AI & ML
LANDSCAPE AND OVERVIEW
The IDC states that in 2018, **75%** of enterprise developments will include AI and ML.

In 2016, companies invested **$26B to $39B** in artificial intelligence. **3x** External investment growth since 2013.

**20%** of AI-aware firms say they are adopters:
- 3+ technologies
- 2 technologies
- 1 technology

**41%** of firms say they are uncertain about the benefits of AI.

**40%** Contemplators

**31%** Partial adopters

**10%** Experimenters

**10%** Experimenters
AT&T’S HISTORY OF INNOVATION IN AI/ML
R U L E  B A S E D  E X T R E M E  A U T O M A T I O N  &  B E N E F I T S

Efficiency & Automation
- Automates operations for AT&T business partners
- Processes over 4,000,000 events per day
- Delivers significant productivity gains

Driving Customer Satisfaction
- Improves overall customer satisfaction
  - Reduces Mean Time To Repair
  - Improves Ops Quality metrics

RUBY = Rule You Build Yourself

Enable operations to change processes swiftly
Monitor events & orchestrate processes
Enable information & services sharing
Enable existing system functionality reuse
R U L E  B A S E D  E X T R E M E  A U T O M A T I O N  E X A M P L E

Protect physical infrastructure with treat assessment & resolution processes automation.

- Premise Security Systems (e.g., ProWatch)
  - Authentication check
  - Open door alarm received by monitoring system, forwarded to RUBY
- RUBY
  - RUBY checks for scheduled maintenance, appropriate authorization
  - If unauthorized, or no scheduled maintenance an alert is sent to CBUS
- Unauthorized entrance to building
- CBUS Notifies Appropriate Security Center
- CBUS
  - Police Dispatched!
- Security Monitoring Center
  - Security contacts police
- C-BUS
- HR
  - Onsite Workforce Schedule
- Police

Protects nearly 1700 AT&T sites
Problem Statement:
- Use of Y-cables prevalent in the layer 2 network (~20K Cisco switches)
- Old Y-cable designs are failure-prone and result in an average of 1 outage/day
- Y-cable failures lead to service-impacting outages & customer dissatisfaction
- Capital and staff intensive to replace all old Y-cables in network

Objectives:
- Develop predictive maintenance algorithm to detect deteriorating performance on Y-Cables well in advance of failure
- Use results to help predict Y-cable failures and to prioritize the Y-cable replacement efforts

Solution:
- Signature based on Statistical and Custom Traps: LCV (Line Code Violations), LES (Line Errored Seconds), UAS (UnAvailable Seconds)
A network modeling and routing application is used to analyze what-if questions about:

- Network failure analysis
- Network planned maintenance
- Network traffic engineering

Networks and services supported:
- Frame Relay/ATM
- Ethernet
- IP/MPLS

Input data used for modeling:
- Network inventory
- Network topology
- Network load measurements

Operations team used Tunnel Based Routing to flawlessly move IP traffic, totaling about 25% of all backbone traffic, to new private peering points:
- 3x increase in customer bitrate
PATH DETERMINATION SUBSYSTEM

1. Compute Least Cost Paths for a Model of an IP network
2. Establish a Usage Count
3. Select a Tunnel Path
4. Add the Tunnel Path to a Model
5. Configure a Network Element of the Network
NEW PARADIGM
AT&T’S DIGITAL PIVOT

PAST
Complex, single-unit, monolithic solutions

HYBRID
API, data integration glue, intelligent routing

FUTURE
Cloud & mS based, SaaS solutions

ENTERPRISE DIGITIZATION
Increased Digital Customer Interaction
Customer touch points, business operations, internal operations

EXTREME AUTOMATION
Intelligent Triage
Achieved ~60% prediction accuracy in less than six weeks

PLATFORM DRIVEN
Extreme Scalability
Vertical and horizontal scalability

INTELLIGENT IT
Data Powered
Data from thousands applications for real time business ready analytics

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AT&T’S PLATFORM APPROACH FOR AI/ML
ACUMOS™ OPEN SOURCE AI PLATFORM

- Framework to Harmonize AI Solutions
- Distributed AI Marketplace
- Interoperable Microservices
- Ecosystem to Expedite Collaboration & Innovation
ACUMOS – PLATFORM OVERVIEW

1. Create & On-Board Models
   - AI Development Service and tools
   - Onboard
   - Model

2. Enhancing Model With Application Data Sets
   - Data Sources
   - Training Dataset
   - Training / Testing Lifecycle
   - Predictor

3. Sharing Models In Marketplace
   - Search
   - Review
   - Chaining
   - Rating

4. Execute In Target Environment
   - Runtime Systems
   - Docker Images
   - Local Learning
   - Deploy
   - Publish
   - AI Platform & Marketplace
   - Continuous Learning

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**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**
**WHAT IS A MICROSERVICE?**

**An architectural style** in which applications are composed from loosely coupled services organized around business capabilities.

**4 Characteristics & 10 Principles**

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Control</th>
<th>Resiliency</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Encapsulation</td>
<td>7. Lightweight Communications</td>
<td></td>
</tr>
<tr>
<td>4. Consumer First</td>
<td>8. Infrastructure Agnostic</td>
<td></td>
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<tr>
<td>5. Infrastructure Agnostic</td>
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</table>

- **= Enabled by design practices**
- **= Enabled by common frameworks**

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Benefits of moving from large, multi-function apps to single-capability mS:

**Traditional Mode**
- Monolithic Application

**mS Mode**
- Business Capability

### Project
- Scoped by applications
- Scoped by mS

### Testing
- Regression entire application
- Regression only mS

### TTM
- Major quarterly releases
- Smaller frequent releases

### Resiliency
- Failures impact many functions
- Failure impact few functions

### Data
- Data shared by many apps
- Data encapsulated in mS
### Problem Statement
Manual inspection of billions of graphs is like finding the needle in many haystacks

**Mean Radio Receive Interference Noise**

The graph in each box is the average received signal strength.

Spikes indicate persistent interference from broadcasters even when controlled for weather and time.

Several patterns are apparent in sites with known interference and not all are expected to be due to FM/Cable TV Harmonic Interference.

![Evidence of successfully remediated site](image)

<table>
<thead>
<tr>
<th>Harmonic Sectors</th>
<th>7A</th>
<th>7B</th>
<th>7C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell Sites</td>
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</table>
Site has *already* had filter installed to remediate Broadcaster Interference issue. The shape of its current data indicates that this did not solve the problem -> this could be an auto-check

Site is confirmed to have Harmonic Interference.
**REFLECTION, SELF-INTERFERENCE, AND POOR PLANNING**

- Signals reflected by excited defrosters from the car rear windows in surrounding lots.
- This issue forced relocation of the site.
- Interpreting a signature from cases like these might enable us to “trial” locations (with M00s) before we do permanent installs.
- Saving money when these interesting, hard to diagnose cases do pop up
Prioritization: Actionable Task Scoring

Due to scale of infrastructure, AT&T funds site fixes reactively, based on cost and consumer impact.

Proactively predicting impact to CQI and related economic losses could automatically prioritize the right fixes for the right time to save money.

Actionable Task Scoring measures the technical impact and severity of site quality degradation.

Composed of:
- Data & VOLTE Retainability
- Data & VOLTE Block Percentage
- Downlink Throughput
- Packet Discard Rate
- CQI Factors

We aim to leverage the Actionable Task Score to pre-tag sites/tickets with a technical impact and priority, providing Ops teams with more up-front data to organize their efforts.
• Detect network outages using CDR call disconnect code “signatures”
• Apply unsupervised and supervised ML algorithms e.g. K-means, Random Forest
• ML Models puts outage NEs with visible “signatures” in same group
**Intelligent Triage** uses Machine learning algorithms to analyze historic pre-production defect data to systematically predict & localize Fault Root Causes.

It directly helps in improving Defect Turnaround Time & Quality of Defect Fixes.
INTELLIGENT TRIAGE - ROOT CAUSE (RC) PREDICTION PROCESS FLOW – PREDICT RC-APP AND RC-CATEGORY

1. **Log Defects**
   - Tester detects defect and logs defects in TDP/ALMQC
   - Example:
     - Defect ID: 1234
     - Originating Application: Opus

2. **Auto pull & Predict**
   - Tester updates the required input in TDP/ALMQC for the logged defect
   - Prediction engine starts the prediction by leveraging the machine learning model prepared from training data
   - Current prediction model is trained with Naive Bayes ML Algorithm
   - Example:
     - Defect ID: 1234
     - Originating Application: Opus
     - Root Cause App Prediction: Telegence
     - Root Cause Category Prediction: Coding

3. **Update Prediction**
   - Prediction engine will update the comments field in ALMQC with the link to intelligent triage with the prediction result for that particular defects
   - Example:
     - Defect ID: 1234
     - Originating Application: Opus
     - Root Cause App Prediction: Telegence
     - Root Cause Category Prediction: Coding

4. **View Defect RC Prediction Result**
   - How prediction works:
     - Input Parameters:
       - Root Cause Category
         (Summary, Phase_Found_In, Assigned_To_Team, Blocked_Test_Cases)
       - Root Cause App
         (Summary, Program, Phase_Found_In, Severity, Assigned_To_Team, Assigned to App-1's value)
     - ML Algorithm
       - Naive Bayes
         - Score: 60%
       - Random Forest (Ensemble)
         - Score: 85%
       - Gradient Boost (Ensemble)
         - Score: 90%
     - Root Cause Category
     - Root Cause App
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DCAE SANDBOX DEMO

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