AT&T TECHNOLOGY TRANSFORMATION
BUILDING THE NETWORK OF THE FUTURE

DAVID LU, VICE PRESIDENT

D2 PLATFORM AND SYSTEMS DEVELOPMENT

AGENDA

1 INDUSTRY EVOLUTION

2 FRAMEWORK FOR REPEATABLE SUCCESS

3 DIGITIZATION

4 SOFTWARE DEFINED NETWORKING

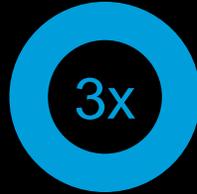**5** POSITIONING YOU FOR THE FUTURE

1

INDUSTRY EVOLUTION

EMERGING NETWORK TRENDS
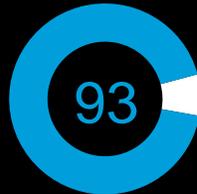
Global IP Traffic is growing exponentially

3x

- Traffic to expand 3x by 2020[1]

The definition of a network "Endpoint" is changing

- There will be 50 billion connected devices by 2020[2]

The Cloud is fundamentally changing wide area networks

93

- 93% of businesses are using cloud technology[3]

Software-Defined Networking is becoming a reality in 2017

- SDN market is expected to reach $12.5B by 2020[4]

EMERGING IT TRENDS

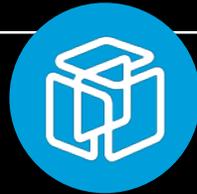**Enterprise Digitization** will reshape competitive landscape

- Organizations with digital strategy up 52% in 3 years[1]

Use of **Private and Public Clouds** is growing rapidly

- $1 trillion in IT spending affected by the shift to cloud by 2020[2]

Artificial Intelligence is beginning to drive IT investment

- Predicted investment in AI will grow 300% in 2017[3]

Security and IT Risk Management is a top technology concern

- Average increase in 2017 security budgets is 42%[4]

Sources: [1]KPMG   [2]Gartner   [3]Forrester   [4]Nemertes

MULTI-YEAR TRANSFORMATION JOURNEY

NETWORK TRANSFORMATION

CONVERGENCE

IT TRANSFORMATION

PROPRIETARY APPLICANCES

SOFTWARE DEFINED NETWORKING

AT&T INTEGRATED CLOUD PLATFORM 5G NETWORKING

END-TO-END SECURITY

AT&T SMART

PLATFORM

ENTERPRISE DIGITIZATION
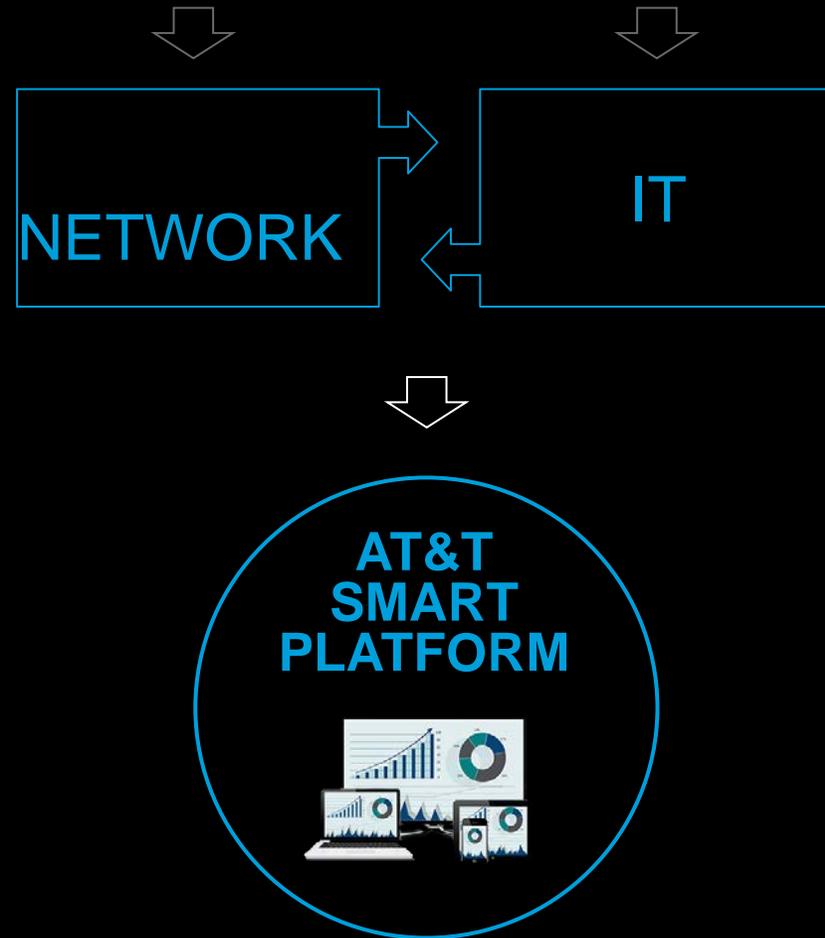
EXTREME AUTOMATION

PLATFORM DRIVEN

INTELLIGENT IT

THOUSANDS OF APPLICATIONS

AT&T'S UNIQUE APPROACH

TECHNOLOGY CONVERGENCE

NETWORK → IT

AT&T SMART PLATFORM

CUSTOMER ADVANTAGE

—

Industry Defining Solutions

Superior Customer Experience

Agility & Elasticity

—

2

FRAMEWORK FOR REPEATABLE SUCCESS

AT&T'S FRAMEWORK FOR REPEATABLE SUCCESS

STRATEGY

Provide products & services controlled by our customers & managed by our employees, through digital experiences woven throughout our operations & extended directly to customers
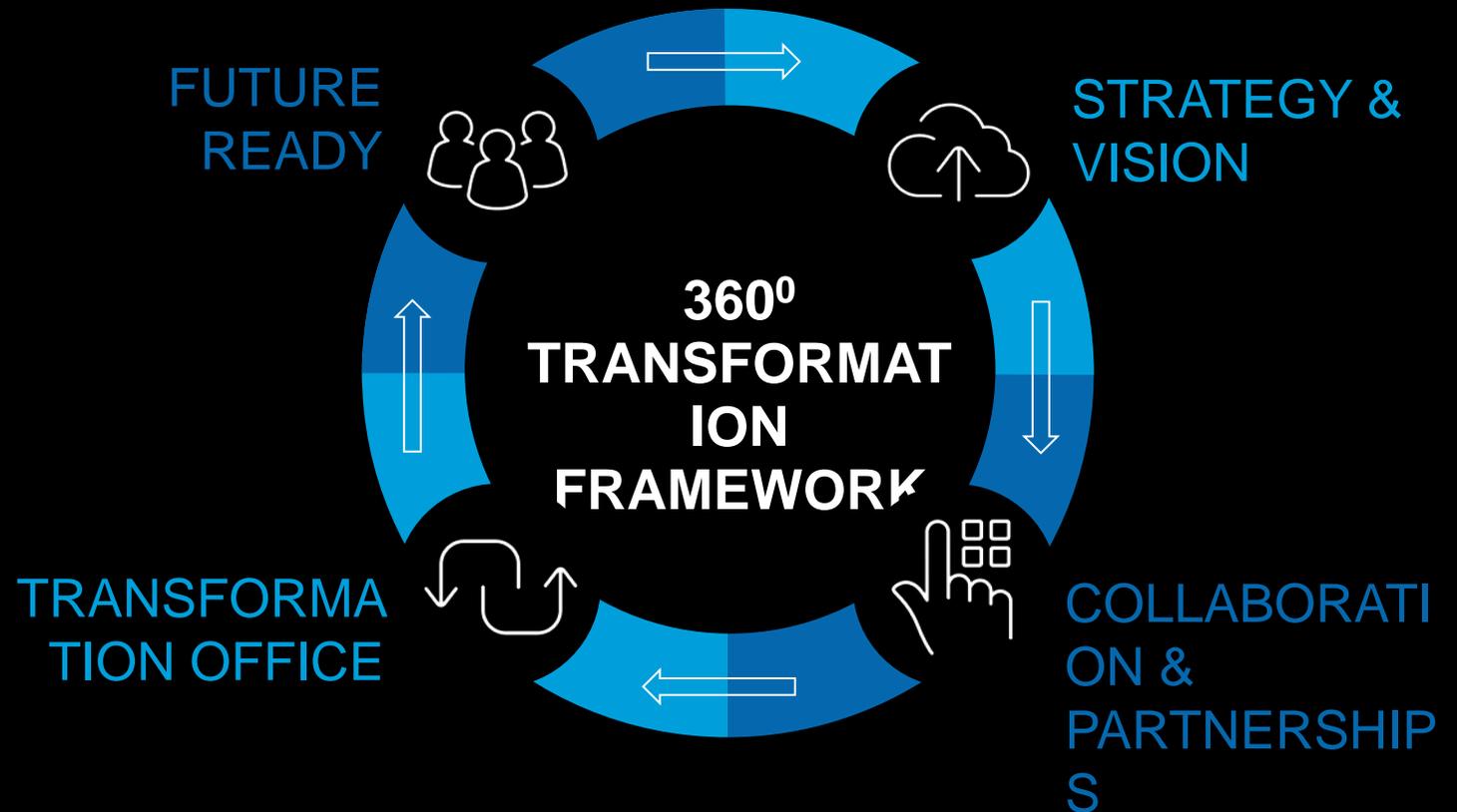
BIG PLAYS

Enterprise Digitization

Extreme Automation

Platform Driven

Intelligent IT

Security by Design

Capabilities Evolution

Collaborative Workforce

FUTURE READY

STRATEGY & VISION

360⁰ TRANSFORMATION FRAMEWORK

TRANSFORMATION OFFICE

COLLABORATION & PARTNERSHIPS

PEOPLE, PROCESS, TECHNOLOGY

PEOPLE

PROCESS

TECHNOLOGY

PAST		
Application centric design	Manual SDLC	Monolithic codebase
Virtual, multi-location	Project governance	Application server technology
Layered functional teams	Waterfall development	VM centric

FUTURE		
Domain driven vs. app teams	Automated CI/CD	Independent mS codebase
Co-located	Technical governance	Platform
Multi-function teams (Product Ops)	Agile & DevOps	Cloud & Container centric

3

DIGITIZATION

AT&T'S DIGITAL PIVOT

PAST
Complex, single-unit, monolithic solutions

⬌

HYBRID
API, data integration glue, intelligent routing

⬌

FUTURE
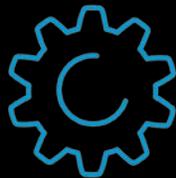Cloud & mS based, SaaS solutions

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ENTERPRISE DIGITIZATION

80% digital by 2020
customer touch points, business operations, internal operations

EXTREME AUTOMATION

Intelligent Triage
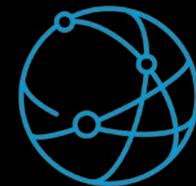Achieve ~60% prediction accuracy in less than six weeks

PLATFORM DRIVEN

Scaled Performance
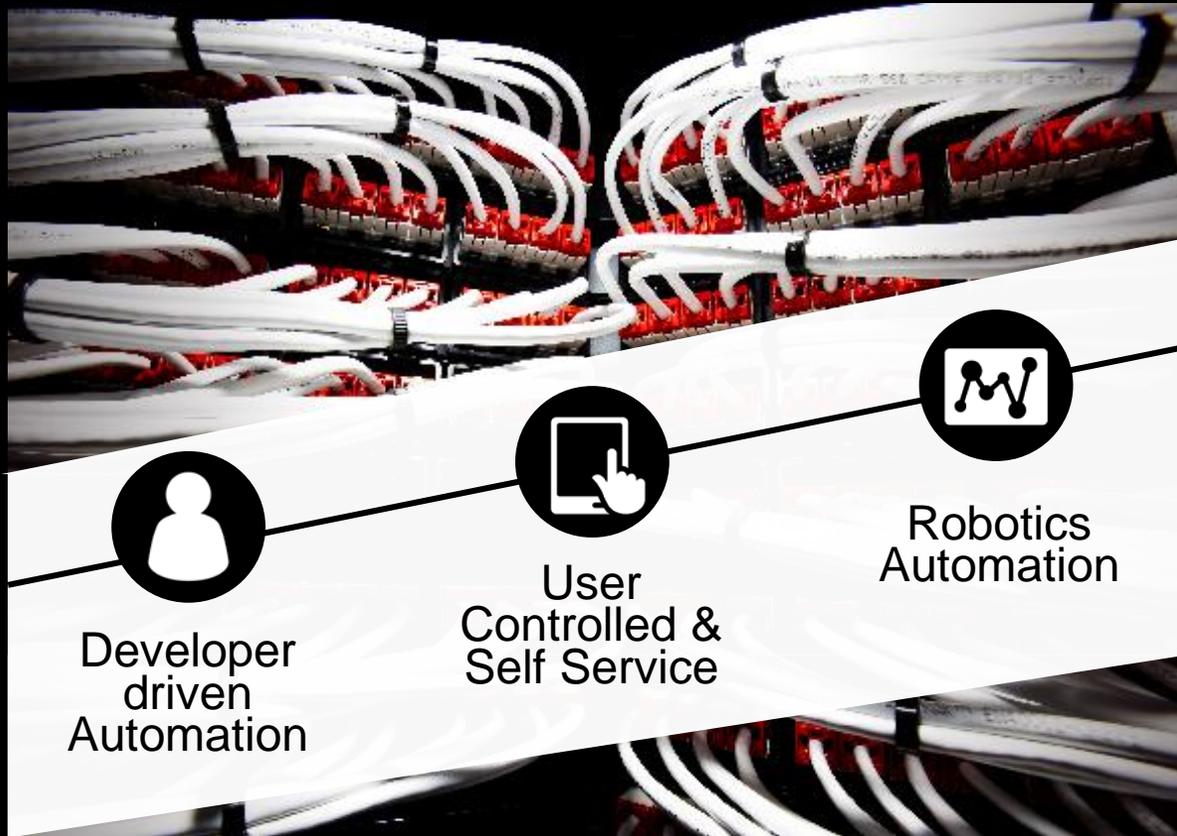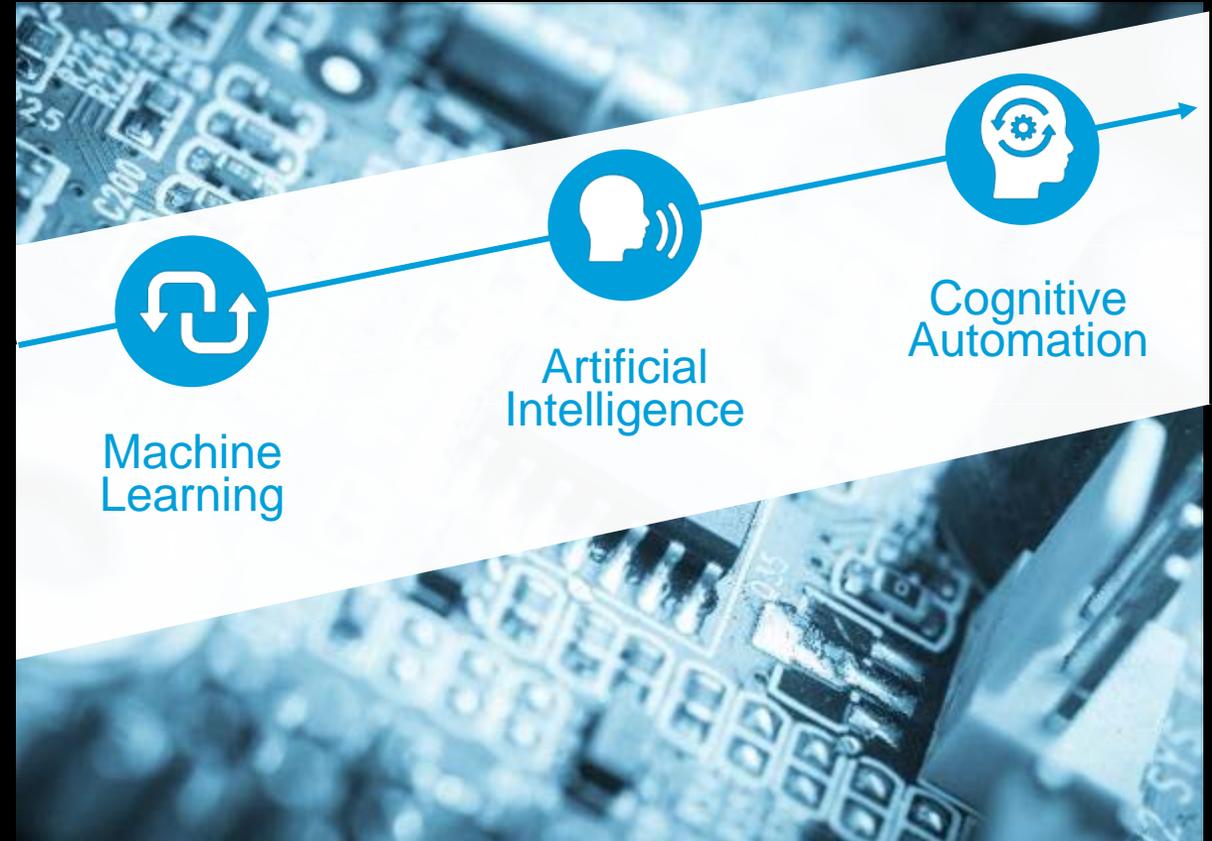Deliver 1 trillion transactions per month in 2020

INTELLIGENT IT

Data Powered
Data from 3,000+ applications for real time business ready analytics

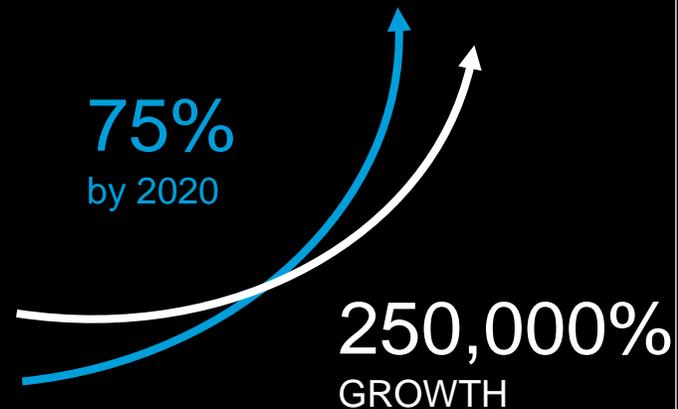# AUTOMATION DEVELOPMENT @ AT&T

TODAY

FUTURE

Developer driven Automation

User Controlled & Self Service

Robotics Automation

Machine Learning

Artificial Intelligence

Cognitive Automation

ANALYTICS

4

SOFTWARE DEFINED NETWORKING

SOFTWARE DEFINED MARKET DRIVERS

HYPER GROWTH

75%
by 2020

250,000%
GROWTH

- Data Traffic
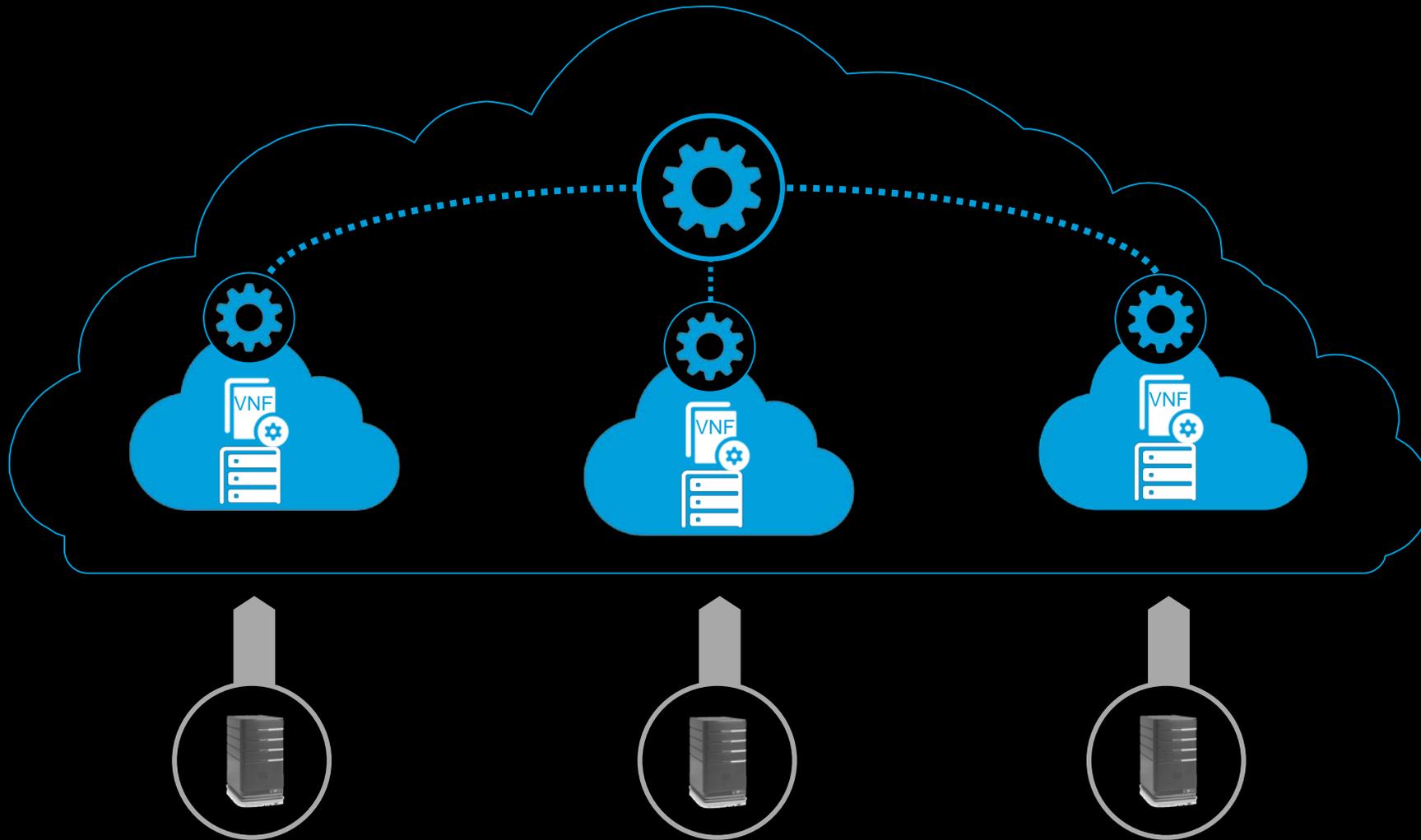- Virtualization Progress

CUSTOMER EXPERIENCE

Real time control and automation

SOFTWARE DEFINED AGILITY

Rapid feature delivery & global network elasticity

SDN & VIRTUALIZATION TRANSFORMATION

GLOBAL & LOCAL CONTROLLERS

VIRTUAL NETWORK FUNCTIONS

CLOUD ORCHESTRATION
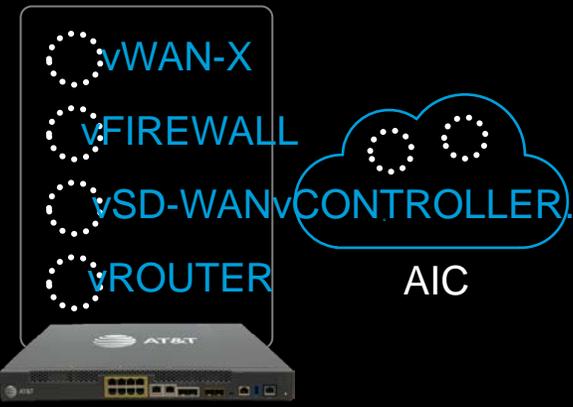
WHITE BOX COMMODITY HARDWARE

BLACK BOX
- Proprietary
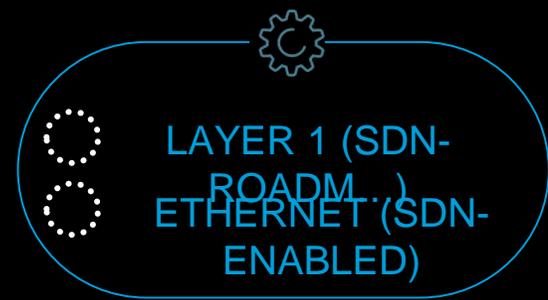- Monolith
- Complex Integration

END-TO-END NETWORK TRANSFORMATION

SOFTWARE DEFINED

CUSTOMER PREMISE	EDGE ACCESS	CORE NETWORK	OVERLAY

CUSTOMER PREMISE
- vWAN-X
- vFIREWALL
- vSD-WAN vCONTROLLER...
- vROUTER

AIC

EDGE ACCESS
LAYER 1 (SDN-ROADM...)
ETHERNET (SDN-ENABLED)

CORE NETWORK
AIC
- vCUSTOMER EQUIPMENT
- vPROVIDER EDGE ROUTE

OVERLAY
AIC
- vTFAS
- vSBC

HARDWARE INTENSIVE

- SD-WAN
- WAN-X
- FIREWALL
- ROUTER

- LAYER 1
- ETHERNET

MPLS CORE
- GATEWAY ROUTER
- BACKBONE ROUTER
- PROVIDER EDGE ROUTER
- OTHER ELEMENTS

VOICE NETWORK
- CONTROL ELEMENTS
- TOLL FREE APP SERVER
- OTHER ELEMENTS

END-TO-END NETWORK SERVICES
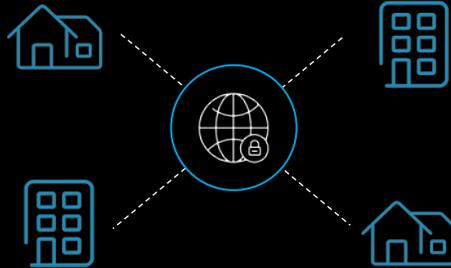
|	CUSTOMER PREMISE	EDGE ACCESS	CORE NETWORK	OVERLAY
SOFTWARE DEFINED	AT&T FLEXWARE	SD-WAN & OTHERS	NETWORK ON DEMAND LAYER 3 VPN SERVICE	UNIFIED COMMUNICATIONS
HARDWARE INTENSIVE	MANAGED ROUTER	REMOTE ACCESS	LAYER 3 – VPN SERVICE	IP TOLL FREE
	MANAGED LAN	LAYER 1 – DEDICATED ACCESS	LAYER 2 – VPN SERVICE	IP SIP TRUNKING
	MANAGED SECURITY	ETHERNET	DEDICATED INTERNET SERVICE	HOSTED VOICE
	OTHER SERVICES	OTHER SERVICES	OTHER SERVICES	OTHER SERVICES

ECOMP IS ONE OF THREE DOMAIN 2.0 PILLARS
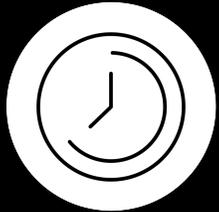
Real-time

Agile customer enablement
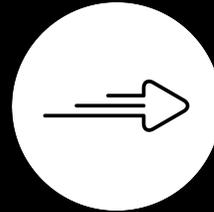
Improved efficiency

Reduced cycle times

Innovative services & apps
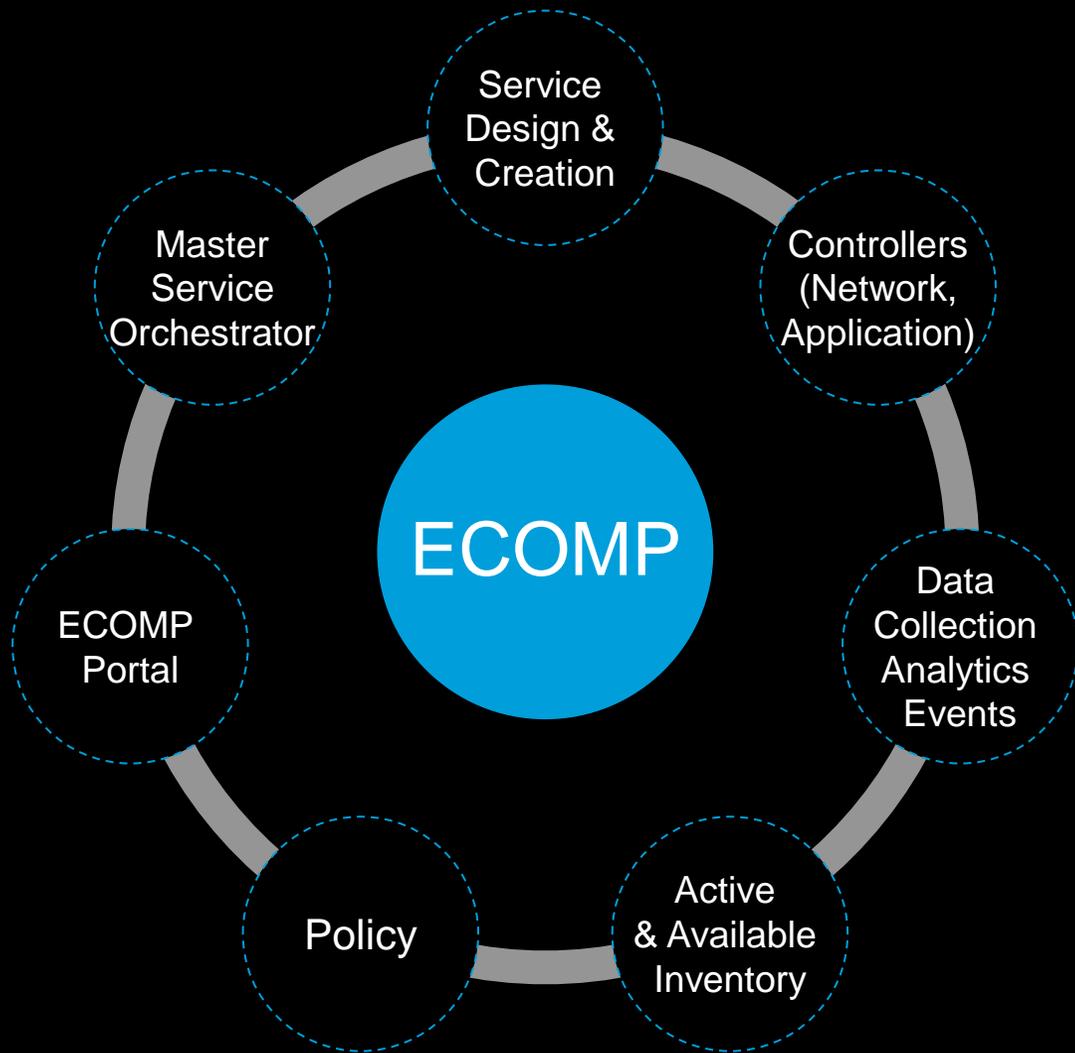
Faster

NFV

ECOMP

SDN

AT&T Integrated Cloud (AIC) – Shared, Common, Homogeneous

AT&T Internal Transformation – People, Process, Culture

ECOMP PLATFORM APPROACH

Open Platform Approach
— Model-driven Software Architecture
— 8.5M+ lines of code
— Open Source Software Adoption
— Services and Operations as Users

1. **Facilitates widespread user development of software apps, products & solutions (*reusable software framework*)**
   a. Core / atomic functions & processes
   b. Micro-services
   c. Re-useable code libraries & tool sets
   d. APIs facilitate solution development

2. **Reusable software framework – extendable by users**
   a. Provides for user-implemented extensions
   b. Extendable, but core code can only be modified by platform

3. **Software platform aims to facilitate service development & reduce operational complexity**

4. **Functionality & size of software modules remain relatively flat as services scale**

MAJOR MODULES OF THE ECOMP ARCHITECTURE

Design Studio

Service Design: Rich catalog-driven environment to construct & maintain service & resource definitions, constraints & management processes & policies (recipes)

Policy Creation: Associate anomalous & actionable conditions with automated remedy actions

Analytic App Design: Design capabilities for creation of analytic apps

Master Service Orchestrator (MSO)

Orchestrates & manages the delivery, modification or removal of networks & services

Provides cross domain orchestration to optimize the utilization of resources or take broad corrective action

Interacts with various applications to collect data to determine network facing parameters

Active & Available Inventory (A&AI)

Real-time topology map with context views of virtual networks, services & applications

Relationship context between components & the network fabric & infrastructure Uses the network resources as the database of record due to their dynamic nature

Provides a registration method used to discover & maintain services & resources

Data Collection, Analytics & Events (DCAE)

Collects Data & Events necessary to manage & evolve D2.0 networks & services

Makes collected data available to real-time apps Provides framework for analytics apps to identify patterns/anomalies & publish events to drive closed-loop control

Provides functions at all layers in architecture

Controllers

Network: Instantiates, configures & manages the lifecycle of Transport VNFs, infrastructure networking (e.g. leaf, spine & virtual switches) & WANs

Service/App: Instantiates, configures & manages the lifecycle of Service VFs

Infrastructure: Instantiates, configures & manages the lifecycle of infrastructure (compute, storage, etc.)
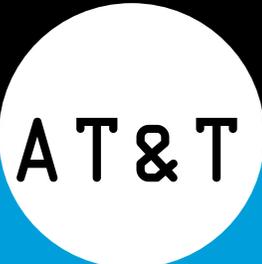
5

POSITIONING YOU FOR THE FUTURE

AT&T BUSINESS SUMMARY

BUSINESS
3.5 million customers served

ENTERTAINMENT GROUP
30 million consumers

MOBILITY
133 million subscribers

DIGITAL INTERACTIO
1 billion YTD

MOBILE COVERAG
390 million locations

BROADBAND COVER
60+ million locations

AT&T

150 petabytes
Daily Network Traffic

270+ thousand
Total Workforce

$163 billion
Annual Revenue

INVESTING IN THE NETWORK OF TOMORROW

140 Years Serving Customers

$140B
U.S. investment past six years

More than any other public company

$146.8B revenue, #12 Fortune 500

#25 in top 50 U.S. patent assignees

On 6 continents, 225+ countries

TOGETHER, WE'RE POSITIONED FOR SHORT **&** LONG TERM SUCCESS

Integrated Solutions

—

Global Scalability

—

Location-by-Location Flexibility

—

Technology Leadership

—

End-to-End Security

THANK YOU