Safe Harbor for Forward-Looking Statements

This presentation contains forward-looking statements under the Private Securities Litigation Reform Act of 1995 including those relating to Rambus’ expectations regarding product and service offerings, growth for 2019 and financial guidance for the first quarter of 2019, including revenue, operating costs and expenses, earnings per share and estimated, fixed, long-term projected tax rates. Such forward-looking statements are based on current expectations, estimates and projections, management’s beliefs and certain assumptions made by Rambus’ management. Actual results may differ materially. Our business is subject to a number of risks which are described more fully in our periodic reports filed with the Securities and Exchange Commission. Rambus undertakes no obligation to update forward-looking statements to reflect events or circumstances after the date hereof.

Effective January 1, 2018, the Company adopted Accounting Standards Update No. 2014-09, Revenue from Contracts with Customers in ASC 606. The adoption of ASC 606 materially impacted the timing of revenue recognition for the Company's fixed-fee intellectual property licensing arrangements. The adoption of ASC 606 did not have a material impact on the Company's other revenue streams, net cash provided by operating activities, or its underlying financial position.

The Company has provided financial results for the fourth quarter and year ended December 31, 2018 under ASC 606 and ASC 605 in order to provide additional transparency. The Company believes that providing this additional disclosure in the short term will help its investors and analysts understand the impact of the change in revenue recognition standards, especially given the material difference in the timing of revenue recognition for its fixed-fee licensing arrangements as mentioned above. Note that the presentation under ASC 605 is not a substitute for the ASC 606 revenue recognition rules under current GAAP.

This presentation contains non-GAAP financial measures, including operating costs and expenses, operating margin, operating income (loss), adjusted EBITDA and net income (loss). In computing these non-GAAP financial measures, stock-based compensation expenses, acquisition-related transaction costs and retention bonus expense, amortization expenses, non-cash interest expense and certain other one-time adjustments were considered. The non-GAAP financial measures should not be considered a substitute for, or superior to, financial measures calculated in accordance with GAAP, and the financial results calculated in accordance with GAAP and reconciliations from these results should be carefully evaluated. Management believes the non-GAAP financial measures are appropriate for both its own assessment of, and to show investors, how the Company’s performance compares to other periods. Reconciliation from GAAP to non-GAAP results are made available and more fully described on our website as well as the back of this deck and in the earnings release.
Rambus at a Glance

### Market Megatrends

- Renaissance of computer architectures, **memory critical and driving innovation**
- Internet giants moving **SoC design in-house**, enabling TAM expansion
- **Secure semiconductor HW, SW and supply chain essential** for global commerce

### Rambus Offerings

- **Architecture Licenses**
- **IP Cores**
- **Chips**
- **Key Management**

### Financial Performance

**Revenue**
- Q418: $68.5M (ASC 606)
- $102.0M (ASC 605)
- 2018: $401.1M (ASC 605)

**Cash from Operations**
- Q418: $35.1M
- 2018: $87.1M

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**NASDAQ: RMBS**

25+ Years
Tech leadership & innovation

2500+
Patents and Applications

**HQ: California**
WW Offices in India, EU, Asia

~800
Employees Worldwide
Moving Data Faster, Safer, and Smarter

Artificial Intelligence & Machine Learning
Accurate training requires enormous amounts of data - memory bandwidth is key

Data Center & Networking
Explosion of data from connect devices and real-time processing needs pushing demands on interconnects to move data faster

Autonomous/ADAS Automotive
Real-time decisions from multiple inputs increase demand on processing and trust in the data

Edge Compute (5G)
Near edge (base stations) drive performance and far edge (gateways and routers) demand power efficiency and trust

Internet of Things
Billions of connected endpoints make device-level security critical to enabling trust across the ecosystem

Government
Trusted device authentication is critical to global supply chain

Billions of connected endpoints make device-level security critical to enabling trust across the ecosystem
Semiconductor Industry Ecosystem Built on Leading-Edge IP

Markets
- AI/ML
- Data Center
- Automotive
- Communications
- IoT
- Government

Cloud Providers
- Google
- Amazon
- Facebook
- Microsoft
- Alibaba Group

System OEMs
- HP
- Dell
- HTC
- Ericsson

Chip Makers
- Micron
- Samsung
- SK hynix
- Qualcomm
- Intel

Foundry
- TSMC
- Samsung
- GLOBALFOUNDRIES

Technology Suppliers
- IDT
- Montage Technology
- Rambus
- Cadence
- Synopsys
- Arm

Sample Ecosystem Example
Semiconductor Solutions Built on Leading-Edge IP

- **Architecture License**
  - Foundational IP

- **IP Cores**
  - High-speed Interfaces and Embedded Security

- **Chips**
  - Buffer Chips

- **Provisioning**
  - Secure Supply Chain Provisioning

**Key Benefits**
- High margin; predictable; fuels investment
- High growth; differentiated margin
Driving Innovation in Foundational Areas

- Extending the performance of DRAM for future generations
- Next-generation hybrid memory subsystems for cost-effective performance
- Application-specific memory solutions for Artificial Intelligence and Machine Learning
Delivering More Data, Faster

High-speed memory and SerDes interfaces are critical for performance in data-intensive applications.

Memory buffers are the key to expanding capacity for data centers and high-performance computing.
Keeping Data Safe with Secure Cores and Provisioning

Secure root of trust in silicon, separate from general processing is critical to creating a trust across connected devices.

- Custom RISC-V CPU
- Secure Memory
- Secure Functionality: Secure Boot, Remote Attestation, Authentication, Runtime Integrity
- Crypto Accelerators (AES, SHA, others...)

Graphs:
- Revenue SAM ($M)
  - 2017 SAM
  - 2019 SAM
  - 2021 SAM

- Total Provisioned Devices (B)
  - 2014
  - 2015
  - 2016
  - 2017
  - 2018
Growing Revenue Base

Large portion of our revenue is fixed & predictable

- 2018 showed year-over-year revenue growth of 6% under ASC 605, excluding impact of Lighting Division
- Continue to leverage our high margin historic businesses to fuel growth in adjacent areas
## Non-GAAP Income Statement

<table>
<thead>
<tr>
<th>In Millions</th>
<th>ASC 606 Q1 2018</th>
<th>ASC 606 Q2 2018</th>
<th>ASC 606 Q3 2018</th>
<th>ASC 606 Q4 2018</th>
<th>ASC 605 Q4 2017</th>
<th>ASC 605 Q1 2018</th>
<th>ASC 605 Q2 2018</th>
<th>ASC 605 Q3 2018</th>
<th>ASC 605 Q4 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>$46.4</td>
<td>$56.5</td>
<td>$59.8</td>
<td>$68.5</td>
<td>$101.9</td>
<td>$100.5</td>
<td>$98.8</td>
<td>$99.8</td>
<td>$102.0</td>
</tr>
<tr>
<td>Total Operating Expenses¹</td>
<td>$68.7</td>
<td>$66.8</td>
<td>$67.6</td>
<td>$61.6</td>
<td>$68.4</td>
<td>$68.7</td>
<td>$66.8</td>
<td>$67.6</td>
<td>$61.6</td>
</tr>
<tr>
<td>Operating Income (Loss)¹</td>
<td>($22.3)</td>
<td>($10.3)</td>
<td>($7.9)</td>
<td>$6.9</td>
<td>$33.5</td>
<td>$31.7</td>
<td>$32.0</td>
<td>$32.2</td>
<td>$40.4</td>
</tr>
<tr>
<td>Operating Margin¹</td>
<td>(48%)</td>
<td>(18%)</td>
<td>(13%)</td>
<td>10%</td>
<td>33%</td>
<td>32%</td>
<td>32%</td>
<td>32%</td>
<td>40%</td>
</tr>
<tr>
<td>Diluted Net Income (Loss) Per Share¹</td>
<td>($0.10)</td>
<td>($0.03)</td>
<td>($0.01)</td>
<td>$0.09</td>
<td>$0.19</td>
<td>$0.21</td>
<td>$0.21</td>
<td>$0.22</td>
<td>$0.28</td>
</tr>
</tbody>
</table>

¹Please refer to reconciliations of non-GAAP financial measures included in this presentation and in our earnings release.

*Growth from product revenue, royalties and incremental licensing agreements*

*Managed expenses through refocus on core growth initiatives*

*Operating Income consistently in line with expectations*

*Operating Margin expansion*

*Delivering profitable growth*
## Financial Strength

<table>
<thead>
<tr>
<th></th>
<th>Q4 2017</th>
<th>Q1 2018</th>
<th>Q2 2018</th>
<th>Q3 2018</th>
<th>Q4 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Cash &amp; Marketable Securities</strong></td>
<td>$329.4</td>
<td>$291.2</td>
<td>$298.3</td>
<td>$248.2</td>
<td>$277.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Assets</strong></td>
<td>$891.1</td>
<td>$1,539.7</td>
<td>$1,525.8</td>
<td>$1,344.0</td>
<td>$1,361.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Stockholders’ Equity</strong></td>
<td>$571.6</td>
<td>$1,119.0</td>
<td>$1,105.5</td>
<td>$1,008.3</td>
<td>$1,012.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Adjusted EBITDA¹</strong></td>
<td>$36.8</td>
<td>$34.7</td>
<td>$34.6</td>
<td>$34.8</td>
<td>$43.0</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹Please refer to reconciliations of non-GAAP financial measures included in this presentation and in our earnings release
Strong Cash From Operations

Low Capital Expenditure, Consistent Return to Shareholders

- Predictable revenue stream provides consistent cash flow
- Returned $200M of cash to shareholders from 2015 through 2018 through Accelerated Share Repurchase programs
Rambus Investment Summary

• Focus on core strength in semiconductor
  Targeting high-growth data center and edge markets with steady growth in product revenue

• Solid foundation of committed, long-term revenue
  Continued profitable growth with high, predictable margin from reoccurring royalties and fees

• Strong balance sheet to support strategic initiatives
  Consistent generation of cash from operations
Thank You
## Reconciliation of Non-GAAP Financial Measures

### Net Income (Loss) in Millions

<table>
<thead>
<tr>
<th></th>
<th>Q1 2018 (ASC 606)</th>
<th>Q2 2018 (ASC 606)</th>
<th>Q3 2018 (ASC 606)</th>
<th>Q4 2018 (ASC 606)</th>
<th>Q4 2017 (ASC 605)</th>
<th>Q1 2018 (ASC 605)</th>
<th>Q2 2018 (ASC 605)</th>
<th>Q3 2018 (ASC 605)</th>
<th>Q4 2018 (ASC 605)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAAP Net Income (Loss)</td>
<td>$(36)</td>
<td>$(15)</td>
<td>$(105)</td>
<td>$(2)</td>
<td>$(36)</td>
<td>$6</td>
<td>$14</td>
<td>$(61)</td>
<td>$25</td>
</tr>
<tr>
<td>Adjustments:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stock-based compensation</td>
<td>$8</td>
<td>$2</td>
<td>$6</td>
<td>$6</td>
<td>$7</td>
<td>$8</td>
<td>$2</td>
<td>$6</td>
<td>$6</td>
</tr>
<tr>
<td>Acquisition-related transaction costs &amp; retention bonus</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Amortization</td>
<td>$11</td>
<td>$9</td>
<td>$5</td>
<td>$5</td>
<td>$11</td>
<td>$11</td>
<td>$9</td>
<td>$5</td>
<td>$5</td>
</tr>
<tr>
<td>Restructuring charges</td>
<td>$3</td>
<td>$(1)</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$3</td>
<td>$(1)</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Non-cash interest expense / Loss on extinguishment of debt</td>
<td>$3</td>
<td>$3</td>
<td>$2</td>
<td>$2</td>
<td>$3</td>
<td>$3</td>
<td>$3</td>
<td>$2</td>
<td>$2</td>
</tr>
<tr>
<td>Provision for (benefit from) income taxes</td>
<td>$(0)</td>
<td>$(0)</td>
<td>$90</td>
<td>$(2)</td>
<td>$36</td>
<td>$(6)</td>
<td>$(3)</td>
<td>$72</td>
<td>$(8)</td>
</tr>
<tr>
<td>Non-GAAP Net Income (Loss)</td>
<td>$(11)</td>
<td>$(3)</td>
<td>$(1)</td>
<td>$9</td>
<td>$21</td>
<td>$24</td>
<td>$24</td>
<td>$24</td>
<td>$30</td>
</tr>
</tbody>
</table>

### Operating Income (Loss) in Millions

<table>
<thead>
<tr>
<th></th>
<th>Q1 2018 (ASC 606)</th>
<th>Q2 2018 (ASC 606)</th>
<th>Q3 2018 (ASC 606)</th>
<th>Q4 2018 (ASC 606)</th>
<th>Q4 2017 (ASC 605)</th>
<th>Q1 2018 (ASC 605)</th>
<th>Q2 2018 (ASC 605)</th>
<th>Q3 2018 (ASC 605)</th>
<th>Q4 2018 (ASC 605)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAAP Operating Income (Loss)</td>
<td>$(44)</td>
<td>$(20)</td>
<td>$(19)</td>
<td>$(4)</td>
<td>$16</td>
<td>$11</td>
<td>$22</td>
<td>$21</td>
<td>$29</td>
</tr>
<tr>
<td>Adjustments:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stock-based compensation</td>
<td>$8</td>
<td>$2</td>
<td>$6</td>
<td>$6</td>
<td>$7</td>
<td>$8</td>
<td>$2</td>
<td>$6</td>
<td>$6</td>
</tr>
<tr>
<td>Acquisition-related transaction costs &amp; retention bonus</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Amortization</td>
<td>$11</td>
<td>$9</td>
<td>$5</td>
<td>$5</td>
<td>$11</td>
<td>$11</td>
<td>$9</td>
<td>$5</td>
<td>$5</td>
</tr>
<tr>
<td>Restructuring charges</td>
<td>$3</td>
<td>$(1)</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$3</td>
<td>$(1)</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Non-GAAP Operating Income (Loss)</td>
<td>$(22)</td>
<td>$(10)</td>
<td>$(8)</td>
<td>$7</td>
<td>$34</td>
<td>$32</td>
<td>$32</td>
<td>$32</td>
<td>$40</td>
</tr>
<tr>
<td>Depreciation</td>
<td>$3</td>
<td>$3</td>
<td>$3</td>
<td>$3</td>
<td>$3</td>
<td>$3</td>
<td>$3</td>
<td>$3</td>
<td>$3</td>
</tr>
<tr>
<td>Adjusted EBITDA</td>
<td>$(19)</td>
<td>$(7)</td>
<td>$(5)</td>
<td>$10</td>
<td>$(37)</td>
<td>$(35)</td>
<td>$(35)</td>
<td>$(35)</td>
<td>$(43)</td>
</tr>
</tbody>
</table>

Certain amounts may be off $0.1M due to rounding.
### GAAP & Non-GAAP P&L

#### ASC 606

<table>
<thead>
<tr>
<th>In $ Millions</th>
<th>GAAP Actual Q4’18</th>
<th>Pro Forma Actual Q4’18</th>
<th>Delta to GAAP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenue</strong></td>
<td>68.5</td>
<td>68.5</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Cost of revenue</strong></td>
<td>10.6</td>
<td>6.7</td>
<td>(3.9)</td>
</tr>
<tr>
<td><strong>Research and development</strong></td>
<td>37.4</td>
<td>34.5</td>
<td>(2.9)</td>
</tr>
<tr>
<td><strong>Sales, general and administrative</strong></td>
<td>24.8</td>
<td>20.4</td>
<td>(4.3)</td>
</tr>
<tr>
<td><strong>Total operating costs and expenses</strong></td>
<td>72.8</td>
<td>61.6</td>
<td>(11.1)</td>
</tr>
<tr>
<td><strong>Operating Income (loss)</strong></td>
<td>(4.2)</td>
<td>6.9</td>
<td>11.1</td>
</tr>
<tr>
<td><strong>Interest and other income (expense), net</strong></td>
<td>4.0</td>
<td>5.7</td>
<td>1.7</td>
</tr>
<tr>
<td><strong>Income (Loss) before income taxes</strong></td>
<td>(0.2)</td>
<td>12.6</td>
<td>12.8</td>
</tr>
<tr>
<td><strong>Provision for income taxes</strong></td>
<td>1.8</td>
<td>3.0</td>
<td>1.2</td>
</tr>
<tr>
<td><strong>Net income (loss)</strong></td>
<td>(2.0)</td>
<td>9.6</td>
<td>11.6</td>
</tr>
</tbody>
</table>

#### ASC 605

<table>
<thead>
<tr>
<th>In $ Millions</th>
<th>GAAP Actual Q4’18</th>
<th>Pro Forma Actual Q4’18</th>
<th>Delta to GAAP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenue</strong></td>
<td>102.0</td>
<td>102.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Cost of revenue</strong></td>
<td>10.6</td>
<td>6.7</td>
<td>(3.9)</td>
</tr>
<tr>
<td><strong>Research and development</strong></td>
<td>37.4</td>
<td>34.5</td>
<td>(2.9)</td>
</tr>
<tr>
<td><strong>Sales, general and administrative</strong></td>
<td>24.8</td>
<td>20.4</td>
<td>(4.3)</td>
</tr>
<tr>
<td><strong>Total operating costs and expenses</strong></td>
<td>72.8</td>
<td>61.6</td>
<td>(11.1)</td>
</tr>
<tr>
<td><strong>Operating income</strong></td>
<td>29.2</td>
<td>40.4</td>
<td>11.1</td>
</tr>
<tr>
<td><strong>Interest and other income (expense), net</strong></td>
<td>(2.2)</td>
<td>(0.5)</td>
<td>1.7</td>
</tr>
<tr>
<td><strong>Income before income taxes</strong></td>
<td>27.1</td>
<td>39.9</td>
<td>12.8</td>
</tr>
<tr>
<td><strong>Provision for income taxes</strong></td>
<td>1.8</td>
<td>9.6</td>
<td>7.8</td>
</tr>
<tr>
<td><strong>Net income</strong></td>
<td>25.2</td>
<td>30.3</td>
<td>5.1</td>
</tr>
</tbody>
</table>

Certain amounts may be off $0.1M due to rounding.
Non-GAAP Provision for (Benefit from) Income Taxes

<table>
<thead>
<tr>
<th>ASC 606</th>
<th>Actual Q4’18</th>
<th>Actual Q3’18</th>
<th>Variance QoQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provision for income taxes (GAAP)</td>
<td>1.8</td>
<td>89.8</td>
<td></td>
</tr>
<tr>
<td>Adjustment to GAAP provision for income taxes</td>
<td>1.2</td>
<td>(90.2)</td>
<td></td>
</tr>
<tr>
<td>Non-GAAP Provision for (benefit from) income taxes</td>
<td>3.0</td>
<td>(0.4)</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Supplemental Reconciliation of GAAP to Non-GAAP Effective Tax Rate (1)

<table>
<thead>
<tr>
<th>Actual</th>
<th>Actual</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q4’18</td>
<td>Q3’18</td>
<td>QoQ</td>
</tr>
<tr>
<td>GAAP effective tax rate</td>
<td>(894)%</td>
<td>(593)%</td>
</tr>
<tr>
<td>Adjustment to GAAP effective tax rate</td>
<td>918%</td>
<td>617%</td>
</tr>
<tr>
<td>Non-GAAP effective tax rate</td>
<td>24%</td>
<td>24%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ASC 605</th>
<th>Actual Q4’18</th>
<th>Actual Q3’18</th>
<th>Variance QoQ</th>
<th>Actual Q4’17</th>
<th>Variance YoY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provision for income taxes</td>
<td>1.8</td>
<td>79.2</td>
<td>47.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjustment to provision for (benefit from) income taxes</td>
<td>7.8</td>
<td>(71.6)</td>
<td>(36.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-GAAP provision for (benefit from) income taxes</td>
<td>9.6</td>
<td>7.7</td>
<td>1.9</td>
<td>11.4</td>
<td>(1.8)</td>
</tr>
</tbody>
</table>

Supplemental Reconciliation of GAAP to Non-GAAP Effective Tax Rate (1)

<table>
<thead>
<tr>
<th>Actual</th>
<th>Actual</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q4’18</td>
<td>Q3’18</td>
<td>QoQ</td>
</tr>
<tr>
<td>GAAP effective tax rate</td>
<td>7%</td>
<td>430%</td>
</tr>
<tr>
<td>Adjustment to GAAP effective tax rate</td>
<td>17%</td>
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(1) For purposes of internal forecasting, planning and analyzing future periods that assume net income from operations, the Company estimates a fixed, long-term projected tax rate of approximately 35 percent for 2017 and 24 percent for 2018, which consists of estimated U.S. federal and state tax rates, and excludes tax rates associated with certain items such as withholding tax, tax credits, deferred tax asset valuation allowance and the release of any deferred tax asset valuation allowance. Accordingly, the Company has applied these tax rates to its non-GAAP financial results for all periods in the relevant year to assist the Company’s planning. Certain amounts may be off by $0.1M due to rounding.
### Revenue Breakdown

#### In Millions

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Certain amounts may be off $0.1M due to rounding.
## Revenue and Licensing Billings

**In Thousands**

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**Delta**

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¹ Licensing billings is an operational metric that reflects amounts invoiced to our patent and technology licensing customers during the period, as adjusted for certain differences.
Product Overview
The Data Center

Data • Faster

- **Cores**
  - SerDes PHYs
    - Move data from chip to chip
  - Memory PHYs
    - Move data between chips and memory

- **Chips**
  - Server DIMM Chipsets
    - Enables more capacity at high performance
Optimized for power and area, our line-up of SerDes Interface solutions deliver maximum performance and flexibility for today’s most challenging systems.

**Fully Standards-Compatible**
- Compliant with the latest industry-standard specifications
- Support for multi-modal functionality

**Enhanced Design Flexibility**
- Support for multiple packaging options
- Enhanced margin and yield

**Reduced Power**
- Improved power efficiency
- Lower signaling and stand-by power

**Improved Performance**
- Increased data rates
- Improved bandwidth
- Higher capacity
Rambus High-Speed SerDes PHY Solutions

**Complete Solutions: SerDes PMA+ PCS, MAC (Partners)**

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<td>28nm &amp; 14nm</td>
<td>14nm</td>
<td>10nm</td>
<td></td>
</tr>
</tbody>
</table>

**LEAD CUSTOMERS**

- PCIe 4/3/2
- CEI 11/6
- XFI/XAUI
- SATA
- SAS

- CEI-28/25/11/6
- 100/50/25GbE
- 10G-KR
- FC28
- XFI/XAUI

**ROADMAP**

- CEI-56G MR
- CEI-56G LR
- CEI-28/25/11
- 400GbE
- PAM-4/NRZ

**LabStation Platform**

- Easy-to-use PC Interface
- Interface to 3rd party software
- Pre-defined test scripts
- PHY control settings
- External instrument control
- System characteristics and analysis

**Validated solutions with partners**
With their reduced power consumption and industry-leading data rates, our line-up of enhanced memory interface solutions support a broad range of industry standards with improved margin and flexibility.

**Fully Standards-Compatible**
- Compliant with the latest JEDEC and industry-standard specifications
- Support for multi-modal functionality

**Enhanced Design Flexibility**
- Support for multitude packaging options
- Enhanced margin and yield

**Reduced Power**
- Improved power efficiency
- Lower signaling and stand-by power

**Improved Performance**
- Increased data rates
- Improved bandwidth
- Higher capacity
Rambus Memory PHY Solutions

Memory PHY Solutions for Networking and Data Center

**DDR4/3**
- 28nm & 14nm
- 3200Mbps
- x16 – x72-bits
- 1-4 Ranks
- DFI 4.0

**HBM2**
- 14nm
- 2000Mbps
- 1024-bit
- 2.5D design architecture

**GDDR6**
- 12-16 Gbps
- 2x 16-bit channels

**DDR5 & HBM3**
- In Development

**ROADMAP**
- LabStation Platform

Integrated tools for easy bring-up and characterization
- Easy-to-use PC Interface
- Interface to 3rd party software
- Pre-defined test scripts
- PHY control settings
- External instrument control
- System characteristics and analysis

Validated solutions with partners
- Northwest Logic
- ARM

Data • Faster • Safer
Built for speed, power efficiency and reliability, the DDRn chipsets for RDIMM, LRDIMM and NVDIMM server modules delivers the top-of-the-line performance and capacity needed to meet the growing demands on enterprise and data center systems.

Industry-leading Performance
• Fully-compliant with the latest JEDEC standards
• Operational speeds up to 3200 Mbps

Enhanced Margin
• Wide margin I/O design with advanced programmability
• Exceed JEDEC reliability standards for ESD and EOS

Optimized Power
• Advanced power management
• Frequency-based, low-power optimization

Superior Debug and Serviceability
• Integrated tools for bring-up and debug
• Works out-of-the-box with no BIOS changes required
Introducing DDR5 Server DIMM Chips

Rambus Announces Industry’s First Functional Silicon of Server DIMM Buffer Chipset Targeted for Next-generation DDR5 Memory Technology

Provides data center architects early path to next-generation memory speeds

SUNNYVALE, Calif. – Sept. 20, 2017 – Rambus Inc. (NASDAQ: RMBS) today announced functional silicon of a double data rate (DDR) server DIMM (dual inline memory module) buffer chip prototype for the next generation DDR5 memory technology. This represents a key milestone for Rambus and the industry’s first silicon-proven memory buffer chip prototype capable of achieving the speeds required for the upcoming DDR5 standard.
Rambus Server DIMM Chipset Solutions

Server DIMM Chipsets: enabling performance and capacity

**DDR3**
- JEDEC Compliant
- Speeds up to 2133
- Multiple OEM qualifications

**DDR4**
- JEDEC Compliant
- Speeds up to 3200
- Multiple OEM qualifications

**NV**
- JEDEC Compliant
- Speeds up to 3200
- Ongoing qualifications

**DDR5**
- Consistent with JEDEC direction

**Available in production**

Smart tools for easy integration and reduced time to market

LabStation Platform and Buffer BIOS Integration Tool

Validated solutions with partners

**SAMSUNG**

**SK hynix**

**Micron**
The Mobile Edge

Data • Safer

Embedded Security
- Secure Cores
  - Embedded device protection
- CryptoManager Platform
  - Secure provisioning and key management

Secure Services
- CryptoManager Trusted Services
  - IoT Security Service

Secure Software
- Mobile Payments
  - Secure payments and trusted transactions
- Smart Ticketing
  - Simplified travel with mobile ticketing
Embedded Security Cores

**DPA Resistance**

DPA Resistant Cores
- Cores and services
- Accelerate integration & TTM

**Anti-Counterfeiting**

CryptoFirewall Cores
- Consumable authentication
- Major printer OEMs

**Content Protection**

CryptoMedia Cores
- Integrated into Set top boxes
- Broadcast and OTT

![Diagram of DPA Resistance](image)

![Diagram of Anti-Counterfeiting](image)

![Diagram of Content Protection](image)
From security cores to high-performance secure device provisioning, the CryptoManager Security platform is a family of hardware security cores and provisioning infrastructure that creates a trusted path from the SoC manufacturing supply chain to downstream service providers with a complete silicon-to-cloud security solution.

**Improved Profitability**
- Improved time-to-market and reduced inventory waste
- Dynamic SKU and feature management lowers inventory costs
- Reduced operating costs through unified manufacturing and provisioning systems

**Superior Security**
- Provide a robust hardware root-of-trust
- Secure valuable secret keys, identity credentials, intellectual property, and other sensitive data
- Protect against cloning, counterfeiting, and reverse engineering

**Control the Value Chain**
- Actively monitor production status, availability, and inventory levels
- Validate process information through secure logs
- Proven in today’s high-volume manufacturing facilities
Security First: Implementing Trust by Design in Silicon

<table>
<thead>
<tr>
<th>Design Freedom</th>
<th>Siloed</th>
<th>Layered Security</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="RISC-V" /></td>
<td><img src="image" alt="Secure Lock" /></td>
<td><img src="image" alt="Key" /></td>
</tr>
<tr>
<td>• Root of trust designed from the bottom up for security</td>
<td>• Separate general and secure processing</td>
<td>• Strongest security enforced in hardware at inner layer</td>
</tr>
<tr>
<td>• Control all implementation starting with open RISC-V Instruction Set Architecture</td>
<td>• Optimize independently for performance and security</td>
<td>• Outer layers are more flexible, but less trusted</td>
</tr>
</tbody>
</table>
CryptoManager Root of Trust

Secure Functionality:
- Secure Boot
- Remote Attestation
- Authentication
- Runtime Integrity

Custom RISC-V CPU

Secure Memory

Crypto Accelerators (AES, SHA, others...)
CryptoManager Embedded Security Infrastructure

**Offline Root Server**
System Root-of-Trust, manages high value keys, kept in secure facility, authorizes all provisioning activity

**CryptoManager Service**
Control center used for monitoring and managing all provisioning activity, typically located in chip maker data center

**CryptoManager Appliances**
Tamper proof HSM-enabled devices that connect directly to testers in the manufacturing facility

---

[Diagram showing the relations between Offline Root Server, CryptoManager Service, and CryptoManager Appliances]
Flexible cloud-to-silicon secure provisioning platform to host, operate and manage on device security services, lifecycle management and applications services for OEMs, service providers and operators.

Device Lifecycle Management
- Cloud-to-silicon security ecosystem
- Secure provisioning, authentication, and device protection

Seamless Secure Connectivity
- Proven platform used to provision billions of chipsets
- Establish independent trust between devices and services

Flexible Platform Integration
- Provisioning infrastructure offered both as a cloud service and as a standalone product
- Secure services implemented via a hardware or software root-of-trust
CryptoManager IoT Security Services Ecosystem

CryptoManager Trusted Services

Provide software

IoT Security Service SDK

Sell Security-as-a-Service

IoT Security Service

Service Provider

Platform as a Service (PaaS) Provider

OEM

Chip Maker

Connected Devices

Data • Faster • Safer
CryptoManager IoT Security Service

Leveraging a Rambus or 3rd-party root of trust, our IoT Security Service enables seamless secure connectivity and security lifecycle management of IoT devices.
Payments & Tokenization

Comprehensive solutions for banks, financial institutions and retailers alike. From Host Card Emulation (HCE) and OEM Pays, to retail scan and go with real-time loyalty redemption, to tokenization of real-time payments (RTP) and Automated Clearing House (ACH) transactions, to blockchain, Rambus software and services, secure a wide range of applications for customers worldwide.

Improved Time-to-market

• Reduce implementation time with proven solutions for mobile, direct debit and credit, and retail payments
• Vertically integrated to provide a comprehensive solution

Enhanced User Experience

• Retain branding and drive digital engagement with bank and retail mobile wallets
• Increase customer adoption with support for major mobile payment platform

Superior Security

• Utilizes tokenization to reduce risk of card-and account-based fraud
• Provides layered security with cryptograms, domain controls and tokenization

Reduced Cost

• Integrates with existing infrastructure and processes
• Supports closed-loop payments to reduce transaction fees
Enabling Mobile Payments for NFC Devices

Token Service Provider

- Leverages Host Card Emulation (HCE) and tokenization to enable secure mobile payments
- Single interface to connect with multiple schemes and OEM Pay platforms
- Maintained up-to-date with latest TSP specifications
# Scan and Go with In-aisle Check Out

<table>
<thead>
<tr>
<th>New Account</th>
<th>In-Aisle Purchase</th>
<th>In-store Advertising</th>
<th>Mobile Check Out</th>
<th>Complete Shopping</th>
</tr>
</thead>
</table>
| • Create account with retailer  
• Load CC info | • Chose an item, photo/scan to add to virtual cart  
• Place item in cart or collect on check-out | • Receive in-store coupons and recommendations based on cart items or geo-beacons  
• Order-ahead goods or services | • Check out on mobile device and skip the lines  
• Automatically accrue loyalty points | • Print or show mobile receipt  
• Collect items  
• Go home happy |
| • Enable account-based retail  
• Create integrated online-to-in-store experience | • Gather customer purchasing data, shopping trends | • Increase upsell and cross-sell opportunities | • Reduce CC transaction fees with integrated retail CC payments  
• Reduce staff requirements for check-out lines  
• Free up more in-store sq. footage for product | • Better user experience drives customer loyalty and brand equity |

---

*Data • Faster • Safer*
Vaultify Trade

A Tokenization platform for the secure transaction and storage of digital assets on blockchain

• Combines multi-signature with bank-grade tokenization to enhance security, confidentiality and privacy of private keys

• First solution to enable banks, exchanges and investment companies to leverage tokens to securely buy, sell, trade and store crypto assets

• Integrates with existing mobile banking, trading and wallet apps for easy access to crypto assets
Improving Security of the Blockchain

1. Encrypted tokens are stored on end-user devices, while private keys to encrypt assets remain safely stored in secure “warm” online vault.

2. Banks support fraud prevention rules.

3. Warm online vault signs transactions, while recovery keys remain safe in “cold” storage even if exchange is hacked.

4. Tokenization mitigates fraud risk to protect crypto assets.
Suitable for multi-modal transport solutions including rail, bus, ferry and taxi, our end-to-end smart ticketing solutions can be implemented in any transport scenario.

**Ease of Integration**
- Comprehensive solutions from back office, to mobile device, to smart card
- Compatible with existing smart systems and suppliers

**Improved Profitability**
- Enhanced business intelligence through account-based ticketing and data analytics
- Easy management of transaction data to ensure correct reimbursements

**Superior Security**
- Reduced risk of fraud with smart technology versus paper tickets
Comprehensive Smart Ticketing Solutions

- End-to-end smart ticketing solutions from back-office processing and traveler analytics, to online purchasing and remote download of tickets
- Leverages secure NFC and mobile technology to replace paper tickets
- Integrated systems for operators to manage passenger journey transactions and analytics to optimize transport systems
First to bring Smart Mobile Ticketing to Rail in UK
Enabling passengers on Scotland’s national railway to use their smartphone to purchase tickets and simply tap to travel
Emerging Solutions

Data • Smarter

Emerging Solutions

From concept to reality

Innovation • Research • Development
Exploring avenues to surpass the slowing of Moore's Law and meet the needs of next-generation data centers through cryogenic and hybrid memory research.
Expanding to Prototypes with Microsoft Research

DRAM Partner

Cryogenic Research Partner

FAB Partner

Development

Modeling

Rambus Cryogenic Research Station
Thank You