

Industry Spotlight

Airlines

Addressing Resiliency in the Digital Age



Executive Summary

For the average commercial airline, IT leaders must deal with:

Multi-Day In-Person Audits

- Under scrutiny of an outage by federal agencies.
- Time-consuming multi-system audits and on-site visits.

Customer Dissatisfaction

- Delayed and canceled flights.
- High MTTR due to repetitive incidents and heavily manual work.
- Lack of operational efficiency.

Outage-Causing Headlines and Fines

- Inadequate failover and redundancy measures led to backup power failure.
- A design flaw, construction error or change, or poor operations procedures set the stage for the catastrophic failure.
- IT demand can grow over time so that the initial redundancy is compromised, and each piece of equipment is overloaded when one fails or is taken offline.
- One of the nation's largest airlines incurring a loss of \$150 million in 2016
 - Due to operational failures that grounded thousands 16,900 flights stranding >2M passengers
 - Due to lack of assessment of redundancy and risk measures
- Operational meltdown cost another large airline >\$750M in 2022, and a firewall failure in 2023.

Information technology systems



Planning your trip

- Reservations
- Frequent flier systems
- Airline website
- Airline mobile app
- Check-in
- Boarding



At the airport

- Airline mobile app
- Airport kiosk
- Check-in
- Boarding
- Baggage
- Flight planning/dispatch
- Aircraft weight and balance
- Crew scheduling

Potential outage effects

Unable to purchase tickets



Unable to update reservations



Unable to access frequent flier benefits



Unable to check flight status



Unable to check-in and/or scan boarding passes and baggage



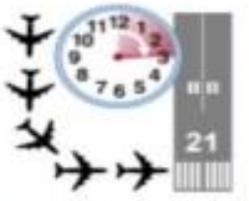
Long wait times for check-in and boarding



Flight delays or cancellations



Ground stop or tarmac delays



The US General Accounting Office (GAO) recently issued a report (GAO-19-514) in which it documents 34 IT outages from 2015 through 2017 that affected 11 of the 12 selected (domestic US) airlines included in the report.

Top IT Challenges

1 Under Investment in IT Systems

- Caused by poor airline profitability
- Need to identify problems and priorities
- Over dependency on humans for monitoring and risk avoidance

2 Aging Systems or Systems Designed not to Work Together

- Complexity due to a multitude of integrated legacy systems that must talk to each other
- Lack of ROI cause low investment in operations
- Lack of focus on building a unified system
- Risk of a break in part of the fragile system causing a major disruption

3 Lack of IT staff and training

- Lack of automation causes inability to keep pace with operational noise
- Making network changes takes too long and is risky
- Operations is mainly reactive and manual



40%

Fragmented operational systems within an airline (e.g., crew and maintenance systems do not talk to passenger systems)
Amadeus Insights

Flight Disruption Causes Mount

Highlights of GAO-23-105524, a report to congressional requesters.

Flight cancellation rates in the last 6 months of 2021 outpaced 2018 and 2019 rates despite 14 percent fewer scheduled flights, according to GAO's analysis of data from the Department of Transportation (DOT).

The airline industry has had several recent system outages and cyberattacks.

Outages and cyberattacks

● Cyberattack ● System outage



Human error

- **September 2010:** Airline (AUSTRALIA) Upgrade to the booking, check-in, and boarding systems resulted in 2 system failures in the first 3 months; hardware failure and subsequent system outage affected ~400 flights

- **September 2014:** Airline (ASIA) Phishing attack resulted in exposure of personal information of up to 750,000 members of frequent-flyer club; later investigation by airline confirmed theft of >4,000 customers' personal details

- **January 2019:** Aircraft manufacturer Company detected a cyberintrusion on its commercial-aircraft business-information system, resulting in unauthorized access to data and compromised professional-contact and IT-identification details of some employees



Applications

- **June 2015:** Airline (EUROPE) Distributed denial-of-service cyberattack grounded ~1,400 passengers

- **March 2019:** Travel-technology company Reservation-system outage delayed passenger check-ins of various major airlines

- **April 2019:** Aviation-infrastructure-system provider Outage of key system that provided weight-and-balance information needed to clear planes for takeoff delayed flights for multiple US airlines



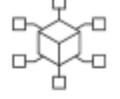
Data

- **July 2016:** Airline (ASIA) Website breach leaked names, dates of birth, and addresses of ~400,000 members of frequent-flyers club

- **June 2018:** Airline (EUROPE) Security incident tricked ~500,000 customers into exposing their log-in, credit-card, and itinerary information; airline was fined \$230 million in July 2019

- **August 2018:** Airline (AMERICA) Undetected unusual log-in behavior in mobile app exposed data (including passport number, country of issuance, NEXUS number, gender, date of birth, and nationality) of up to 20,000 users, compromising sensitive user information

- **January 2019:** Airline (ASIA) Unauthorized access to personal data (including name, date of birth, passport number, and historical travel information) compromised sensitive user information of up to 9.4 million passengers



Infrastructure

- **July 2016:** Airline (AMERICA) Failed computer-network router disrupted airline's reservation system, leading to >2,300 canceled flights within 4 days

- **August 2016:** Airline (AMERICA) Global computer-system outage caused large-scale cancellations, resulting in flights grounded for 6 hours; 1 airline confirmed >1,000 of its flights affected

- **May 2017:** Airline (EUROPE) Major IT failure affected >1,000 flights

- **June 2017:** Logistics company (EUROPE) Cyberattack resulted in shutdown of multiple sites and business units

- **April 2019:** Airline (AMERICA) Global computer-system outage grounded flights for several hours, causing large-scale cancellations across several airlines

Shifting Spending Priorities

Modernizing your airline's approach to Network Management

50%

28%

FSC LCC

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Travel Technology Investment Trends 2024: Airlines

Automating your approach to disruption management to better re-accommodate passengers and recover flight operations

30%

20%

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Operational Goals

Lower OPEX by reducing
MTTR



Quicker Safer Change
Management

Reduce Manual Touch,
Increase Efficiency



Accelerate Cloud
Migration

Improve Network
Reliability



Get real-time visibility into
the hybrid network



Targeted Automation Results



Ensure critical application performance and visibility to key stakeholders.



Execute 50% more network configuration changes at scale while protecting from config drift.



Cut outages and service disruptions in half with NetBrain platform.



OPEX savings in labor from MTTR reduction and automated diagnostic troubleshooting.

Key IT Processes Suited for Automation



Network Assessments



Troubleshooting



Change Management



Cloud Transformation



Improve Network Reliability with Network Assessment

Key Value: Improve network reliability through continuous assessment of hidden problems leading to potential outages.



Auto-Discovery

Reverse engineer and decode a network design's golden configurations



Application Performance

Continuously assess critical applications for performance, topology, connectivity issues and avoid application outages



Continuously assess for config drift:

- Golden configurations
- PCI/SOC best practices
- Device security hardening
- EoL/EoS



Network Performance

Continuously assess critical WAN interface, QoS performance related metrics

Airline Customer Spotlight #1

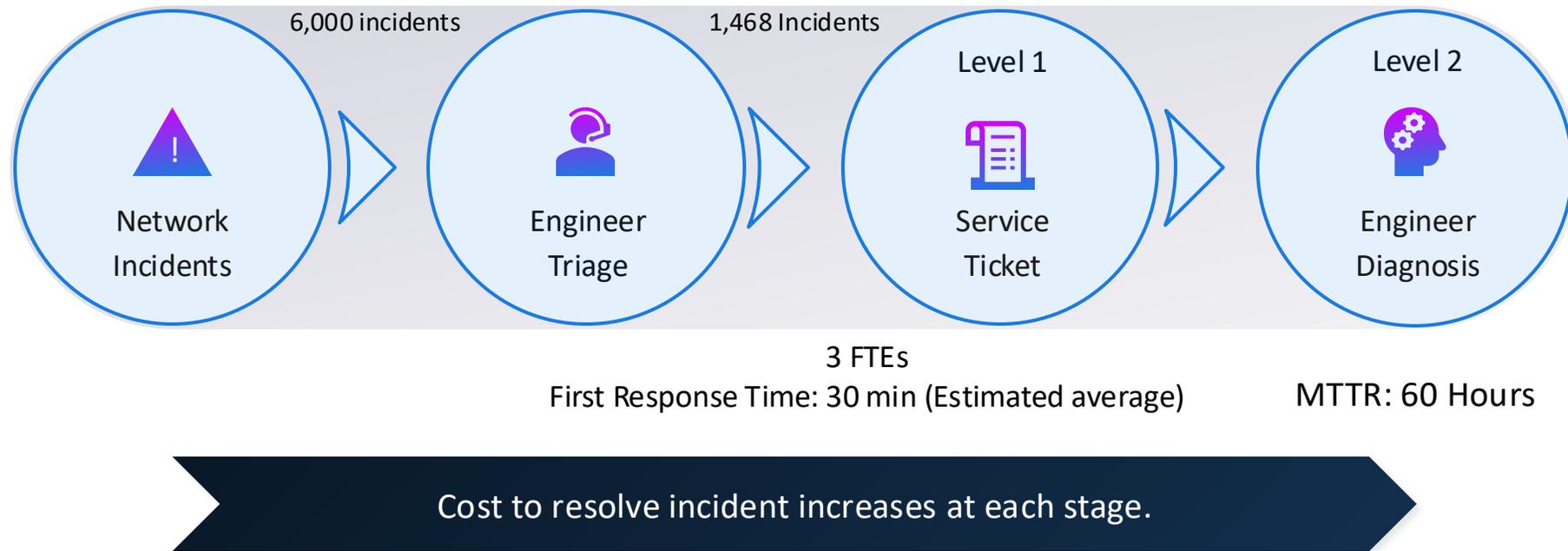
Airline Ticket Data Summary

- 34,576 Tickets Analyzed
- 24-Month Period
- 1,468 Tickets per Month
- 60.93 hrs. Overall Average of MTTR
- >\$10M/Year Savings

Symptom	Current MTTR	Reduction	Projected MTTR
URL Unreachable	24.98	20%	19.98
Loss of Connectivity	7.46	20%	5.97
WIFI Issue	114.37	20%	91.50
Device Unreachable	19.92	20%	15.94
Device Hardware	42.05	0%	42.05
BGP Down	11.36	20%	9.09
Interface Bad Link	284.10	20%	227.28
Interface Utilization or Error	150.53	20%	120.42
OSPF Issue	10.54	20%	8.43
Environment Power Supply	38.25	20%	30.60
Interface Duplex Mismatch	9.62	20%	7.70
Environment Memory	3.36	20%	2.69

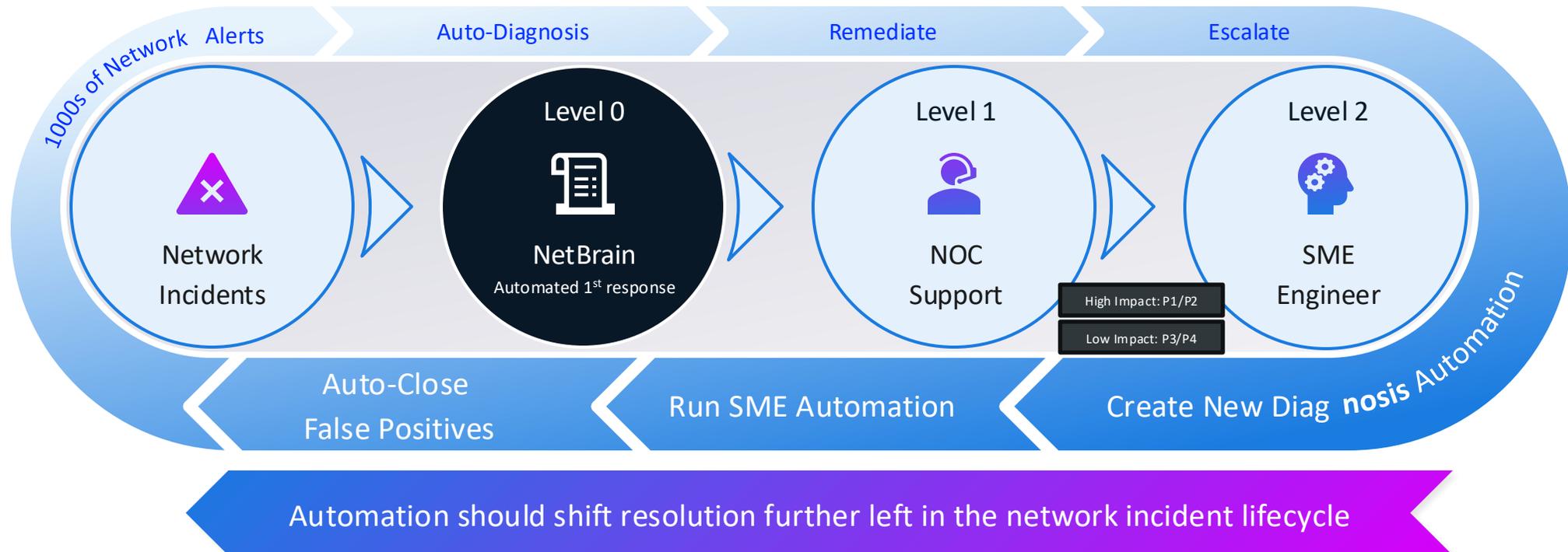
Before Automation Applied

Incident Lifecycle *Without* Automation



With Automation: “Shift Left” First-Touch Troubleshooting

Incident Lifecycle *With* Automation



- Reduce first response time by 50%
- Auto-close reduces ticket volume by 65%
- Auto-diagnosis for informed ticket escalation
- High-impact issues auto-escalated
- Free up 2nd level/3rd level engineers' time for project work (fewer escalations)
- 20% MTTR reduction

Trigger Automation (MTTR/MTTI) Use Case

Interface Utilization or Error

Target MTTR (HRS)	Resolution MTTR (Hrs)	Resolution Time with NetBrain (Hrs)	Priority	Enhancement with NetBrain	Close notes
8	3.1	5 minutes	p3	<ol style="list-style-type: none"> NB to confirm device capacity, no drops/error in logs and check health of device Wait 15 minutes, rerun playbook, if no issues auto close ticket with info 	Known issue of WAN over utilization, Closing ticket
8	253.4	30 minutes	p3	Same as above	Utilization went high, but normal, closing ticket

Interface Bad Link

Target MTTR (HRS)	Resolution MTTR (Hrs)	Resolution Time with NetBrain (Hrs)	Priority	Enhancement with NetBrain	Close notes
24	6	2	P4	<ol style="list-style-type: none"> Netbrain auto diagnose verify issue is not reoccurring auto close the ticket 	Mac Flap, caused by chg288998 Reboot device in ATL1 DC
24	56	30 minutes	P4	<ol style="list-style-type: none"> NB to confirm device health, logs, cpu,mem,errors Wait 15 minutes-run health check. if no issues auto close ticket with info 	CLI: Device int up and running, Neighbor is up and running. resolving

The screenshot displays the NetBrain interface integrated with ServiceNow. At the top, there are logos for NetBrain and ServiceNow, and a section titled "Interface Check". Below this, a network diagram shows several nodes: ATL_ADM_WAN_200, ATL_ADM_WAN_100, ATL_RCC_WAN_200, and ATL_RCC_WAN_100. Each node has associated interface status indicators, such as "Interface GigabitEthernet0/0/0 utilization is below 70" and "Interface Loopback1 utilization is below 70".

On the left side of the interface, a "Temporary Intent" panel is visible, showing a list of diagnostic steps:

- 11/21/2023 08:21 AM
- Interface GigabitEthernet0/0/0 low input 2
- Interface GigabitEthernet0/0/0 utilization 6

 Below the list, there are sections for "show interface" (2 Diagnoses, 8 Successes) and "Configuration" (1 Diagnosis, 4 Successes). The configuration details for "Interface GigabitEthernet0/0/0" are shown, including description, reliability, txload, rxload, and various error counters.

Device Unreachable

Target MTTR (HRS)	Resolution MTTR (Hrs)	Resolution Time with NetBrain (Hrs)	Priority	Enhancement with NetBrain	Close notes
8	47.1	30 minutes	p3	<ol style="list-style-type: none"> 1. Netbrain auto diagnose 2. verify issue is not reoccurring 3. auto close the ticket, 	Device is up and stable, gets rebooted by power "Sh ver"
8	4.8	30 minutes	p3	<ol style="list-style-type: none"> 1. Netbrain auto diagnose 2. verify issue is not reoccurring 3. auto close the ticket, 	Device stopped responding to polls, closed no resolving comment

BGP

Target MTTR (HRS)	Resolution MTTR (Hrs)	Resolution Time with NetBrain (Hrs)	Priority	Enhancement with NetBrain	Close notes
8	1.6	30 minutes	p3	<ol style="list-style-type: none"> 1. NB to confirm device is back up, check logs and health of device 2. Wait 15 minutes, if no issues auto close ticket 	Device link flapped has been up for 1:21:44, hence closing
8	2.1	10 minutes	p4	<ol style="list-style-type: none"> 1. Netbrain auto diagnose 2. verify issue is not reoccurring 3. auto close the ticket, 	Tunnels are up, 10.230.16.3 made down by engineering team due to change

Incident Improvement



This intent execution is finished at 06/07/2023 12:48 PM with 0 errors. You can View Execution Log

ABEFTOMCR-SR01 - switch 1A PID is OK 11

ABEFTOMCR-SR01 Fan 1 is OK 4

show env all 4 Diagnoses

```

1 ABEFTOMCR-SR01#show env all
2 FAN 1 is OK
3 FAN 2 is OK
4 FAN PS-1 is OK
5 FAN PS-2 is OK
6 SYSTEM TEMPERATURE is OK
7 System Temperature Value: 21 Degree Celsius
8 System Temperature State: GREEN
9 Yellow Threshold : 46 Degree Celsius
10 Red Threshold : 60 Degree Celsius
11 SW PID Serial# Status Sys Pwr PoE Pwr Watts
12 -----
13 1A C3XX-PWR-350WAC LIT18170A43 OK Good Good 350/0
14 1B C3XX-PWR-350WAC LIT181709UT OK Good Good 350/0
15
16 SW Status RPS Name RPS Serial# RPS Port#
17 -----
18 1 Not Present <>
19
20
21
    
```

- FAN PS-1 is OK
- FAN PS-2 is OK
- Fan 1 is OK
- Fan 2 is OK
- System Temperature is GREEN
- SWITCH 1A PID is OK
- switch 1B PID is OK

BGP Internet Facing Dashboard

BGP Neighbor Status 8/29/2023, 1:02:59 PM View Report

Filter: All

BGP Internet Facing Report 8/29/2023, 1:02:59 PM View Report

Filter: All

BGP Internet Facing Report 8/29/2023, 1:02:59 PM View Report

Filter: All

Intent Name	Device Alert Status Code Count	Device Name
BGP Neighbor Check 1	0	ATL1R025-RW009
BGP Neighbor Check 1	0	ATL1R025-RW009
BGP Neighbor Check 2	0	ATL1R110-RW010
BGP Neighbor Check 3	0	ATLEQXAT1-INET01
BGP Neighbor Check 4	0	ATL1ADM-INET02

Productivity Gains

50%

50%

90%

50%

50%
Protected

2X

Reduce MTTR

- High impact P1/P2 incidents
- P3/P4/P5 incidents
- Reduce mean time to acknowledge situations

Reduce Manual Touch

- Situation first response
- Self service for stakeholders

Continuous Assessment of Hidden Problems

- Critical applications
- Critical design rules
- Critical performance

Safe Change

- Change execution
- Post-change validation against critical application and design rules

Accelerate Cloud Migration

- Visibility
- Incident response
- Continuous assessment

Self-Service Troubleshooting via Chatbot

➤ ChatNBT is a self-service chatbot tool that can be utilized by a large audience with no NetBrain know-how or seat license

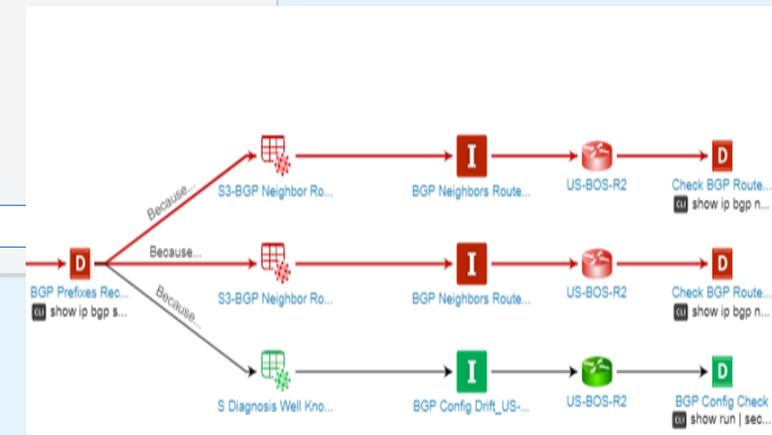
➤ Customizable for specific user roles.

➤ Control the automation and devices available per role.

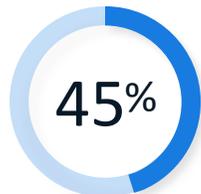
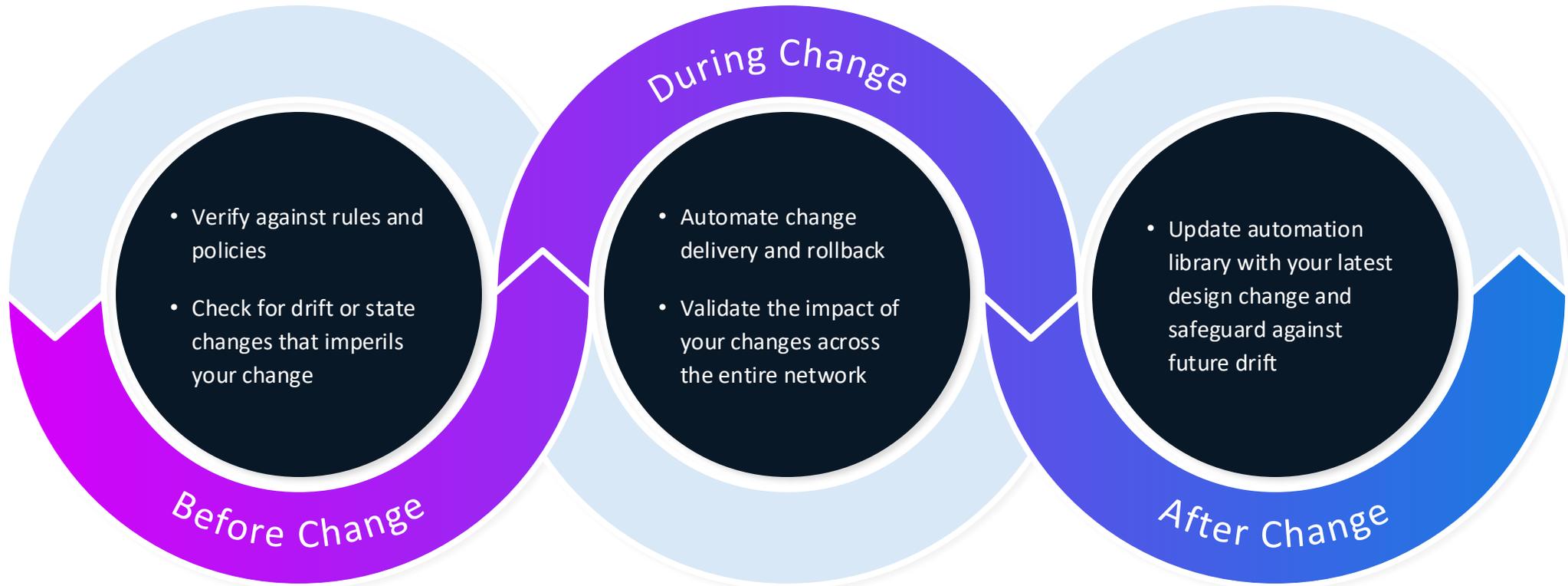
➤ **End users** use to troubleshoot network issues and obtain relevant diagnostic data and results.

- ✓ Interact with the bot to provide input
- ✓ Run multiple sessions to perform different diagnoses simultaneously
- ✓ Share chat history and findings with others

The screenshot shows a chat window titled "Troubleshoot Application" with a "Current Session" dropdown. At the top, there are three buttons: "Check BGP", "Check OSPF", and "Check Core Devices". The chat history shows a user inputting "Check BGP" at 10:04 am. The bot responds with a form: "Please select devices" with a dropdown menu (currently showing "--Select--") and a "Submit" button. The user then provides "R1" as the device. The bot asks for the destination IP, and the user provides "10.1.1/0/24, 10.2.1.1.0". The bot then displays the "Execution Result of Check_BGP", stating "Diagnosed 10 devices, found 3 error messages on 2 devices". Below this result are three buttons: "View Status Code", "Intent Map", and "Diagnosis Tree". At the bottom of the chat window, there is a text input field with the placeholder text "| Type '/' for shortcut commands".



Why Automate Change Management?



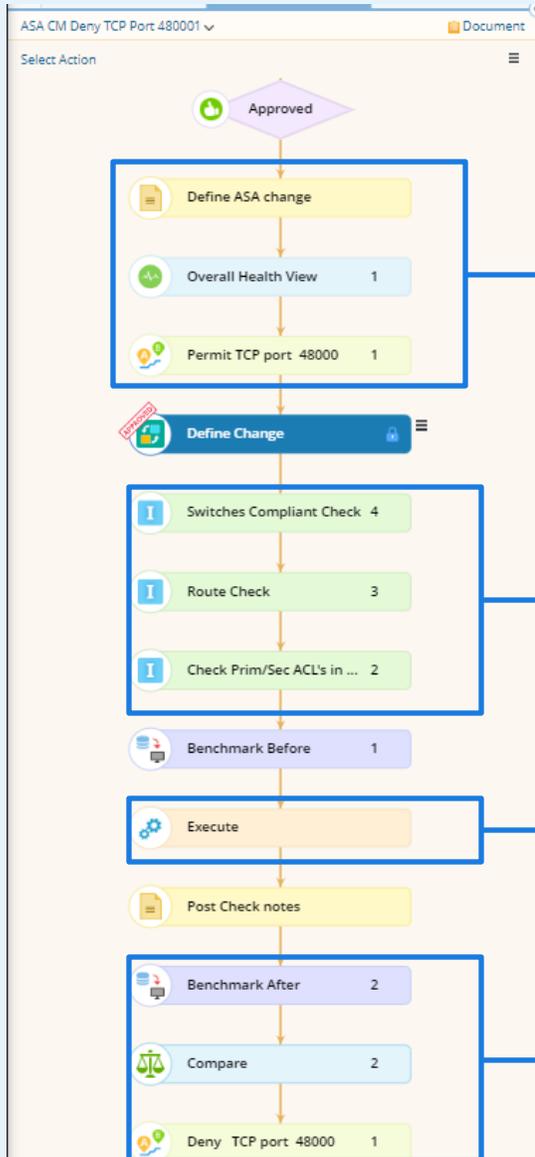
of all outages have root cause in configuration & change mgmt. errors*



of all datacenter outages saw human error play a role*

* according to Uptime Institute's Annual Outage Analysis 2023

Automated Change Management Results



Baseline network assumptions prior to change design

Ensure network is ready for change

Automated Execution

Verify change successful
Verify no unintended results

50% more changes with automated pre-post checks

- Key Value points**
- Vendor agnostic change mgmt. platform
 - No code automation, low barrier to learn and execute changes
 - Pre and post validation of key network intents (application, design, performance)
 - Integrate into existing workflow (Ansible + ServiceNow for approval)
 - Protect existing network design from new changes

Airline Customer Spotlight #2

Airline Ticket Data Summary

- Average Tickets 1850 per month
- 1-hour MTTR

Problem Type	Productivity Impact	MTTR (Current – New)
BGP States	25% MTTR Reduction	1 hr -> 45 min
WAN links down	25% MTTR Reduction	1 hr -> 45 min
Device not reporting	25% MTTR Reduction	1 hr -> 45 min

Automation Use Cases

Without Automation

- No ability to monitor firewall rule policies
- Cannot save golden paths for comparison
- Lack of single pane of glass
- Conventional high volumes of alerts that deliver little to no information
- Many repetitive tickets that take too much engineering time to resolve

With Automation

- Determine what firewalls need what policy rules to ensure application health
- When troubleshooting applications, save paths and ports to run against live paths
- Perform path calculations continuously even if a firewall is blocking the path
- See L3 and L2 together
- Integrate DataView Templates with LiveAction (monitoring tool) to easily obtain the NetFlow last 15 min report
- Integration with ServiceNow to trigger NetBrain incident diagnosis for application troubleshooting
- High-value observability of priority root causes, providing more context and understanding (intelligence) to monitoring

Summary

Automation Helps Airlines IT:

Avoid Multi-Day In-Person Audits

- Reduce audit budgets with continuous assessment.
- Ability to provide ongoing evidence through network assessments.

Stay Out of Headlines and Avoid Fines

- Backup power failures and redundancy measures are critical.
- Design flaws, construction changes, and poor procedures lead to failures.
- Increasing IT demand can compromise initial redundancy.

Improve Customer Satisfaction

- Avoid costly flight delays and cancellations due to outages.
- Enhance Mean Time to Repair (MTTR) by reducing repetitive incidents.
- Reduce manual work and increase efficiency.



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NetBrain Technologies Inc. is the leading provider of network automation solutions with offices throughout the world including Boston, London, Munich, Beijing, Toronto and Pune.

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