Broadcom Ships Tomahawk 3:

Industry’s Highest Bandwidth Ethernet Switch Chip at 12.8 Terabits per Second

Under Embargo
Confidential Until 6am PDT, December 19th 2017
Safe Harbor Statement

This presentation contains forward-looking statements (including within the meaning of Section 21E of the United States Securities Exchange Act of 1934, as amended, and Section 27A of the United States Securities Act of 1933, as amended) concerning Broadcom Limited (“Broadcom” or the “Company”). These statements include, but are not limited to, statements about historical results that may suggest trends for our business and other statements identified by words such as “will”, “expect”, “intends”, “believe”, “anticipate”, “estimate”, “should”, “intend”, “plan”, “potential”, “predict” “project”, “aim”, and similar words, phrases or expressions. These forward-looking statements are based on current expectations and beliefs of the management of Broadcom, as well as assumptions made by, and information currently available to, such management, current market trends and market conditions and involve risks and uncertainties, many of which are outside the Company’s and management’s control, and which may cause actual results to differ materially from those contained in forward-looking statements. Accordingly, you should not place undue reliance on such statements.

Particular uncertainties that could materially affect future results include risks associated with any acquisitions we may make, such as delays, challenges and expenses associated with integrating acquired companies with our existing businesses and our ability to achieve the benefits, growth prospects and synergies expected from such acquisitions, including our pending acquisition of Brocade Communications Systems, Inc.; our dependence on outsourced service providers for certain key business services and their ability to execute to our requirement, any loss of our significant customers and fluctuations in the timing and volume of significant customer demand; our dependence on contract manufacturers and outsourced supply chain; our ability to accurately estimate customers’ demand and adjust our manufacturing and supply chain accordingly; our significant indebtedness, including the need to generate sufficient cashflows to service and repay such debt; increased dependence on a small number of markets; quarterly and annual fluctuations in operating results; cyclicality in the semiconductor industry or in our target markets; global economic conditions and concerns; our competitive performance and ability to continue achieving design wins with our customers, as well as the timing of those design wins; rates of growth in our target markets; prolonged disruptions of our or our contract manufacturers’ manufacturing facilities or other significant operations; our dependence on outsourced service providers for certain key business services and their ability to execute to our requirements; our ability to maintain or improve gross margin; our ability to maintain tax concessions in certain jurisdictions; our ability to protect our intellectual property and the unpredictability of any associated litigation expenses; any expenses or reputational damage associated with resolving customer product and warranty and indemnification claims; dependence on and risks associated with distributors of our products; our ability to sell to new types of customers and to keep pace with technological advances; market acceptance of the end products into which our products are designed; and other events and trends on a national, regional and global scale, including those of a political, economic, business, competitive and regulatory nature.

Our filings with the Securities and Exchange Commission (“SEC”), which you may obtain for free at the SEC’s website at http://www.sec.gov, discuss some of the important risk factors that may affect our business, results of operations and financial condition. We undertake no intent or obligation to publicly update or revise any of these forward looking statements, whether as a result of new information, future events or otherwise, except as required by law.
# Agenda

<table>
<thead>
<tr>
<th>Broadcom Switch Portfolio</th>
<th>Unrivaled Investment and Roadmap Velocity Spanning All Network Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomahawk 3 – World’s First 12.8T Switch</td>
<td>Enabling Mass Buildout of Next-Gen Hyperscale Data Center Network Infrastructure at 100/200/400GE</td>
</tr>
<tr>
<td><strong>Leading-Edge Feature Set for Hyperscale</strong></td>
<td>Best-in-class 50G-PAM4 serdes, Buffer architecture, &amp; Instrumentation</td>
</tr>
<tr>
<td><strong>Summary</strong></td>
<td>Broadest Ecosystem, Highest Scale, Leading on all Product Vectors</td>
</tr>
</tbody>
</table>
Driving Cloud Network Evolution & Industry Cadence with Three High-Performance Switch Architectures

- **10.0T**: Massive Bandwidth for Hyperscale Fabrics
  - **Tomahawk**

- **5.0T**: Programmable, Feature-Rich Switches for Enterprise and Data Center
  - **Trident**

- **1.0T**: Scale-Out, Converged Carrier-Grade Infrastructure
  - **Jericho**

**Bandwidth** vs **Features**

- **Versatility**
- **Extensibility**
| Agenda |
|------------------|------------------------------|
| **Broadcom Switch Portfolio** | Unrivaled Investment and Roadmap Velocity Spanning All Network Applications |
| **Tomahawk 3 – World’s First 12.8T Switch** | Enabling Mass Buildout of Next-Gen Hyperscale Data Center Network Infrastructure at 100/200/400GE |
| **Leading-Edge Feature Set for Hyperscale** | Best-in-class 50G-PAM4 serdes, Buffer architecture, & Instrumentation |
| **Summary** | Broadest Ecosystem, Highest Scale, Leading on all Product Vectors |
Hyperscale Data Center Ethernet Market Opportunity

Public Cloud Revenues Expected to Triple by 2021

50/100/200/400GE Approaches 50% of All Data Center Ports by 2021

~100 Million Port TAM for Hyperscale Ethernet Switching next 5 years
What’s Driving Next-Gen Hyperscale Bandwidth?

Exploding Hyperscale Workloads Require Quantum Leap in Network Performance

Deep Learning Workloads

- Massive Machine-to-Machine Communication
- Alternative Computing with Fat Network I/F
- Low E2E Latency → Flat Topology, High Radix

Storage Disaggregation Revolution

- Massive Server to JBOF (East-West) Traffic
- Larger, Faster NVM over 100/400GE Fabric I/F
- Low E2E Latency → Flat Topology, High Radix

Source: Yahoo, Nvidia, Kazan, Publicly Available Sources
Introducing StrataXGS® Tomahawk 3

Monster Bandwidth
Record 12.8Tbps Line Rate Switching in a Single Chip

Bleeding Edge Speeds & Feeds
First to 32x400GbE / 64x200GbE / 128x100GbE Ports

Architected for Hyperscale
Serves Exploding Next-Gen AI & Storage Workloads

Step Function in Opex/Capex Efficiency
40% Lower Power and 75% Lower Cost per 100Gbps

Unrivaled Execution Velocity
Leading the 400GbE Build-out, 14 months post 6.4T

32 ports 400GbE
64 ports 200GbE
128 ports 100GbE
Critical Enablers for 1-Year Step to 12.8Tbps
- 40% Reduced Power/Port
- Scalable, High-Performance Packet Processing & Buffer Architecture
- Robust 50G PAM-4 Serdes IP
- Ultra-efficient design in 16nm

Next Performance Node Drivers
- Deep Learning Clusters
- NVMe over Fabrics
- Evolved DC Pod Architecture
Tomahawk 3: Highest Performing Ethernet I/O

**Supports Currently Deployed** 10/25G NRZ Based Ethernet Speeds
- 10GbE (1-lane)
- 40GbE (4-lane)
- 25GbE (1-lane)
- 50GbE (2-lane)
- 100GbE (4-lane)

**Supports Next-Gen Hyperscale** 50G PAM-4 Based Ethernet Speeds
- 50GbE (1-lane)
- 100GbE (2-lane)
- 200GbE (4-lane)
- 400GbE (8-lane)
- Full IEEE Standards Compliance

2X Per-lane Baud Rate

**12.8Tbps**
256 lanes x 50G PAM-4 Serdes

The Industry Benchmark for Switch Serdes Performance

- High-density, low power integrated PHY core
- Long-Reach Channel Performance (>30dB)
- Enables in-rack DAC, Backplane, & LR Optics
- Fully Configurable Speeds, Settings & FEC modes
Tomahawk 3 Collapses End-to-End Application Latency

Lower Switch Radix Creates Multiple Hops

3 Intra-Cluster Switch Hops > 1 µs
Using ‘lowest latency’ 64x100GbE alternative

Tomahawk 3 Flattens Pods & Slashes Nominal Latency

Single Switch Hop ~ 400 ns
>60% Reduction in intra-cluster network latency
Tomahawk 3 Collapses End-to-End Application Latency

**State-of-the-Art 12.8Tbps Shared Buffer Architecture**

- **Packet Processing Pipe**
  - Ingress PP
  - Egress PP

- **High-Performance, Shared Buffer Memory Management Unit (MMU)**

**Drives Down Job-Critical Tail Latency**

- 3-5X Greater Incast Absorption & Lossless Capacity vs. Alternative Switches

**Features**

1. **Large, Integrated Shared Buffer**
   - Maximizes available packet buffer per congested destination port

2. **Comprehensive RoCEv2 Support**
   - Supports Multiple Lossless Classes

3. **Advanced Congestion Control**
   - Extensive ECN and WRED Configurability for End-to-End Pacing

4. **Flow-Aware Traffic Scheduling**
   - Real-time elephant flow detection and re-prioritization
Tomahawk 3: Purpose-Built for Next-Gen Hyperscale Needs

**Scalable Forwarding for Container Networking**
- >2X IPv4, IPv6 Route Capacity
- Rich Tunneling Support
- Segment Routing

**Scale-Out, Configurable Load Balancing & Multipathing**
- Doubled ECMP Scale
- Dynamic Load Balancing
- Adaptive Multipathing

**Broadview Gen3 Network Instrumentation**
- In-Band Network Telemetry
- Per-packet Timestamping
- Traffic Flow & Load Monitoring
- Enhanced Mirroring

**40% Reduced Watt/Gbps in 16nm**

Power Per 100Gbps

TD+ TD2+ TH TH2 TH3

40%
Tomahawk 3: Quantum Leap in Switch Power & Cost Efficiency

75% Reduction in System Power, 85% reduction in System Cost *

FB Backpack | Next Gen
---|---
128x100GbE | 32x400GbE / 128x100GbE
128x QSFP28 | 32x QSFP-DD or OSFP
8U Chassis | 1U Fixed
12 x Tomahawk | 1 x Tomahawk 3

* Power Metric Includes Optics, Cost Metric Excludes Optics

Source: Facebook, OCP
## Agenda

<table>
<thead>
<tr>
<th>Broadcom Switch Portfolio</th>
<th>Unrivaled Investment and Roadmap Velocity Spanning All Network Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tomahawk 3 – World’s First 12.8T Switch</strong></td>
<td>Enabling Mass Buildout of Next-Gen Hyperscale Data Center Network Infrastructure at 100/200/400GE</td>
</tr>
<tr>
<td>Leading-Edge Feature Set for Hyperscale</td>
<td>Best-in-class 50G-PAM4 serdes, Buffer architecture, &amp; Instrumentation</td>
</tr>
<tr>
<td><strong>Summary</strong></td>
<td>Broadest Ecosystem, Highest Scale, Leading on all Product Vectors</td>
</tr>
</tbody>
</table>
BCM56980 “Tomahawk3”

- **12.8 Tbps L3 Ethernet Switch**
  - 50G single-lane to 400GE (x8) clear-channel ports

- **High Performance Integrated SerDes**
  - Up to 256 x 50G-PAM4/25G-NRZ Dual-Mode Serdes
  - Guaranteed LR Performance (Supports >30dB Insertion Loss)

- **High Density Port Configurations**
  - 128 x 100GE
  - 64 x 200GE
  - 32 x 400GE

- **Proven XGS Cloud-Optimized Features**
  - Massive Forwarding Scale
  - Enhanced ECMP Hashing & Dynamic Load Balancing
  - Comprehensive, Software-Defined BroadView™ Gen3 Instrumentation
  - New shared-buffer MMU architecture delivering 3X higher burst absorption & advanced E2E congestion control
  - High-performance control plane, Gen3 PCIe 64b

- **Power Efficient**
  - ~40% less power per 100G in same 16nm process
# Tomahawk 3: High-Density 100/400GbE Switch Line Available Now

<table>
<thead>
<tr>
<th>Device</th>
<th>Example Port Configurations</th>
<th>Application</th>
<th>I/O BW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomahawk 3 12.8T</td>
<td>32 x 400GE 128 x 100GE or 64 x 200GE</td>
<td>Hyperscale Spine 1-Tier ML Cluster Middle-of-Row</td>
<td>12.8Tbps</td>
</tr>
<tr>
<td>Tomahawk 3 8.0T</td>
<td>80 x 100GE 48 x 100GE + 8 x 400GE or 16 x 200GE 96 x 50GE + 8 x 400GE or 16 x 200GE</td>
<td>100G Top of Rack</td>
<td>8.0Tbps</td>
</tr>
<tr>
<td>Agenda</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Broadcom Switch Portfolio</strong></td>
<td>Unrivaled Investment and Roadmap Velocity Spanning All Network Applications</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tomahawk 3 – World’s First 12.8T Switch</strong></td>
<td>Enabling Mass Buildout of Next-Gen Hyperscale Data Center Network Infrastructure at 100/200/400GE</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Leading-Edge Feature Set for Hyperscale</strong></td>
<td>Best-in-class 50G-PAM4 serdes, Buffer architecture, &amp; Instrumentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Summary</strong></td>
<td>Broadest Ecosystem, Highest Scale, Leading on all Product Vectors</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What Does Scale Mean to Customers?

- Robust Ecosystem
- Broadest Portfolio
- Quality
- Innovation
- Accelerated Time to Revenue
Industry’s Broadest Ecosystem

Network Controller
- OpenDaylight
- Lagopus
- Nuage Networks
- Ryu
- NEC
- Juniper
- OpenContrail

NV Controller
- Plumgrid
- Midokura
- VMware NSX

Orchestration & Automation
- OpenStack
- Chef
- Puppet Labs

Operating System
- Arista
- HP
- Cisco
- Juniper Networks
- Extreme Networks
- Ruijie
- Huawei
- ZTE

Hardware Platform
- Celestica
- QCT
- Alpha Networks
- H3C
- Dell
- Ruijie
- ZTE
Summary

• Broadcom has unmatched investment, scale, and quality in its Ethernet switching technology portfolio.

• Tomahawk 3 is the world’s first 12.8Tbps switch chip, now sampling to customers, that will accelerate the next wave of 100GbE/400GbE hyperscale cloud build-out.

• Tomahawk 3 boasts best-in-class 50G serdes, port radix, buffer architecture, instrumentation, power & cost efficiency - tailored to the needs of hyperscalers.
Thank You!

Rochan Sankar
Sr. Director, Switch Product Marketing