Forward Networks has created a revolutionary platform, Forward Enterprise, for analyzing network behavior and quickly isolating configuration errors and policy violations. The platform can compare the intent of the network designers and all connectivity and compliance requirements to the actual behavior and network design. Network IT teams can now troubleshoot faster and proactively eliminate problems prior to a breach or outage.

Because Forward Enterprise automates the intelligent analysis of network designs, configurations and state, we provide an immediate and verifiable return on investment (ROI) in terms of accelerating key IT processes and reducing man-hours of highly skilled engineers in troubleshooting and testing the network. In this white paper, we will quantify the ROI of a large financial services firm and document the process improvements that led to IT cost savings and a more agile network.

In this analysis, we will look at process improvements in trouble ticket resolution, audit-related fixes and acceleration of network updates and change windows. We will explore each of these areas in more detail, along with the input assumptions for the calculations, but for this financial services customer, the following benefits were achieved, resulting in an annualized net savings of over $3.5 million:

<table>
<thead>
<tr>
<th>Operational Costs</th>
<th>Today</th>
<th>With Forward</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours spent on Ticket Resolution</td>
<td>PER WEEK: 1,800</td>
<td>PER YEAR: 93,600</td>
</tr>
<tr>
<td></td>
<td>PER WEEK: 1,350</td>
<td>PER YEAR: 70,200</td>
</tr>
<tr>
<td>Hours spent on Audit Related Fixes</td>
<td>PER WEEK: 600</td>
<td>PER YEAR: 31,200</td>
</tr>
<tr>
<td></td>
<td>PER WEEK: 384</td>
<td>PER YEAR: 19,968</td>
</tr>
<tr>
<td>Hours spent on Change Windows</td>
<td>PER WEEK: 92</td>
<td>PER YEAR: 4,800</td>
</tr>
<tr>
<td></td>
<td>PER WEEK: 78</td>
<td>PER YEAR: 4,080</td>
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</tbody>
</table>

Operational Costs associated with network activities:

- Today: $249,231, $12,960,004
- With Forward: $181,246, $9,424,803

Overall reduction in costs related to ticket resolution, audit related fixes and change windows:

- PER WEEK: $67,985
- PER YEAR: $3,535,201
METHODOLOGY:
Key Process Improvements and Metrics

The primary function of Forward Enterprise is to collect device configuration data from every network device, including state information that governs the active behavior of the device. Forward Enterprise can then emulate the behavior of the entire network end-to-end, and report on potential vulnerabilities, policy violations or risk exposure.

The common identified process improvements we have seen at several large customers are:

+ Reduced time to trouble ticket resolution
+ Reduced time spent on audit related fixes and updates
+ Fewer, shorter and more reliable change windows or network updates

Some of the quantifiable savings include:

+ 50% faster trouble ticket resolution
+ 90% faster audit related fixes
+ 33% reduction in aborted or erroneous change windows

For each of these processes, we have identified improvements in several steps to complete the process, as well as documenting the actual improvements and related costs from this specific financial services customer.

Process 1: Reduced Time to Trouble Ticket Resolution

Forward Enterprise improves the time to resolve the average high to medium-high complexity ticket. These events are defined as trouble tickets which require the operator to troubleshoot a path through a network of more than four network elements (switches, routers, firewalls, or load balancers).

The typical work flow for a ticket resolution is defined left in Figure 1a.

The approximate time spent on each step is illustrated in Figure 1b.

Using Forward Enterprise, steps 1 – 3 are completely automated and reduced to effectively zero time spent. These steps are done instantaneously as the network engineer begins troubleshooting. Forward Enterprise is designed to highlight network paths, including traffic origin and destination that could potentially result in an error or policy violation. All paths that either support or violate a defined policy or requirement are immediately highlighted for further analysis.

Figure 1a - Ticket Resolution Flow

Figure 1b - Percentage of time spent in each step of the ticket resolution for a high to medium-high complexity trouble ticket.
In Figure 2, we show how a typical network path is presented. Each hop can be quickly analyzed to see how traffic is routed and modified for each service. In addition, once the desired device configurations are updated, Forward Enterprise can automate the testing of the new configuration in step 8. IT admins can immediately see if the proposed changes remediate the problem as well as not introducing any potential new policy violations. We will explore the net benefits from this step as we look closer at changes windows.

When considering the process improvements from steps 1-4 of remediating trouble tickets, a conservative measurement of time spent on ticket resolution ranges 25-50%. Our financial services customer conservatively estimated saving 25% of man-hours on trouble ticket remediation, or over 23,000 hours per year. As we document in the summary table, assuming $100/hour for the overhead costs of a network engineer, this translates to a savings of $2,300,000 per year.

![Figure 2 – Forward Enterprise shows allowed paths through the network that match the policy or search query. We can explore paths device by device to quickly identify root-cause issues.](image)

**Process 2: Reduced Time Spent on Audit Related Fixes**

Forward Enterprise reduces the time needed to audit the network with regards to several fundamental configurations. Audit related problems are defined as any item within the Forward Platform that is found by using the “predefined check” library.

**Significant examples are:**

+ Link speed mismatches
+ Maximum Transmission Unit (MTU) size mismatches
+ Forwarding loops
+ VLAN definition inconsistencies
+ Port channel inconsistencies
Typically, audit related items are bulk remediated by a small team of network engineers. Audit processes are very detailed and time consuming: 95% of the time is spent inspecting network elements that do not exhibit the problem, simply verifying that they are configured correctly. 5% of the time is spent remediating failed network elements.

Forward Enterprise provides a report that instantaneously identifies configurations that are not compliant, so that network engineers do not have to look at network devices without problems. Additionally, Forward Enterprise verifies that any changes have been successful, reducing time to resolution in case of more complicated audit items (e.g., forwarding loops).

Forward Enterprise provides coverage for 60% of self-identified audit items, and reduces time to resolve them by 95%. There is no appreciable change in the time to resolve the 40% of uncovered audit items. Across all self-identified audit items, this means time to audit is reduced 57%.

Process 3: Reduced Number of Change Windows

Forward Enterprise reduces the number of change windows needed to accomplish complex changes within the network. Roughly one third of changes fail because of change procedures, unexpected network conditions, or user error. Forward Enterprise creates a snapshot at the beginning of the change window and another snapshot at the end of the change window. After pushing all changes to the network, the operator can automatically verify that all services are functional.

A typical change window flow process is illustrated in Figure 4.

In Fig 4, 65% of changes result in a success (green) result. However, 35% of changes do not.

20% of changes resulting in “Revert” (gray) result in one additional change window. Because of improved troubleshooting, Forward Enterprise can help identify the failure quicker and troubleshoot 50% faster. (See Reduced time to ticket resolution)

15% of changes result in exiting the change window in a failed state. These failures result in two additional changes windows. One to solve the problem created by the change window, and a subsequent change window to solve the original problem.

Figure 3 – Forward Enterprise continually checks path and device-to-device configurations to identify errors and inconsistencies that cannot be detected by looking at devices individually.

Figure 4 – Common workflow for a network change window, with aborted changes highlighted in black or gray.
When using Forward Enterprise, the following work flow is observed as in Figure 5.

The result is only 10% of changes will require an additional change window due to a failure instead of 20% requiring one additional, and 15% requiring two additional. Given 100 theoretical changes, in the first example, 150 change windows are required. In the second example, with Forward, 110 change windows are required. The reduction in change windows necessary is 27%, with the complete elimination of self-inflicted emergency change windows.

ROI Analysis

Based on the process improvements discussed above, we modeled time and financial variables at our large financial customer according the following assumptions:

+ 60 full-time network engineers
+ $100 per hour burdened cost per engineer
+ 30 hours per week spent on trouble ticket resolution
+ 10 hours per week on audit-related issues
+ 4 change windows per month
+ 10 engineers assigned per change window
+ 10 hours spent per change window

Based on the above inputs, we calculated the costs of managing their network trouble tickets, audit resolution and change window processes. Again, we summarize the results from these assumptions as shown on the first page:

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Summary
Forward Networks has delivered the first behaviorally-accurate software model of large enterprise networks.

Our platform provides a revolutionary approach to analyzing and troubleshooting complex network issues, as well as allowing functional validation of network designs.

Cost savings from leveraging Forward Enterprise can be a significant percentage of network IT spending when factored over the three areas of trouble ticket resolution, audit-related fixes and reduced number of change windows. Based on these process improvements and savings, we expect intent-based verification to be an important part of IT networking strategy and future network automation projects.

About Forward Networks
Forward Networks’ mission is to de-risk and accelerate network operations, by increasing efficiency, reducing outages and verifying network intent. Built on a series of breakthrough algorithms, the Forward Platform provides enhanced network visibility, policy verification and change modeling for legacy, SDN or hybrid environments.

Forward Networks is headquartered in Palo Alto, California, and funded by top-tier investors, including Andreessen Horowitz, DFJ, A.Capital, SV Angel, and several luminaries in the networking and systems space.

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