Workflow Redesign of Network IP Addressing for UMHS Devices

Final Report

April 23, 2013

To: Client
Charles Singer
Manager, Networking and Security Services
Infrastructure and Systems Operations (ISO)
csinger@med.umich.edu

Coordinator
Daniel Hazlett
Fellow, Michigan Quality System (MQS)
dthazle@med.umich.edu

Supervising Faculty Member
Mary Duck
Instructor and UMHS Liaison
University of Michigan Health System
mgduck@med.umich.edu

From: Project Team #6
Yue (Cindy) Li
Jordan Milanowski
Jade Watts
IOE Senior Students, University of Michigan
Table of Contents

Executive Summary ...................................................................................................................... 1
  Background ............................................................................................................................. 1
  Methods ................................................................................................................................. 1
  Findings and Conclusions .................................................................................................... 2
  Recommendations ............................................................................................................... 3

Introduction ................................................................................................................................ 4

Background .................................................................................................................................. 5
  Groups Involved ...................................................................................................................... 5
  Technical Terms ...................................................................................................................... 5
  IP Addressing Process Overview ............................................................................................. 6

Key Issues ..................................................................................................................................... 6

Goals and Objectives .................................................................................................................. 7

Project Scope .............................................................................................................................. 7

Methods ....................................................................................................................................... 8
  Mapping the Current State .......................................................................................................... 8
    Step I: Personal Interviews of Groups Involved in Current IP Addressing Process ........ 8
    Step II: Value Stream Map Group Session ............................................................. 9
  Analyzing Historical IP Request Data ................................................................. 9
    Selecting Key Fields ............................................................................................................. 10
    Separating Worklog Field ................................................................................................. 11
    Filtering and Flagging Historical Tickets of Interest .................................................. 11

Findings and Conclusions .......................................................................................................... 13
  Variation of Multiple Steps in the Current IP Addressing Process ..................................... 13
  Low First Time Accuracy ......................................................................................................... 15
  Excessive Group Transfers ...................................................................................................... 16
  Problematic Information within CWDB ................................................................................ 16

Recommendations ....................................................................................................................... 17
  Implement Standard IP Request Method .................................................................................. 18
  Develop A Single Centralized IP Database ........................................................................... 19
  Create Standard Communication Flow ................................................................................. 19
  Incorporate Standard Error Correction Process .............................................................. 19

Expected Impact .......................................................................................................................... 20

Appendix ..................................................................................................................................... 21
Appendix A: Snapshot of the IP Request Form ................................................................. 21
Appendix B: Snapshot of the general Remedy Ticket .................................................... 22
Appendix C: Standard Questions for Interview ............................................................. 23
Appendix D: Initial Current Process Workflow .............................................................. 24
Appendix E: Initial Value Stream Map .......................................................................... 25
List of Figures and Tables

Figure 1. Example of VLAN Configuration for Specific Device Groups ........................................... 4
Figure 2. Initial Basic Model of Current IP Addressing Process ..................................................... 6
Figure 3. Overview of Current IP Addressing Process VSM ............................................................ 13
Figure 4. Search for Appropriate Subnet Process Details ............................................................... 14
Figure 5. Attempt to Connect Device with IP and Error Correction Process Details ...................... 14
Figure 6. Fraction of Requests Transferred to Groups Indicating Low First Time Accuracy ......... 15
Figure 7. Frequency and Percentage of Requests with Varying Number of Group Transfers. ....... 16
Figure 8. Overview of Future IP Addressing Process VSM .......................................................... 18
Figure 9. Future Standard Search for Appropriate Subnet Process ............................................... 19
Figure 10. Future Attempt to Connect Device with IP and Error Correction Process ................. 20
Table 1. Groups Involved in the IP Addressing Process ............................................................... 5
Table 2. Key Fields Selected from Remedy for IP Request Data Analysis ................................... 10
Table 3. Example of Worklog Separated into Individual Timestamp Entries .............................. 11
Table 4. Search Phrases used to Identify Problematic Tickets .................................................... 12
Table 5. Examples of Inconsistent Naming Convention within the CWDB ................................. 17
Executive Summary

The University of Michigan Health System’s (UMHS) Hospital customers have frequently received incorrect IP addresses in the current process for requesting and assigning an IP address (IP addressing process) for a workstation or medical device. UMHS Networking and Security Services (Networking) want to know why and how incorrect IP addresses have been assigned. Therefore, Networking has requested an IOE 481 Student Project Team from the University of Michigan analyze the current IP addressing process and develop recommendations for improvement. In order to address the Networking group’s concern, the project team has interviewed groups involved in the process, developed a Value Stream Map (VSM) of the current state, initiated a live VSM group session, and analyzed historical IP request data.

Background

The current IP addressing process can result in hospital customers receiving incorrect IP addresses. New or relocated devices require an IP address to connect to a proper subnet associated with where that device resides. When an IP request is created, it is routed to the Service Desk Tier II Technical in two different ways. Hospital customers may send an IP request through Desktop Support or request through their Department IT; both an IP Request Form and a general Remedy ticket can be used to create IT requests (see Appendices A and B). Regardless of how the requests are made, the Service Desk Tier II Technical uses the information received and attempts to find an IP address that would provide accessibility to the customer within the correct subnet.

The primary goals of the project were to improve the current IP addressing process and eliminate any communication gaps between groups. To accomplish these goals, the team has identified the following objectives: (1) collect both anecdotal and numerical data about the current IP addressing process, (2) understand the current work flow of the IP addressing process, (3) determine root causes of the incorrect IP addresses, and (4) develop a future state with high first time accuracy and reduced turnaround time.

Methods

The project team performed two methods: mapping the current IP addressing process and analyzing the historical IP request data. Each method comprised data collection and data analysis components.

The method of mapping the current state included two steps:

- **Step I: Personal Interviews of Groups Involved in Current IP Addressing Process.** The project team interviewed representatives from five groups (except for Hospital customers) in the current IP addressing process. Ten total interviews were organized and a standard question list (See Appendix C) was also used to ensure interview consistency. After interviews, the project team used the information collected to develop a detailed flowchart of the current IP addressing process (See Appendix D)

- **Step II: Value Stream Map Group Session.** The project team used the flowchart developed from the interviews to draft an initial Value Stream Map of the current IP
addressing process (See Appendix E). Later, the initial VSM draft was used as the starting point for the VSM group session. During the session, the project team distributed the VSM draft to the attendees, mapped the draft process on a whiteboard, and gathered input from each group to iteratively refine the process steps. The results from the live VSM group session were later synthesized to develop a more accurate VSM and to help determine the root causes of incorrect IP addresses.

The historical data given to the project team had 2937 Remedy tickets about IP requests. The historical data was used to quantify aspects of the current IP addressing process and identify causes of incorrect IP addresses. The project team analyzed the historical IP request data in four steps:

- **Selected ten key fields** used most frequently based on Networking’s expertise. The worklog field was identified as the most useful field because it contains every activity that happens to one ticket until it is closed.
- **Separated the worklog field** by each time the ticket was updated to permit filtering the out-of-scope data and creating flags.
- **Filtered the out-of-scope tickets** by excluding the tickets for DHCP address requests and the tickets requesting the addition, removal or update of subnet information in the CWDB.
- **Flagged tickets of interest** by searching phrases in the worklog entries that indicate problems with the IP request and counting the number of times the phrase were found for each ticket.

**Findings & Conclusions**

From the data collection and analysis, the project team found four major areas of concern with the current IP addressing process: (1) variation of multiple steps in the current process, (2) low first time accuracy, (3) excessive group transfers, and (4) problematic information within the CWDB.

The variation in steps throughout the current IP addressing process ultimately decreases the likelihood of identifying the correct subnet and assigning a proper IP address for the customer’s device. This variation is consequently contributing to the low first time accuracy of the current IP addressing process. From the historical data, the project team found 24% of tickets transferred to Networking, which often indicates the Service Desk Tier II Technical was not provided adequate information to identify the correct subnet from which to assign an IP address. Requests need to have more accurate location and device information to assign an IP address correctly the first time. The historical data also pointed to poor communication between groups as seen by the regularity of tickets transferred multiple times between various groups. The project team calculated that over 50% of tickets are transferred more than three times and about 15% more than six times.

From the interviews and historical data, the project team also found problems within the CWDB that contribute to incorrect IP addresses including outdated or inadequate subnet and location information. The problems within the CWDB are believed to be the result of inadequate database management and a lack of a single centralized database of subnet information.
Recommendations

The project team developed four conclusions from the findings: (1) the current IP addressing process needs standard methods for both requesting and assigning an IP address, (2) the current IP addressing process needs standard communication flow to reduce transfers between groups and improve group interaction, (3) subnet information in Remedy and the CWDB needs to be accurate and consistent across both databases to ensure first time accuracy of identifying the correct subnet and assigning an appropriate IP address, and (4) the current IP addressing process needs a standard method for the tracking IP request errors to reduce escalation of the same question and improve first time accuracy of assigning an appropriate IP address.

As part of the project goal, the project team also developed recommendations for the future IP addressing process:

- **Implement Standard IP Request Method.** IP requests are currently routed to the Service Desk Tier II Technical in either the IP Request Form or the general Remedy ticket. Instead of choosing only one or the other, the project team recommends a standardized IP request web form that incorporates the updated dropdown fields similar to the IP Request Form and the ability to transfer the tickets between groups similar to the general Remedy ticket.

- **Develop a Single Centralized Information Storage.** The inconsistent information in the CWDB and Remedy database increase the difficulty of the Service Desk Tier II Technical’s search for the correct subnet. For short-term implementation, the project team recommends establishing a standard procedure to update the data in CWDB and Remedy consistently. For long-term implementation, the project team recommends a single centralized database with subnet information, which will simplify the subnet searching and thus improve the first time accuracy.

- **Create Standard Communication Flow.** When problems with the IP addressing process arise, the groups involved do not have a clear set of rules that designate which group should be contacted for help. The project team recommends establishing standard communication flow so each group should know whom to contact for a given issue. This standard flow would reduce the unnecessary transfers between groups and therefore decrease the turnover time.

- **Incorporate Standard Error Correction Process.** In the current IP addressing process, no historical records of incorrect IP assignment issues are tracked, which has led to the same questions repeatedly escalated to other groups for assistance. Therefore, the project team recommends implementing a future error correction process incorporating an IP Request Problems Tracking System to track IP assignment errors. This system will save time and effort for all groups involved in the IP addressing process; groups will only communicate about new problems and not previously resolved problems.
Introduction

The University of Michigan Health System’s (UMHS) Networking and Security Services (Networking) believes that the current process for requesting and assigning an IP address (IP addressing process) for a workstation or medical device is ineffective. Currently, UMHS IP requests are routed through Desktop Support or Department IT groups to the Service Desk Tier II Technical. Requests come in multiple forms and the Service Desk Tier II Technical uses various methods to look for network information for the device. The IP addressing process occasionally leads to incorrect IP address assignments, which cause delays in connecting devices to the appropriate medical networks. When this delay occurs, the problem frequently escalates from Service Desk Tier II Technical to Networking or other groups to connect the devices to the proper network. This escalation creates extra labor and frustration to get the right IP address to the customer. Different types of medical workstations and devices also require different IP addresses to connect to the correct IP subnet and Virtual Location Area Network (VLAN). The variety of devices complicates the process of assigning a correct IP address for the appropriate subnet. Figure 1 serves as an example how one switch can route multiple VLAN’s and how each VLAN can be configured for specific device types.

![Figure 1. Example of VLAN Configuration for Specific Device Groups](http://www.cisco.com/en/US/docs/routers/access/1800/1801/software/configurationguide/dhcpvlan.html)

The Networking and Security Services group has requested an IOE 481 Student Team from University of Michigan analyze the current IP addressing process and develop recommendations to improve the process. To fully understand the current process, the project team conducted interviews with the many groups involved in the process, initiated a live value stream group mapping session with the groups interviewed, and analyzed the historical data of IP request information. The project team analyzed the root causes of the incorrect IP assignments and has
provided recommendations for improving the effectiveness of the IP addressing process. The purpose of this final report is to outline the project background, goals and objectives, scope, methods, findings, conclusions and recommendations for improving the effectiveness of the IP addressing process.

**Background**

The project involves six groups related to the current IP addressing workflow and many terms that may be unfamiliar to those outside of technology departments. To aid the understanding of the project work, this section includes the groups involved, defines technical terms, and describes the current IP addressing process.

**Groups Involved**
The IP addressing process involves six groups: the Hospital customers, Department IT, Desktop Support, Service Desk Tier II Technical, Enterprise Device and Engineering Management (EDEM), and Networking. Table 1 shows the function of each group.

<table>
<thead>
<tr>
<th><strong>Group</strong></th>
<th><strong>Responsibilities</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital customers</td>
<td>• Request IP addresses for workstations and medical devices</td>
</tr>
<tr>
<td></td>
<td>• May request IP through Department IT or Desktop Support</td>
</tr>
<tr>
<td>Department IT (Pathology, Radiology etc.)</td>
<td>• Handle requests from customers</td>
</tr>
<tr>
<td></td>
<td>• Create IP request ticket when necessary</td>
</tr>
<tr>
<td>Desktop Support</td>
<td>• Handle requests from customers</td>
</tr>
<tr>
<td></td>
<td>• Activate new devices (with IP given)</td>
</tr>
<tr>
<td></td>
<td>• Create IP request ticket when necessary</td>
</tr>
<tr>
<td>Service Desk Tier II Technical</td>
<td>• Receive IP requests from Department IT or Desktop Support</td>
</tr>
<tr>
<td></td>
<td>• Search databases for available IP addresses on desired subnet</td>
</tr>
<tr>
<td></td>
<td>• Assign IP addresses for customer devices</td>
</tr>
<tr>
<td>EDEM</td>
<td>• Manage Core Workstation Database (CWDB) used by Service Desk Tier II Technical</td>
</tr>
<tr>
<td>Networking</td>
<td>• Create IP subnets and manage networks through internal database</td>
</tr>
<tr>
<td></td>
<td>• Support Service Desk Tier II Technical with IP issues when necessary</td>
</tr>
</tbody>
</table>

**Technical Terms**

This section includes the technical terms used within this document to properly describe the IP addressing process, which are listed below:
• **Subnet** – A logical subdivision of an IP network, which has a specified range of IP addresses.

• **Dynamic Host Configuration Protocol (DHCP) Address** – A device configured with DHCP can roam to different subnets with DHCP services, which automatically provide an IP address to the device.

• **Static IP Address** – A device configured with Static IP can only connect to the subnet to which it is configured; the device can roam so long as this subnet is available.

• **Private Network** - Devices on this network can initiate and connect to the internet but the public web cannot initiate contact with the device (one-way communication).

• **Public Network** - Devices can be seen and can exchange information with the public web (two-way communication).

• **Remedy System** - UMHS IT system used to create IT tickets such as IP requests.

• **Remedy Subnet Database** – Database with information on subnets created by Networking but without individual IP address data.

• **Core Workstation Database (CWDB)** - Database of IP subnets and their IP addresses used to locate and assign IP addresses.

• **IP Addressing Process** - The steps associated with a customer sending a ticket request for an IP address to Service Desk Tier II Technical using the Remedy system and the steps associated with the process the Service Desk Tier II Technical implements to search for an available IP address and assign it to the device that the request was sent for.

• **Worklog** - A textbox that tracks changes to an individual Remedy ticket.

**IP Addressing Process Overview**

The UMHS Networking group is responsible for creating IP subnets and managing the network structure. The network is layered to support the subnets and subsequently the IP addresses that can operate within those subnets. The Networking group captures the network design layout as established and stores this information within the Remedy Subnet Database. When a new subnet is created, the Networking group notifies the Service Desk Tier II Technical to add the subnet information to the CWDB. Because the responsibility for issuing IP addresses is sanctioned to the Service Desk Tier II Technical, they also update the subnet information in CWDB. Figure 2 shows an overview of the current IP addressing process.

![Figure 2. Initial Basic Model of Current IP Addressing Process](image-url)
New devices or relocated devices that move to a new location require an IP address to connect to a proper subnet in that area. As seen in Figure 2, IP requests can be routed to the Service Desk Tier II Technical in two ways, through their respective IT Department or Desktop Support. Workstations and medical devices require different IP addresses, and different locations belong to different subnets, having this accurate information is crucial to assigning a correct IP address. If the device and location information is not accurate, the Service Desk Tier II Technical may have to return the request and ask for the accurate device type and location. In either case, the Service Desk Tier II Technical is responsible for taking the information provided and assigning an IP address that connects the customer to the appropriate subnet. At times the Service Desk Tier II Technical cannot identify the correct subnet and might assign the customer an incorrect IP address. The customer then notifies the Service Desk Tier II Technical of the error and the Service Desk Tier II Technical must resolve the problem by themselves or request assistance from other groups.

Key Issues

The following key issues are the driving force of the project:
- Hospital customers report they receive incorrect IP addresses.
- Turnaround time takes more than a week to correct wrong IP addresses, which may disrupt customer workflow.
- UMHS workstations and medical devices require different kinds of IP ranges.
- Information in the CWDB and Remedy subnet database are inconsistent.
- Communication gaps between and within groups may delay IP addressing process

Goals and Objectives

The primary goals of the project are to eliminate the communication gaps between groups and to improve the current IP addressing process. To accomplish these goals, the team has identified the following objectives:
- Collect both anecdotal and numerical data about the current IP addressing process
- Understand the current work flow of the IP addressing process
- Determine root causes of the incorrect IP addresses
- Develop a future state with high first time accuracy and reduced turnaround time

Project Scope

This project encapsulated the IP addressing process for both core workstations and other medical devices. The IP addressing process is defined to begin with a hospital customer request and ends when the customer is able to connect their related device to the desired network using the assigned IP address. The project also included the process of resolving incorrect IP addresses when they are assigned. The groups involved in this process include: Hospital customers, Department IT, Desktop Support, Service Desk Tier II Technical, EDEM, and Networking. The process is limited to requests for Static IP addresses that are needed to manually configure devices to the desired network.
The project did not include the process of activating the Ethernet wall jack and acquiring a cable to connect the device to an appropriate wall jack. This project also does not include customer requests for Dynamic Host Configuration Protocol (DHCP) IP addresses.

Methods

The project data was broken down through two methods: mapping the current state map and analyzing the historical IP request data. Each method comprised data collection and data analysis components. The main goal of mapping the current state and analyzing the historical IP request data was to measure first time accuracy and identify causes of incorrect IP addresses. The process of mapping the current state set the foundations for the analysis of the historical IP request data, since the accurate understanding of the current state helped the project team build enough expertise to filter and flag the historical data.

Mapping the Current State

To build an initial understanding of the current state, the project team interviewed representatives from the groups involved in the current IP addressing process. The project team then compiled the interview results to draft the first Value Stream Map (VSM), which was used as the starting point for the second step, the VSM group session.

Step 1: Personal Interviews of Groups Involved in Current IP Addressing Process

The project team interviewed representatives from each group in the current IP addressing process to understand the current state of the IP addressing process, as well as identify information and communication gaps between groups. Interviews were organized with members from five groups (except for Hospital customers) in the current IP addressing process, with ten total interviews from February 5th through February 20th. The following list shows the groups interviewed and the number in the parentheses is the number of interviewees from each group:

- Department IT - Pathology (1)
- Desktop Support (1)
- Service Desk Tier II Technical (2)
- EDEM (1)
- Networking (5)

The representatives interviewed were specifically selected by the manager of the Networking group (project client) for the individual’s expertise of his or her group’s involvement in the current IP addressing process. The interviews provided the project team with each group’s knowledge of the current process and their opinions on its effectiveness. The project team used a standard question list to eliminate wording bias and ensure interview consistency while conducting the interviews (see Appendix C). During some interviews, the interviewees walked through their portion of the process while explaining each step, which provided the project team with realistic process observation. Each interview was scheduled for an hour and information recorded was distributed among the project team for further analysis.

Using information gathered from interviews, the project team initially developed a detailed flowchart of the current IP addressing process. The flowchart showed the groups, decisions, and systems involved in the process (see Appendix D). This flowchart was then used as a starting
point to validate the understanding of the current process model and provided the focal point for a live value stream group session.

**Step II: Value Stream Map Group Session**

Using the process flowchart developed from the interviews, the project team drafted an initial VSM of the current IP addressing process (see Appendix E). The drafted VSM was used as the starting point for the VSM group session held on Wednesday, March 13th. The VSM group session was used to help validate the understanding of the current IP addressing process, facilitate communication between groups, and clarify any points of confusion in the current IP addressing process. Representatives from each of the groups involved were invited. The following list shows the groups that attended and the number in the parentheses is the number of attendees from each group:

- Department IT - Pathology (1)
- Desktop Support (1)
- Service Desk Tier II Technical (3)
- Networking (2)

At the beginning of the VSM group session, the project team distributed the VSM draft to the attendees and mapped the draft process on a whiteboard in the front of the room. During the session, the project team led discussion and gathered input from each group to iteratively refine the value stream on the whiteboard, noting differences between group’s understandings of process steps. The project team discussed the IP addressing workflow step by step to capture the current process accurately.

From the live VSM group session, the project team synthesized the information to develop a more accurate current VSM. The VSM results were used to focus the analysis of root causes of incorrect IP addresses. As part of the recommendations, the project team incorporated feedback from the session to propose a future IP addressing process.

**Analyzing Historical IP Request Data**

The Networking group provided the project team Excel books with data on Remedy tickets from six category-class-item combinations commonly selected to request an IP address on two separate dates. An example of the Remedy ticket can be seen in Appendix B. The time range for the database is from March 16th, 2005 to March 28th, 2013. The following list shows the six category-class-item combinations determined through the interview process and the VSM group session and the number in the parentheses is the number of Remedy tickets.

The following three classes have Category “Infrastructure” and Item “Any”.

- New IP Address (547)
- IP Address (947)
- Networking (44)

The following three items have Category “Desktop Support” and Class “Core Image”

- Term ID Request (826)
- IP Conflict (125)
- IP Address Change Request (448)
The Service Desk Tier II Technical group also provided records for 3800 items from the CWDB related to IP requests. Originally, the CWDB was intended as a tool to cross-reference the data captured in the Remedy ticket database. However, the project team lacked the technical background to be able to navigate through all information that was captured by the CWDB. The CWDB log excerpt was later disregarded, providing limited value to identifying IP address attributes. The Remedy ticket database was established as the main source for quantifying the process metrics.

Selecting Key Fields
The original data received had 357 fields. The groups who use the Remedy system seldom used the majority of the fields. From the fields used most frequently (more than 95%), 10 key fields were selected based on Networking’s expertise and for the purpose of the project to determine the root causes of incorrect IP addresses, which are listed in Table 2 below:

<table>
<thead>
<tr>
<th>Key Field</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>The unique identifier for each Remedy ticket</td>
</tr>
<tr>
<td>Building</td>
<td>Building location of the requester (not necessarily the room location of the device)</td>
</tr>
<tr>
<td>Category</td>
<td>Categorization of a Remedy ticket as different kinds of issues</td>
</tr>
<tr>
<td>Class</td>
<td>A subset of the a category</td>
</tr>
<tr>
<td>Closed Date</td>
<td>The date and time when a Remedy ticket is closed</td>
</tr>
<tr>
<td>Create Date</td>
<td>The data and time when a Remedy ticket is created</td>
</tr>
<tr>
<td>Description</td>
<td>A textbox that the requestor use to describe the situation and provide the necessary information</td>
</tr>
<tr>
<td>Resolved Date</td>
<td>The data and time that a Remedy ticket is resolved. A Remedy ticket can only be resolved by whom request an IP address</td>
</tr>
<tr>
<td>Room</td>
<td>Room location of the requester (not necessarily the room location of the device)</td>
</tr>
<tr>
<td>Worklog</td>
<td>A textbox that tracks changes to an individual Remedy ticket.</td>
</tr>
</tbody>
</table>

These key fields contained important information for calculating turnover time and identifying causes of incorrect IP address assignments.
 Separating Worklog Field  

The worklog was identified to be the most useful field since it shows how each ticket develops from the Create Date to Closed Date. As Figure XX shows, the worklog contains every activity that happens to one ticket. The worklog field is an open text box that appends every change to a ticket each time the ticket is updated, which causes difficulties for filtering through the data. Therefore, the worklog entries were separated by each time the ticket was updated, to permit filtering the out-of-scope data and creating flags. An example of separated worklog is shown in Table 3.

Table 3. Example of Worklog Separated into Individual Timestamp Entries

<table>
<thead>
<tr>
<th>ID</th>
<th>Time Stamp</th>
<th>Log Entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>1139921</td>
<td>1/21/09 3:27 PM</td>
<td>1/21/2009 3:27:35 PM ashaver  The Group field has been changed to ISO(-)NSS(-)TECHSECU  The Incident field has been changed to No  The Priority field has been changed to Normal  The Publish In Web field has been changed to No  The Urgency field has been changed to Normal  The Status field has been changed to New</td>
</tr>
<tr>
<td>1139921</td>
<td>1/21/09 4:04 PM</td>
<td>1/21/2009 4:04:29 PM jsimonis  The Staff Assigned field has been changed to JAMES SIMONIS  The Status field has been changed to Assigned</td>
</tr>
<tr>
<td>1139921</td>
<td>6/20/12 3:45 PM</td>
<td>6/20/2012 3:45:37 PM jsimonis  The Resolution Details field has been changed to: not sure what was done for this request. closing old ticket.  The Status field has been changed to Resolved</td>
</tr>
<tr>
<td>1139921</td>
<td>6/23/12 1:00 AM</td>
<td>6/23/2012 1:00:30 AM AR_ESCALATOR  Automatically Closed by Remedy Escalator  The Status field has been changed to Closed</td>
</tr>
</tbody>
</table>

 Filtering and Flagging Historical Tickets of Interest  

The project team then filtered all this Remedy data to find 2211 IP address requests within the project scope. Tickets for DHCP address requests and tickets requesting the addition, removal, or update of subnet information in the CWDB were filtered out. The worklog entries were then flagged for key identifiers of requests that resulted in escalation to other groups or an incorrect IP address assignment. Table 4 below lists the search phrase to count, calculated fields, and the corresponding implications of these fields. For each calculated field, the project team counted the number of times the search phrase occurred in worklog entries for each ticket.
Table 4. Search Phrases used to Identify Problematic Tickets

<table>
<thead>
<tr>
<th>Search Phrase to Count</th>
<th>Calculated Field</th>
<th>Implication</th>
</tr>
</thead>
<tbody>
<tr>
<td>“The Group field has been changed to”</td>
<td>Total Group Transfers per Ticket</td>
<td>Excessive transfers may indicate the Service Desk Tier II Technical did not have enough initial information to assign a correct IP</td>
</tr>
<tr>
<td>“ISO(-)NSS”</td>
<td>Transfers to Networking per Ticket</td>
<td>Transfers to Networking likely indicate the Service Desk Tier II Technical did not have enough information to assign a correct IP or they need help resolving an incorrect IP</td>
</tr>
<tr>
<td>“ISO(-)TOS(-)CORE(-)ROLLOUT”</td>
<td>More than One Transfer to Service Desk Tier II Technical per Ticket</td>
<td>Transfers to Service Desk Tier II Technical more than once indicate they did not have enough initial information to assign a correct IP</td>
</tr>
<tr>
<td>“The Group field has been changed to DES(-)RCD”</td>
<td>Transfers to Desktop Support per Ticket</td>
<td>Transfers to Desktop Support more than once indicate they did not have enough initial information to assign a correct IP</td>
</tr>
<tr>
<td>“IPV4”</td>
<td>Number of IPV4’s Assigned per ticket</td>
<td>More than one IPV4 assigned per ticket may indicate the first IP address assigned did not work</td>
</tr>
<tr>
<td>“The Status field has been changed to Resolved”</td>
<td>Number of Times Status Changed to Resolved per ticket</td>
<td>Tickets changed to resolved more than once may indicate the first IP address assigned did not work</td>
</tr>
<tr>
<td>“The Status field has been changed to Closed”</td>
<td>Number of Times Changed to Closed per ticket</td>
<td>Tickets changed to closed more than once may indicate the first IP address assigned did not work</td>
</tr>
</tbody>
</table>

The project team counted the number of tickets with each of these search phrases to determine the volume and fraction of total tickets with the related attributes. Because there were no clear identifiers of requests, which resulted in an incorrect IP assignment, multiple calculated fields were created to capture as many instances as possible. The historical data was expected to establish first time accuracy to set a baseline for the current state. This data also helped verify the accuracy of interview information and the VSM group session.
Findings and Conclusions

From the interviews, VSM group session, and historical data analysis, the project team identified four areas of concern with the current IP addressing process: (1) variation of many steps in the Current IP addressing process (2) excessive group transfers, (3) low first time accuracy and (4) problematic information with the Core Workstation Database.

Variation of Multiple Steps in the Current IP Addressing Process

The information gathered through the interviews and VSM group session indicates there is no standardized process for requesting or assigning an IP addresses. Figures 3, 4, and 5 display the overview and detailed sub steps of the IP addressing process established from the interviews and VSM group session.

UMHS customers can call their Department IT or Desktop Support to request an IP address. The Department IT or Desktop Support then fills out an IP Request Form or general Remedy ticket, which have different fields and implications within Remedy. One implication is the IP Request Form closes once an IP address is assigned and cannot be reopened if the address does not work. The historical data also demonstrates the general Remedy ticket has six or more categories that have been used by different groups to identify an IP request.

The completed forms are sent to the Service Desk Tier II Technical to identify the subnet from which to assign an IP to the requested device. However, some requests have inaccurate descriptions of the device type or location while other requests may lack this information altogether, which makes identifying the right subnet and assigning a correct IP address very difficult. To find the correct subnet, the Service Desk Tier II Technical frequently uses the CWDB, the Remedy subnet database, another excel database derived from Remedy, and even hospital building maps, as shown in Figure 4.
At times the CWDB is inconsistent with the Remedy subnet database, which may result in an incorrect IP address assigned from a wrong subnet. In order to resolve incorrect IP addresses, the Service Desk Tier II Technical may transfer the ticket to Networking or other groups, not always understanding other groups’ responsibilities in the IP addressing process, as shown in Figure 5. Resolving an incorrect IP address often wastes time and effort from multiple groups and may perpetuate the delay of getting the device connected to the proper network.

Figure 5. Attempt to Connect Device with IP and Error Correction Process Details
The current IP addressing process clearly has many steps that could lead to an incorrect IP address being assigned: the request might come in the wrong category, the request may have inaccurate or missing information, the subnet databases may have differing or outdated information, and the hospital building maps can be difficult to navigate. From the interviews, the project team also noted that different workers may use different combinations of lookup methods. The overarching problem is the lack of standardized processes from the beginning to end of an IP address request. Each non-standard step provides the opportunity for interpretation and consequently human error. Incorrect IP addresses are the accumulated effect of the variation in different steps of the current IP addressing process.

**Low First Time Accuracy**

The Networking group also identified certain transfers between groups that would indicate a problem with the request including: (1) any transfers to Networking, (2) transfers to the Service Desk Tier II Technical more than once, and (3) transfers to Desktop Support more than once. Transfers to these groups point to the problem of assigning an IP address correctly with the information received the first time. Figure 6 below shows the volume and fraction of tickets with these transfers.

![Figure 6. Fraction of Requests Transferred to Groups Indicating Low First Time Accuracy](image)

A ticket transferred to the Networking group usually indicates the Service Desk Tier II Technical group needs assistance in selecting the correct subnet from which to assign an IP address. Ticket transfers to the Service Desk Tier II Technical or Desktop Support more than once point to inadequate or missing information in the request. Again, this could result from a poor request or poor database information, but in either case an incorrect IP address might be assigned. Poor initial requests also indicate communication gaps exist between the requesters and the Service Desk Tier II Technical, since the requesters do not understand what information the Service Desk Tier II Technical exactly needs.

Transferring tickets to Networking has become a regular response to identifying the correct subnet since they have the most expertise to identify the correct subnet from which to assign an IP address, but their time is dedicated to creating and managing the networks. The Service Desk
Tier II Technical should be able to assign an IP address correctly without contacting Networking. Better device, location, and subnet information is needed in both the request and subnet databases to help improve the Service Desk Tier II Technical’s first time accuracy of assigning IP addresses. The Service Desk Tier II Technical also needs a method for tracking IP request problems with specific device types or locations and thereby reduces escalating the same questions to other groups.

**Excessive Group Transfers**

Since the quality of the first time communication is low, groups frequently have to transfer the ticket multiple times among groups in order to collect the enough and accurate information. The historical data was analyzed to determine the total number of groups involved per ticket. The volume and percentage of tickets involving varying numbers of groups can be seen in Figure 7. The optimal number of group transfer is two.

![Figure 7. Frequency and Percentage of Requests with Varying Number of Group Transfers](image)

The excessive number of groups involved in IP requests indicates the Service Desk Tier II Technical group does not have all the information necessary to assign an IP because they are transferring the ticket back to the requester for clarification or to other groups for assistance determining the correct subnet from which to assign the IP address.

Because the Service Desk Tier II Technical works evening and night shifts, each transfer to another group can add a day to the IP addressing process. Not having the right information or knowing who to contact when certain problems arise lengthens the time until a customer is able to connect to the right subnet and network. The excessive transfers further demonstrate the need for standardized processes to provide consistent information to the Service Desk Tier II Technical.

**Problematic Information within CWDB**

Information gathered from the interviews pointed to multiple issues with the CWDB that might be causing incorrect IP addresses to be assigned including:
The primary purpose of the CWDB is tracking Core Workstations, not IP addresses
Subnet information was frequently inaccurate or outdated
Subnet information was frequently misaligned with Remedy subnet database
Most subnets have little building information other than the name
Lack of active method to identify IP addresses that are already being used
Lack of standard naming conventions with regards to building names, some specific examples shown in Table 5.

Table 5. Examples of Inconsistent Naming Convention within the CWDB

<table>
<thead>
<tr>
<th>Building Name</th>
<th>Different Names Used in Tickets and Database</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taubman Medical Library</td>
<td>TL, Taubman Library</td>
</tr>
<tr>
<td>University Hospital</td>
<td>UH, University Hospital,</td>
</tr>
<tr>
<td>North Campus Research Complex</td>
<td>NCRC, North Campus Research Complex</td>
</tr>
<tr>
<td>Argus Building 1</td>
<td>Argus BLDG. 1, Argus I</td>
</tr>
<tr>
<td>Traverwood Building 1</td>
<td>Traverwood, Traverwood I</td>
</tr>
</tbody>
</table>

Because the CWDB is not dedicated to tracking IP addresses, the database is not structured to sufficiently store subnet information. Within the CWDB and Remedy, multiple groups can add or change information easily without checking the existing information. No point of authority is established to make sure changes made in one database are also made in the other and new entries are not duplicates of existing records. These facts account for many cases when information is not accurate, updated, or well-managed within the CWDB. From the interviews, many interviewees implied that the problematic information in CWDB is a huge obstacle for the Service Desk Tier II Technical to locate the right subnet. The problematic information in CWDB mainly stems from poor database management and the lack of a single centralized database with subnet information.

**Recommendations**

This section provides recommendations to improve the first time accuracy and reduce the turnover time of the current IP addressing process. The recommendations will follow from the project team’s conclusions, which are summarized below:

- The current IP addressing process has no standard methods for both requesting and assigning an IP address.
- The current IP addressing process has no standard communication flow to reduce transfers between groups and improve group interaction.
- Subnet information in Remedy and the CWDB is not accurate and consistent across both databases to ensure first time accuracy of identifying the correct subnet and assigning an appropriate IP address.
The current IP addressing process has no standard method for the tracking IP request errors to reduce escalation of the same question and improve first time accuracy of assigning an appropriate IP address.

The project team developed a future VSM that can be seen in figure 8 below. The future VSM includes a standard IP request method, centralized IP database, standard communication flow, and standard error correction process, which will be expanded in the succeeding sections.

**Implement Standard IP Request Method**

IP requests are routed to the Service Desk Tier II Technical in two possible ways: through the IP Request Form or the general Remedy ticket. Instead of choosing to only use one or the other, the project team recommends a standardized IP request method that includes updated dropdown fields similar to those in the IP Request Form and the ability to transfer the tickets between groups like a general Remedy ticket. One possible solution that could provide both qualities would be an IP Request web form. A standard web form would decrease IP request information variation by requiring fields for all necessary information for the Service Desk Tier II Technical to accurately assign an IP address the first time. Standard requests would also reduce transfers to other groups as first time accuracy is improved. In addition, a web form could re-establish standard naming conventions for device types and locations. The reduction in request variation would improve the first time accuracy, reduce unnecessary transfers to other groups, and decrease the overall turnover time associated with current IP addressing process.

**Develop a Single Centralized IP Database**

The CWDB and the Remedy databases collectively store all of the IP request and addressing information. However, the CWDB and Remedy ticket databases do not store all of the IP request and addressing information consistently. This complicates the Service Desk Tier II Technical’s search for the correct subnet from which to assign an IP address. For this reason, the project team recommends changing to a single centralized database for subnet information. Figure 9 represents what the recommended standard search procedure for the appropriate subnet would look like with a centralized subnet database. With a centralized subnet database, the standard search process would be simplified and involve less iteration.
The project team recommends for short-term implementation that a standard procedure be put in place in order to update the data within both the CWDB and Remedy system. For long-term implementation, the project team recommends that a single centralized database system be established. Currently, the CWDB is not dedicated to tracking IP addresses and is therefore not the best database moving forward. With a single centralized information database, the Service Desk Tier II Technical would only have to consult one resource for locating the correct subnet. Whether a standardized procedure for updating the databases or a single centralized database is established, the project team believes the first time accuracy and turnover time associated with current IP addressing process will improve.

Create Standard Communication Flow
The groups involved in the current IP addressing process are not familiar with each other’s workflow. When problems arise, the groups involved in the current IP addressing process do not have a clear set of rules that designate which group should be contacted for help. The project team recommends that standard communication guidelines be established and agreed upon by all of the groups involved in the IP addressing process. Once these guidelines have been created, each group should know who to contact for a given issue. The project team believes that this will reduce the variability associated with the current IP addressing process, especially the error correction process, which would decrease unnecessary transfers to other groups and reduce the turnaround time.

Incorporate Standard Error Correction Process
The current IP addressing process lacks historical records of incorrect IP assignments. The root cause of some assignment issues pertain to unique circumstances that are never logged and captured. Without historical records of incorrect IP assignment issues, the same questions may be repeatedly escalated to other groups for assistance. The project team recommends establishing a standard error correction process to reduce repeated escalations of the same questions. Figure 10 provides the recommended standard error correction procedure to effectively resolve incorrect IP address assignments.
Figure 9 shows the Service Desk Tier II Technical may refer to the IP Request Problems Tracking System if they have a similar issue and can update the system with new issues as they occur. The IP Request Problems Tracking System would improve the first time accuracy, reduce unnecessary transfers to other groups, and decrease the overall turnover time associated with current IP addressing process.

**Expected Impact**

The recommendations provided will improve the first time accuracy, reduce unnecessary transfers to other groups, and decrease the overall turnover time associated with current IP addressing process. If the recommendations are implemented, the project team believes that the primary goals of improving the current IP addressing process and eliminating the communication gaps will be accomplished.
Appendix A: Snapshot of the IP Request Form

<table>
<thead>
<tr>
<th>Building Name 1</th>
<th>Room #1</th>
<th>Type of Equipment 1</th>
<th>Address Type 1</th>
<th>Assigned IP 1</th>
<th>Gateway 1</th>
<th>Mask 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Name 2</td>
<td>Room #2</td>
<td>Type of Equipment 2</td>
<td>Address Type 2</td>
<td>Assigned IP 2</td>
<td>Gateway 2</td>
<td>Mask 2</td>
</tr>
<tr>
<td>Building Name 3</td>
<td>Room #3</td>
<td>Type of Equipment 3</td>
<td>Address Type 3</td>
<td>Assigned IP 3</td>
<td>Gateway 3</td>
<td>Mask 3</td>
</tr>
<tr>
<td>Building Name 4</td>
<td>Room #4</td>
<td>Type of Equipment 4</td>
<td>Address Type 4</td>
<td>Assigned IP 4</td>
<td>Gateway 4</td>
<td>Mask 4</td>
</tr>
<tr>
<td>Building Name 5</td>
<td>Room #5</td>
<td>Type of Equipment 5</td>
<td>Address Type 5</td>
<td>Assigned IP 5</td>
<td>Gateway 5</td>
<td>Mask 5</td>
</tr>
</tbody>
</table>

Enter any special considerations that would delay a request. Requests for IP assignment will be targeted for completion within 1 business day from receipt.

Considerations: 

<table>
<thead>
<tr>
<th>Team</th>
<th>Status</th>
<th>Work Log</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Assigned To:  

Special Instructions: 

<table>
<thead>
<tr>
<th>IPAddress/Email</th>
<th>Created By</th>
<th>Last Modified By</th>
<th>Modified Date</th>
</tr>
</thead>
</table>

(If not submitter)
Appendix B: Snapshot of the general Remedy Ticket
Appendix C: Standard Questions for Interviews

Main Topics to Tell Groups Being Interviewed:
- We are trying to accurately capture the CURRENT STATE
- We are not inferring that your group is the problem
- We want to know how your group is involved in the IP addressing process
- We want to know what documents, systems, people are involved in your group’s steps
- We want to know their satisfaction with the process and if they can identify any root causes or key issues

1. How are you and your team involved in the IP addressing process?

2. What documents, systems, or other persons are used in your work?

3. What information do you need to successfully do your part?

4. Is there a standard procedure for your work in the process?

5. What is your opinion of the current process? (i.e. satisfied, frustrated) Can you rate the effectiveness of the process/workflow from 1 to 10? (10 being most efficient)

6. Can you identify any major issues and/or their possible causes?

7. What do you do when a problem arises? Who do you ask for help?

8. How long does it usually take to resolve an issue? A regular request?
Appendix D: Initial Current Process Flowchart

1. Call IT Helpdesk (Desktop Support)

2. Hospital User Requests IP Address

3. Call Department IT Group

4. Desktop Support

5. Department IT

6. Create "IP Request Form" or General Remedy Ticket

7. Service Desk

8. Create "IP Request Form" or General Remedy Ticket

9. Search for Correct IP Subnet

10. CWDB "Locate Subnet by Building"

11. Remedy Network-IP Subnet Matching

12. Remedy Building Subnet Excel DB

13. Hospital Building Maps

14. Find Correct Subnet?

15. NO

16. ?

17. YES

18. Find Available IP Address and Assign to Device

19. Send Remedy Ticket to User with IP Address

20. Error Correction Process

21. IP Address Correct?

22. NO

23. END

24. YES
Appendix E: Initial Current Process Flowchart