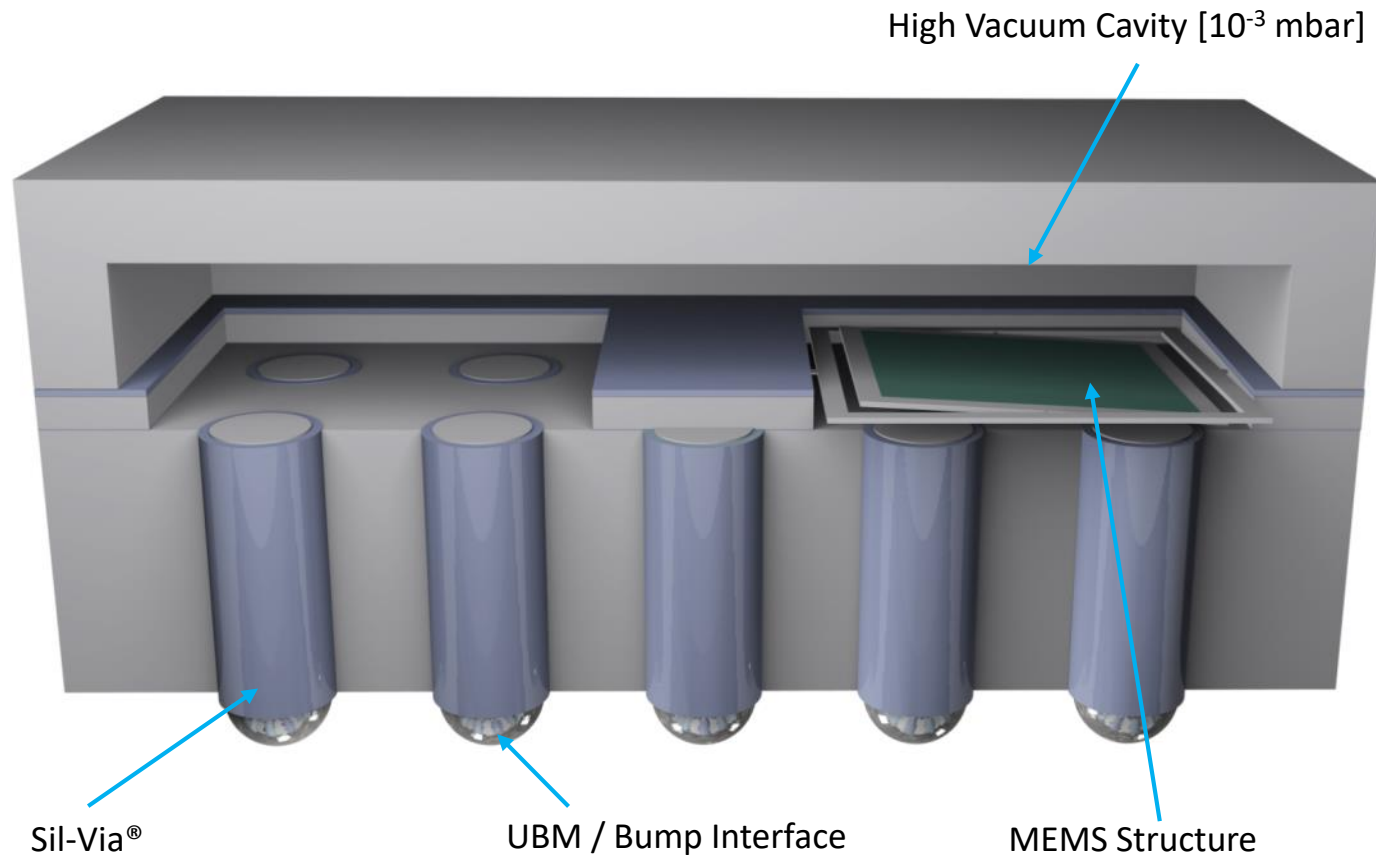
TRB - Technical Review Board

- ✓ Strong IT support throughout productification process
- ✓ MiniTAB SPC fully integrated into production system





Customer Integration of Sil-Via[®] TSV in Device Designs



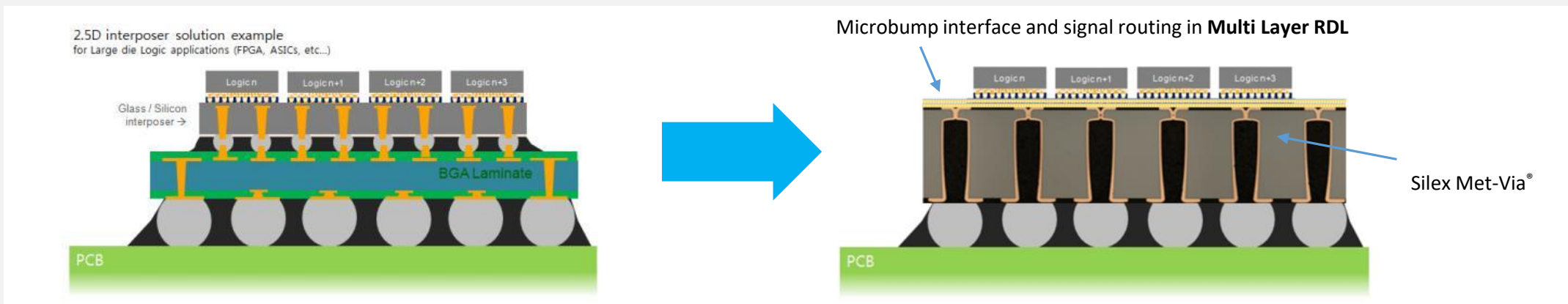
Examples of products manufactured at Silex:

- Accelerometers*
- Cantilevers
- Cell Analysis
- Drug Delivery
- Electrodes*
- Filter structures
- Flow sensors*
- Gyros*
- IC Interposers*
- Lab-on-chips*
- Microphones*
- Mirrors*
- Micro-Needles*
- Optical Membranes
- Optical Benches*
- Pressure sensors*
- Print heads*
- RF switches
- Resonators*
- Touch Membrane
- μ Batteries*
- IR Sensors

* Sil-Via[®] TSV implemented



Met-Via[®] “Rigid” Si Interposers Enable 2.5D Integration

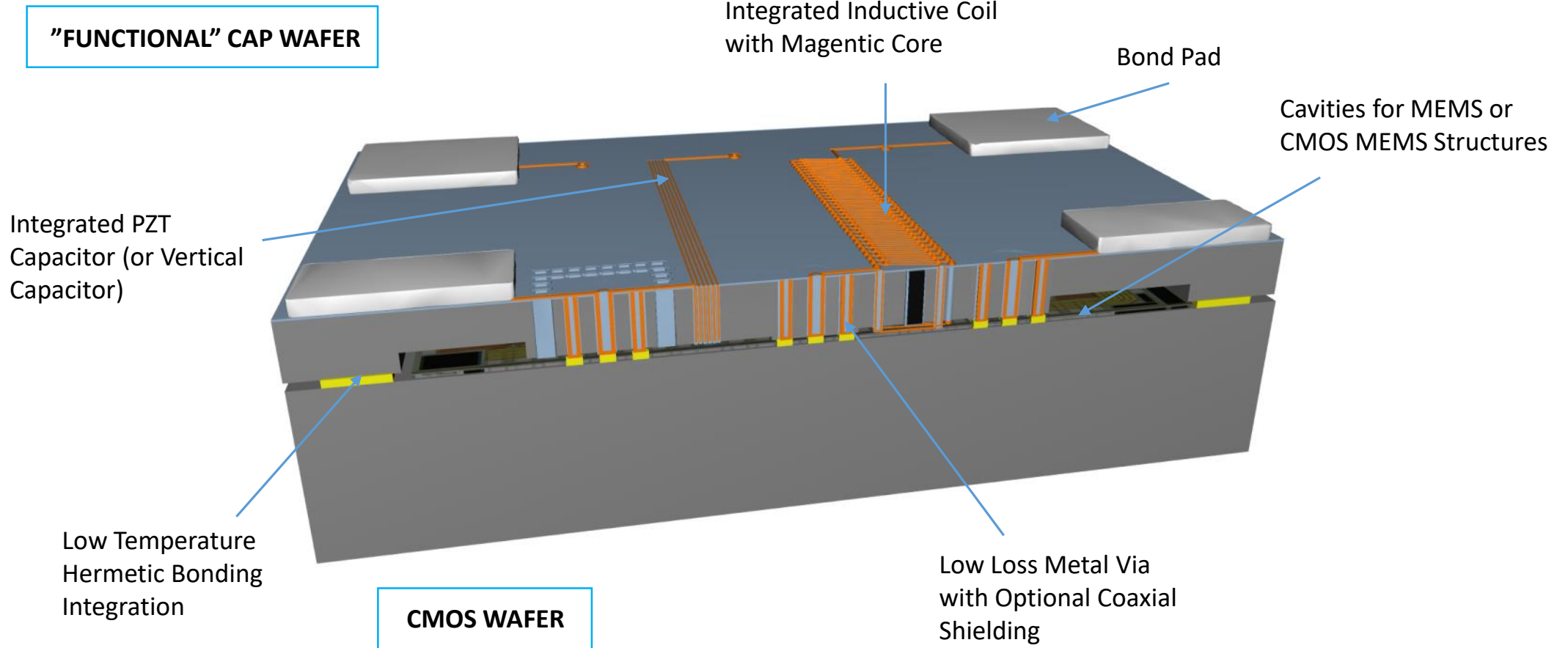


- Met-Via[®] TSVs is full wafer thickness TSV, which means the Si interposer replaces the need for an intermediate BGA laminate in 2.5D solutions
- Rigid interposers take advantage of robust wafer processing
 - Eliminates thin wafer handling (temporary bonding / de-bonding)
 - Reliable wafer handling at 300-400 μm

- Eliminating organic substrate improves heat transfer and thermal matching of die to package
- **All signal routing is done in a multilayer RDL on top side of the Met-Via[®] Interposer – going directly from microbump with 5 μm /5 μm line/space to a PCB pitch of 400 μm or 500 μm**
- **Attractive integration technology for next generation RF system design where short distance and tight tolerances are key to performance**



What "Moore" can MEMS Foundries do for CMOS and Packaging?





Thank You