GLOBALFOUNDRIES, the world’s first full-service semiconductor foundry with a truly global manufacturing and technology footprint, is reshaping the semiconductor industry through collaboration and innovation in its world-class manufacturing, R&D and design enablement centers in the United States, Europe and Asia. We develop and support leading-edge and mainstream process technology platforms, dramatically reducing time-to-market and time-to-volume with rapid yield learning, optimized performance and low defect densities.

Two 28nm technologies based on high-k-metal-gate (HKMG) technology provide optimized scalability (die size, design compatibility, performance) and manufacturability:

**28nm-HPP – Highest Performance Per Watt**
28nm High Performance Plus (28nm-HPP) platform is optimized for computing, networking, storage, and other wired applications requiring highest performance per watt

**28nm-SLP – Lowest Complexity GHz Performance**
28nm Super Low Power (28nm-SLP) platform is optimized for cost- & power-sensitive applications in mobile, wireless, consumer and other markets requiring GHz performance at the lowest power and cost
Optimized 28nm Platforms

GLOBALFOUNDRIES 28nm platforms offer superior Performance, Power, Area and Cost (PPAC) characteristics optimized for a wide range of applications from power-critical mobile, wireless and consumer to high-performance computing, networking and storage.

28nm-HPP and 28nm-SLP utilize High-k Metal Gate (HKMG) “Gate First” technology with superior control of the channel for high on currents and low leakage current. Both provide twice the gate density of comparable 40nm processes and an SRAM cell size shrink greater than 50 percent.

Superior Performance, Power, Area

28nm-HPP and 28nm-SLP versus comparable 40/45nm platforms:

“Gate First” High-k Metal Gate (HKMG) Technology Advantages

1. Similar architecture and design rules maintained, avoiding design time and density penalties from restrictive design rules for “Gate Last” approach
2. Lower cost for 28nm-SLP versus “Gate Last” approach due to:
   - Mask adders
   - Area overhead for power management
   - Area scaling disadvantage of gate last
3. Better performance/watt for 28nm-HPP due to lower voltage process
   - Higher performance
   - Lower power
   - Area scaling disadvantage of gate last
Comprehensive, Validated EDA and IP Ecosystem

The 28nm-HPP and 28nm-SLP platforms include a complete, design-ready ecosystem with familiar design flows and a broad range of validated IP.

The 28nm platforms also allow you to maintain design styles and architecture from prior nodes, further facilitating easier node migration to 28nm.

Silicon-validated IP

<table>
<thead>
<tr>
<th>IP</th>
<th>28nm-HPP</th>
<th>28nm-SLP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation IP</td>
<td>Standard cells, memories, GPIOs</td>
<td>Standard cells, memories, GPIOs</td>
</tr>
<tr>
<td>Basic IP</td>
<td>PLL, DLL, ADC, DAC, specialty I/Os, AFE</td>
<td>PLL, DLL, ADC, DAC, specialty I/Os, AFE</td>
</tr>
</tbody>
</table>
| Complex IP | High-speed Interfaces  
Application specific IPs | High-speed Interfaces  
- PCIe, DDR3, LPDDR2/3, XAUI, SATA, USB2/3, MHL, HDMI 2.0, MIPI...  
Application specific IPs |
| Processor IP | In progress | ARM Processor Optimization Packs  
ARM High Performance Kits  
ARM Fast Cache Instances |

28nm Device Components

Each platform supports several Vt and I/O options to meet exacting product specifications. Both feature a wide choice of metal options. 28nm-SLP also includes Super Low Vt.

28nm-SLP utilizes HKMG and presents the same dense routing of 28nm-HPP, but is a lower cost technology in terms of the performance elements utilized to boost carrier mobilities.

<table>
<thead>
<tr>
<th>28nm Device</th>
<th>28nm-HPP</th>
<th>28nm-SLP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Device (SG)</td>
<td>SLVt</td>
<td>–</td>
</tr>
<tr>
<td>Core Vdd = 0.85V (HPP)</td>
<td>LVT</td>
<td>√</td>
</tr>
<tr>
<td>Core Vdd = 1.0V (SLP)</td>
<td>RVT</td>
<td>√</td>
</tr>
<tr>
<td>I/O Devices (EG)</td>
<td>28A – 1.5V 1.8V</td>
<td>√</td>
</tr>
<tr>
<td>FEOL Passives</td>
<td>Resistors suite</td>
<td>√</td>
</tr>
<tr>
<td></td>
<td>Capacitors suite</td>
<td>√</td>
</tr>
<tr>
<td></td>
<td>VNP</td>
<td>√</td>
</tr>
<tr>
<td></td>
<td>ESD device support</td>
<td>√</td>
</tr>
<tr>
<td>BEOL Passives</td>
<td>VNCAP, Inductor</td>
<td>√</td>
</tr>
<tr>
<td>Memory</td>
<td>Regular SP SRAM</td>
<td>√</td>
</tr>
<tr>
<td></td>
<td>Dense SP SRAM</td>
<td>√</td>
</tr>
<tr>
<td></td>
<td>8T DP and TP SRAM</td>
<td>√</td>
</tr>
<tr>
<td>eFuse</td>
<td>Poly-based</td>
<td>√</td>
</tr>
</tbody>
</table>
Collaborative Device Manufacturing

GLOBALFOUNDRIES supports a unique model for design enablement that includes open access to fab technology, and involves in-depth collaboration to optimize your product performance and yields.

Collaboration extends from EDA support to providing a focused physical presence for design-technology co-optimization, with early engagement being a key success factor of the methodology. GLOBALFOUNDRIES collaborates closely with all major EDA companies and third party IP providers to validate EDA tool flows and IP on process technologies.

The GLOBALSOLUTIONS ecosystem includes partners in all aspects of design enablement and turnkey services, OPC and mask operations, and advanced capabilities in assembly solutions. Thus, you can innovate and differentiate at all levels of the design process, from the silicon and SoC level to the full system.

GLOBALFOUNDRIES is dedicated to product design and technology co-optimization to enable the fastest time-to-market for customers.

GLOBALSHUTTLE Service

GLOBALFOUNDRIES’ prototyping service allows multiple designs to share the costs of a single mask set, as well as multi-layer reticle (MLR) approach to low volume manufacturing. 28nm-SLP and 28nm-HPP shuttles are regularly scheduled to fit your design schedule; find details at www.globalfoundries.com.

Worldwide 28nm HKMG Adoption

- Consistently strong design win pipeline, long life expectation for 28nm
- Multiple chips in production, Ramping volume now

28nm High Performance Adoption
- CPU / APU
- Server CPU
- ARM-based Server / Networking SoC
- Wireless Backhaul
- GPU
- Network Processor
- Game Console

28nm Low Power Adoption
- Apps Processor
- Communications, Consumer SoCs
- Baseband, Apps Processor
- Computing SoC
- Industrial, Automotive SoC
- Gaming
- High Speed Memory SoC

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