Internet for the Future

New Normals
For the way we Work, Live, Play, and Learn

New Participants
Many remain unconnected and emerging IoT

New Potentials
The foundation of economies, governments, and societies
Market Dynamics

Explosive Internet Growth
2016 Cisco VNI

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>45%</td>
<td>60%</td>
<td></td>
</tr>
<tr>
<td>More Users (% of population)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>More Devices per User</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>14.6</td>
<td></td>
</tr>
<tr>
<td>More M2M Connections (billions)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>39</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>More Broadband Speed (Mbps)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Economic Challenges for SPs
IHS Markit Report

- 0.5% Flat Revenue Growth (2017 – 2022 CAGR: 0.5%)
- 11x $1 of CapEx in 2020 has to do 11X the work it did in 2012
- 5x Today, operators spend $5 of OpEx for each $1 of CapEx

SPs Want More for Less

- Reduce Costs (CapEx, OpEx) and Latency. Increase Capacity.
- Create New Revenue, Improve Experiences and Time to Service
- Increase Trust and Security

HOWEVER, BUDGETS REMAIN FLAT
New Architectures for a New Internet
Converged, Cloud Enhanced, Distributed Edge

68% Better OPEX Utilization | 81% Faster Time-to-Service | 59% Improved Capital Efficiency
Requirements for Edge Infrastructure

- Feature rich with forward & backwards compatibility
- TCO optimized
- Automation ready
- Trustworthy & secure
- Carrier class reliability
- Fixed and modular scale for all applications & scenarios
Your Network’s Edge
Lightspeed+

- Refined
  - ...with cutting edge 7nm silicon
  - With power savings of ~75%*+
  - ...with industry best service edge performance at scale

- Reloaded
  - ...with 400 GbE port support
  - ...with Coherent optics for next level of IP-Optical convergence
  - ...with enhanced port flexibility (1G, 10G, 25G, 40G, 100G and 400G)

- Retuned
  - ...Efficient memory use, download & bootup time
  - ...to be automation ready with open APIs, native, Yang, and Open Config Models
  - ...to be one OS for all network

- Reinforced
  - ...to measure trust at all stages (in HW, SW, at bootup, at runtime...)
  - ...with best in class TAM root of trust & Integration to Trust insights - Get audited, visualize security

Edge ready. Available today.

*Power Savings Over Tomahawk
Cisco ASR 9000 Series
Edge Ahead with ASR9000

Best in Quality
- Rated best in SW quality amongst 1100 CISCO Products
- 7 Months Chip-to-Ship for Lightspeed+

Customer’s Favorite
- Highest NPS score in SPBU; 2nd highest across all CISCO

Years of Heritage
- Most rich feature-set
- Versatile use-cases
- Huge incumbency

Why Invest in ASR 9000

Committed Investment
- 6 New LCs, 2 Fixed Routers
- LS+ – To Infinity & Beyond

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Cisco ASR 9000 Series
Reinforcing the value of your investment

10+ years of innovation
100x capacity increase

OPEX savings through:
- Automation
- 75% power reduction per Gbps
- New power efficiencies & advanced power management with slicing

CAPEX savings:
- Same chassis’ & same commons for 3rd, 4th, and 5th generation linecards
## Cisco ASR 9000 Silicon Evolution

<table>
<thead>
<tr>
<th>Year</th>
<th>1st Generation</th>
<th>2nd Generation</th>
<th>3rd Generation</th>
<th>4th Generation</th>
<th>5th Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trident, 90nm, 15 Gbps</td>
<td>Typhoon, 55nm, 60 Gbps</td>
<td>Tomahawk, 28nm, 240 Gbps</td>
<td>Lightspeed, 16nm, 400 Gbps</td>
<td>Lightspeed+, 7nm, 400 Gbps</td>
</tr>
<tr>
<td>Fabric</td>
<td>Octopus 130nm, 60 Gbps</td>
<td>Skytrain 65nm, 60 Gbps</td>
<td>Tigershark 28nm, 200 Gbps</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Interconnect ASIC</td>
<td>PowerPC Dual Core, 1.2 Ghz</td>
<td>PowerPC Quad Core, 1.5 Ghz</td>
<td>X86 6 Core, 2 Ghz</td>
<td>X86 8 Core, 2.2 Ghz</td>
<td>X86 8 Core, 2.2 Ghz</td>
</tr>
</tbody>
</table>

### Silicon Evolution

<table>
<thead>
<tr>
<th>Technology Node (nm)</th>
<th>Per Slot Capacity (Gbps)</th>
<th>Power (Watts per Gbps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90nm</td>
<td>40 Gbps</td>
<td>10 W/Gbps</td>
</tr>
<tr>
<td>55nm</td>
<td>360 Gbps</td>
<td>2.5 W/Gbps</td>
</tr>
<tr>
<td>28nm</td>
<td>1200 Gbps</td>
<td>1.5 W/Gbps</td>
</tr>
<tr>
<td>16nm</td>
<td>3200 Gbps</td>
<td>0.5 W/Gbps</td>
</tr>
<tr>
<td>7nm</td>
<td>4000 Gbps</td>
<td>0.39 W/Gbps</td>
</tr>
</tbody>
</table>

### Timeline

- **2008**: Trident, 90nm, 15 Gbps
- **2012**: Typhoon, 55nm, 60 Gbps
- **2015**: Tomahawk, 28nm, 240 Gbps
- **2018**: Lightspeed, 16nm, 400 Gbps
- **2020**: Lightspeed+, 7nm, 400 Gbps
Commercial Offers
Lightspeed+

Flexible Consumption Model

- A la Carte
  (Scale Enhanced)
- Advanced Software
  (L3VPN - MPLS IPv4/IPv6, MACSec, TE, L3 Tunnel, SL-APIs)
- Essentials Software
  (Most of the transport oriented feature set with Automation, NSO)
- Hardware Infrastructure

Traditional Model

- A la Carte
  (BNG, CGN, MACSec, 400G)
- Advanced IP
- Base - IVRF
- Service Edge
- Transport
- Hardware Infrastructure

License Portability
PayG
License Pooling
Ease of Use
Perpetual
Innovations in Technology & Silicon

Lightspeed+

Edge Performance
- 300 Mpps at 400Gbps per ASIC
- Industry best performance for service edge profiles

Built for Scale
- Dynamic TCAM Carving
- Dynamic Buffer Pooling
- Increased TCAM & SRAM

Rich Feature Repertoire
- Tomahawk Parity Day 0
- Most complete SR-MPLS, SRV6 and EVPN feature set & roadmap
- 10 Years of ASR9K XR Hardening; 8 Releases of LS hardening

Automation & Security
- Day 0 integration with Crosswork
- Native & Open-config model parity with Tomahawk
- MACSec on 10/25/40/100/400G; Secure boot & Trust Anchor Capability
# Cisco ASR 9000 Series

Reloaded with 5th Generation Silicon and support for 400GbE

<table>
<thead>
<tr>
<th>Model</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASR 9903</td>
<td>3.2 Tbps* capacity</td>
</tr>
<tr>
<td></td>
<td>2 Tbps capacity</td>
</tr>
<tr>
<td></td>
<td>0.8 Tbps capacity</td>
</tr>
</tbody>
</table>

### 400GE

- 5th Generation Service Edge scale in compact and modular form-factor
- 3.6 Tbps in 3RU
- 0.4 Watts/Gbps
- 5th Generation silicon
- Support for 10, 25, 40, 100 & 400G ports
- Same set of commons: 3rd, 4th, & 5th generation linecards

*3.2T Card only has QSFP-28 Ports.

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Cisco ASR 9000 Series
5th Gen ASIC: Investment Profile

ROADMAPS ARE SUBJECT TO CHANGE AT THE SOLE DISCRETION OF CISCO.

EXECUTE COMMITTED

* Release numbering to be confirmed for XR7.1.15 or XR7.1.2
## Lightspeed Plus Portfolio
### Phase-I Overview

<table>
<thead>
<tr>
<th>Model</th>
<th>Ports Description</th>
<th>Bandwidth</th>
<th>Combo Ports</th>
<th>MACSec/FlexE</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A99-32X100GE</strong></td>
<td>32 Ports of QSFP28</td>
<td>3.2 Tbps</td>
<td>No</td>
<td>No</td>
<td>Class B</td>
</tr>
<tr>
<td><strong>A9K-20HG-FLEX</strong></td>
<td>15 Ports QSFP28, 5 Ports QSFP-DD</td>
<td>2 Tbps</td>
<td>Yes</td>
<td>Yes</td>
<td>Class C</td>
</tr>
<tr>
<td><strong>A9K-8HG-FLEX</strong></td>
<td>6 Ports QSFP28, 2 Ports QSFP-DD</td>
<td>0.8 Tbps</td>
<td>Yes</td>
<td>Yes</td>
<td>Class C</td>
</tr>
<tr>
<td><strong>ASR-9903</strong></td>
<td>16 Ports QSFP28, 20 Ports SFP+</td>
<td>1.6 Tbps</td>
<td>No</td>
<td>Yes</td>
<td>Class C</td>
</tr>
<tr>
<td><strong>A9903-20HG-PEC</strong></td>
<td>15 Ports QSFP28, 5 Ports QSFP-DD</td>
<td>2 Tbps</td>
<td>Yes</td>
<td>Yes</td>
<td>Class C</td>
</tr>
</tbody>
</table>

*ROADMAPS ARE SUBJECT TO CHANGE AT THE SOLE DISCRETION OF CISCO*
Lightspeed Plus Portfolio

Combo Ports Introduced

Each Slice of 4 ports can be independently configured in one of the following combinations:
- 1x400GE
- 4x100GE
- 1x200GE & 2x100GE
Almost Complete Feature parity with Tomahawk at FCS*

* Release numbering to be confirmed for XR7.1.15 or XR7.1.2

* Note: Gaps on legacy tech; check SW roadmap for details
Cisco ASR 9000 Series
IOS XR Roadmap

**HW SUPPORT**
- 0.8T linecard
- 2T linecard
- 3.2T linecard
- Parity with LSQ
- GRE, BVI, VXLAN
- Dynamic TCAM Carving

**KEY FEATURES**
- Core
- Peering
- Service Edge
- DCI Gateway
- MACSec
- 4X100G Breakout
- 10K BGP Flowspec Rules
- 128K EFP/LC
- UBRL (microflow policer)
- BNG Ph-I
- Cloud Native BNG Datapath
- Traditional BNG

**USE CASES**
- Core
- Peering
- Service Edge
- DCI Gateway
- Mobile Edge/Mobile Agg. requiring Class C timing

**IOS XR 7.1.2**
- 0.8T linecard
- 2T linecard
- 3.2T linecard
- Parity with LSQ
- GRE, BVI, VXLAN
- Dynamic TCAM Carving

**IOS XR 7.1.3/7.3.1**
- ASR 9903
- 2T PEC
- 0.8T PEC
- 4T LC
- 400G LC
- MACSec
- 4X100G Breakout
- 10K BGP Flowspec Rules
- 128K EFP/LC
- UBRL (microflow policer)
- BNG Ph-I
- Cloud Native BNG Datapath
- Traditional BNG

**IOS XR 7.4.1**
- 2.4T LC
- Class C Timing RP/RSP
- Flex Ethernet
- Class C Timing Qual
- ISSU
- BNG Ph-II

**COMMITTED**
- 0.8T linecard
- 2T linecard
- 3.2T linecard

**ROADMAP**
- 4T LC
- 400G LC

**ROADMAP**
- 2.4T LC
- Class C Timing RP/RSP

*Release numbering to be confirmed for XR7.1.15 or XR7.1.2*
Cisco ASR 9000 Series

Key milestones

**Limited orderability**
- Ph-I Linecards
- Spares for BAU
- Commercial model
  - Jan 20, 2020

**Full orderability**
- Ph-I Linecards for FCM commercial model, Systems & Bundles
  - Feb 20, 2020

**FCS**
- 5th Gen 3.2Tbps linecard
  - Mar 31, 2020

**EFT**
- ASR 9903
  - 2Tbps PEC
  - June 2020

**Alpha EFT**
- 5th Gen 3.2Tbps Linecard with select customers
  - Jan 30, 2020

**Open EFT**
- All 5th Gen linecards available for all customers
  - Apr 25, 2020

**FCS**
- 5th Gen 2Tbps linecard
- 5th Gen 0.8Tbps linecard
  - Aug 2020

Enroll for EFT Here
Lightspeed+ : Get Engaged; Get Addicted

**Reloaded.** Increased capacity with 400GE.

**Refined.** Cutting edge 7nm silicon for performance & efficiency.

**Reinforced.** Scalable, secure, & trustworthy system.

**Retuned & Refactored.** Automation ready with feature rich OS.
## Cisco ASR 9000 Series

### Optics roadmap

<table>
<thead>
<tr>
<th>7.1.2 (FCS)</th>
<th>7.1.3 (FCS +1)</th>
<th>Roadmap</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>400G</strong></td>
<td><strong>400G</strong></td>
<td><strong>400G</strong></td>
</tr>
<tr>
<td>- QDD-400G-DR4-S</td>
<td>- QDD-400G-SR4-BD</td>
<td>- QDD-400-CUxM</td>
</tr>
<tr>
<td>- QDD-400G-FR4-S</td>
<td>- QDD-400G-ZR-S</td>
<td>- QDD-400G-AOC-10M</td>
</tr>
<tr>
<td>- QDD-400G-LR8-S</td>
<td>- QDD-400G-ZRP-S</td>
<td>- QDD-400G-LR4-S</td>
</tr>
<tr>
<td><strong>40G</strong></td>
<td><strong>40G</strong></td>
<td><strong>40G</strong></td>
</tr>
<tr>
<td>- QSFP-40G-SR4</td>
<td>- QSFP-40G-SR-BD</td>
<td>- QDD-400-4W40-I</td>
</tr>
<tr>
<td>- QSFP-40G-SR-BD</td>
<td>- QSFP-40G-LR4</td>
<td>- QSFP-40GE-CSR4</td>
</tr>
<tr>
<td>- QSFP-40G-LR4</td>
<td>- QSFP-4X10G-LR-S</td>
<td>- QSFP-H40G-ACU7M</td>
</tr>
<tr>
<td>- QSFP-40G-ER4</td>
<td>- QSFP-40G-SR-4-S</td>
<td>- QSFP-H40G-ACU10M</td>
</tr>
<tr>
<td>- QSFP-40G-SR-4-S</td>
<td>- QSFP-40/100-SRBD</td>
<td>-</td>
</tr>
<tr>
<td>- QSFP-40/100-SRBD</td>
<td>- QSFP-40G-LR4-S</td>
<td>-</td>
</tr>
<tr>
<td>- QSFP-40G-LR4-S</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>- QSFP-40G-SM-SR</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>100G</strong></td>
<td><strong>2x100G</strong></td>
<td><strong>100G</strong></td>
</tr>
<tr>
<td>- QSFP-100G-SR4-S</td>
<td>- QDD-2X100-LR4-S</td>
<td>- QSFP-100G-LR-S</td>
</tr>
<tr>
<td>- QSFP-100G-PSM4-S</td>
<td>- QDD-2X100-CWDM4-S</td>
<td>- QSFP-100G-AOC10m</td>
</tr>
<tr>
<td>- QSFP-100G-CWDM4-S</td>
<td>- QDD-2X100-SR4-S</td>
<td>- QSFP-100G-CU</td>
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<tr>
<td>- QSFP-100G-LR4-S</td>
<td>-</td>
<td>- QSFP-100G-4W40-I</td>
</tr>
<tr>
<td>- QSFP-100G-ER4-L-S</td>
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<td>-</td>
</tr>
<tr>
<td>- QSFP-40/100-SRBD</td>
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</tr>
<tr>
<td>- QSFP-100G-SM-SR</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* QDD-2X100-PSM4-S de-prioritized