

UMICH Hosting Infrastructure Reports

UMICH 2012

1. Description

- To support the requirements that come with the roles of PREDICT Data Host (DH) and Data Provider (DP), the University of Michigan and Merit Network, Inc. maintain numerous computers in disparate locations. Our system administrators have designed, configured and deployed these hosts to provide high availability for data collection, indexing, curation, and distribution to researchers approved via the PREDICT vetting mechanism.
- As a general strategy, we separate collection, storage, and research infrastructure. Five span port network taps collect data from the Michnet Infrastructure. Data from these taps is aggregated at our collection infrastructure. Storage is provided by SAN storage attached to these collection boxes. A separate server is responsible for monitoring the collection and storage infrastructure. A limited storage and processing infrastructure is used for temporary storage and computation of datasets for researchers at the University of Michigan.
- Merit Network, Inc. was founded in 1966 to develop and promote advanced networking services for research and education. In the early ARPANET days, Merit developed and operated one of the first packet-switched data networks for computer timesharing. From 1987 to 1995, under contract from the National Science Foundation and in partnership with IBM and MCI, Merit engineered and operated the NSFNET backbone for research and education organizations throughout the United States. The success of the NSFNET led directly to the growth of the commercial Internet.
- Merits regional research and education network is largest IP network in Michigan, and is a major resource for targeted research deployments. Merits IP network provides Internet service to nearly one million individuals and transmits 1.1 billion packets per month. The Merit network includes a wide range of link types that include link speeds from T1 thru 10Gbps, a range of technologies and optical equipment such as CWDM and DWDM, and equipment from a wide array of network equipment vendors. The network backbone consists of a 10G fiber ring, which passes through the cities of Ann Arbor, Detroit, Lansing, Grand Rapids, Chicago, and Kalamazoo. The network is currently undergoing extensive expansion due to Merits participation in federal Broadband Technologies Opportunities Program which is funded via the American Reinvestment and Recovery Act (ARRA). The close relationship between Merits research and development and operations groups is an important asset, which greatly benefits our team. The cross-pollination helps ensure that Merits research and development activities are always tempered by a heavy dose of real world experience.
- The proposed research at the University of Michigan will be conducted in the Software Systems Laboratory (SSL). SSL serves as the focal point for interdisciplinary research on software systems and applications at the University of Michigan. SSL consists of 14 EECS professors and has strong research programs in security, networked and distributed systems, operating systems, fault-tolerant systems, and databases.
- The Software Lab houses several research testbeds, over 300 Intel-based workstations, and various hardware networking technologies. Gifts from Intel and Cisco to the faculty in the Software Lab have supplied the Lab with state-of-the-art equipment to aid in development and experimentation. The Lab currently houses sufficient equipment to set up a small but realistic

network testbed including: 5 enterprise-class Cisco routers, 10 Intel 10 Giga-bit Ethernet switches, and numerous 10/100/1000 Mb/s Ethernet switches. The Lab has access to the NSF-supported Internet2 and DARPA-supported CAIRN nationwide network testbeds.

- In addition, the lab has access to the Computer Aided Engineering Network (CAEN), which provides the College of Engineering with a comprehensive set of computing technologies that support its instructional, research, administrative and service missions. CAENs high performance desktop computers, up-to-date data network, software library, and over-all information and instructional technology environment improve the quality of education and research throughout the College. The computing environment is comprised of an integrated set of resources at the College, department, and lab levels that together total over 10,000 network-attached devices. CAEN-supported student computing labs provide over 1,000 desktop computers available to students on a drop-in basis, 24 hours/day. These computing labs offer an extensive array of software for engineering design and analysis, software development, and personal productivity. This lab environment is complemented by high-performance computing clusters maintained jointly by CAEN and the Center for Advanced Computing (CAC).

2. System Inventory

Merit Network, Inc.

- Data Collection Server
 - o OS: CentOS x86 64
 - o CPUs: 8 Cores (Dual Intel Xeon E5506 @ 2.13GHz, no HT)
 - o Memory: 32GB
 - o Storage: 200 GB HD (RAID 1) + 140TB of SAN storage (RAID6)
 - o Description: Netflow collector. Storage of archival Netflow data.
 - o Software: flow-tools
- Data Collection Server
 - o OS: CentOS x86 64
 - o CPUs: 8 Cores (Dual Intel Xeon E5506 @ 2.13GHz, no HT)
 - o Memory: 32GB Storage: 200 GB HD (RAID 1) + 180TB of SAN storage (RAID6)
 - o Description: Darknet, BGP, DNS collector. Storage of archival Darknet, BGP, DNS, darkhex, IMS-datasets, Departmental Netflow, syn-flood attack, SKAION, and other.
 - o Software: libpcap-based tool, quagga, rsyslog
- Data Collection Server
 - o OS: CentOS x86 64
 - o CPUs: 24 Cores (Intel(R) Xeon(R) CPU X5675 @ 3.07GHz)
 - o Memory: 94GB
 - o Storage: 32TB (RAID6)
 - o Description: Darknet IPv6 collector and analyzer
 - o Software: lippcap-based tool
- Disaster Recovery Server
 - o OS: CentOS x86 64
 - o CPUs: Two Quad-Core Xeon X5550 @ 2.67GHz
 - o Memory: 24GB

- Storage: 2TB (RAID1 of 2 2TB spindles) for OS, and 2x 10TB (each a RAID 5 of 6 2TB spindles)
 - Description: Disaster Recovery server for Netflow, DNS, BGP.
 - Software: flow-tools, quagga, rsyslog
- Data Monitor Server
 - OS: CentOS x86 64
 - CPUs: Virtual Server, 2 cores, Intel(R) Xeon(R) CPU X5650 @ 2.67GHz
 - Memory: 8GB
 - Storage: 50GB
 - Description: Monitor and dashboard of PREDICT collection
 - Software: Python programs, apache server, PHP, MySQL
- SPAN server
 - OS: CentOS x86 64
 - CPUs: 16 cores, Intel(R) Xeon(R) CPU E5530 @ 2.40GHz
 - Memory: 6GB
 - Storage: 300GB
 - Description: Netflow packet tap, Chicago
 - Software: fprobe, flow-tools
- SPAN server
 - OS: CentOS x86 64
 - CPUs: 16 cores, Intel(R) Xeon(R) CPU E5530 @ 2.40GHz
 - Memory: 6GB
 - Storage: 300GB
 - Description: Netflow packet tap, Chicago
 - Software: fprobe, flow-tools
- SPAN server
 - OS: CentOS x86 64
 - CPUs: 4 cores, Intel(R) Core(TM)2 Quad CPU Q6600 @ 2.40GHz
 - Memory: 3GB
 - Storage: 450GB
 - Description: Netflow packet tap, Chicago
 - Software: nprobe, flow-tools
- SPAN server
 - OS: CentOS x86 64
 - CPUs: 12 cores, Intel(R) Xeon(R) CPU E5-2630 0 @ 2.30GHz
 - Memory: 64GB
 - Storage: 1000GB
 - Description: Netflow packet tap, Chicago (not yet deployed)
 - Software: nprobe, flow-tools
- SPAN server
 - OS: CentOS x86 64
 - CPUs: 4 cores, Intel(R) Core(TM)2 Quad CPU Q6700 @ 2.66GHz
 - Memory: 3GB
 - Storage: 250GB

- Description: Netflow packet tap, Detroit
- Software: fprobe-ulong, flow-tools

University of Michigan

- Storage Server: SILO
 - Model: Dell C2100
 - OS: RHEL
 - MEM: 92GB
 - CPU: 2x (Xeon X5670 @2.93Ghz 6core)
 - Local Storage: 12x 2TB
 - SAS Disks Attached Disk Arrays: 4x (Dell MD1200 w/ 12x 2 or 3TB SAS Disks)
 - Total Usable Storage: 107TB
 - Description: Misc. storage and analysis server
- Storage Server: SILO2
 - Model: Dell R720xd
 - OS: CentOS
 - MEM: 128GB
 - CPU: 2x (Xeon E5-2670 @2.6Ghz 8core)
 - Local Storage: 12x 3TB
 - SAS Disks Attached Arrays: 4x (Dell MD1200 w/ 12x 3 or 4 TB SAS Disks)
 - Total Usable Storage: 154TB
 - Description: Misc. storage, backup, and analysis server

UMICH 2013

1. Description

- To support the requirements that come with the roles of PREDICT Data Host (DH) and Data Provider (DP), the University of Michigan and Merit Network, Inc. maintain numerous computers in disparate locations. Our system administrators have designed, configured and deployed these hosts to provide high availability for data collection, indexing, curation, and distribution to researchers approved via the PREDICT vetting mechanism. As a general strategy, we separate collection, storage, and research infrastructure. Five span port network taps collect data from the Michnet Infrastructure (Merit Network). Data from these taps is aggregated at our collection infrastructure. Storage is provided by Merit cloud storage services attached to these collection boxes. A separate server is responsible for monitoring the collection and storage infrastructure. A limited storage and processing infrastructure is used for temporary storage and computation of datasets for researchers at the University of Michigan.
- Merit Network, Inc. was founded in 1966 to develop and promote advanced networking services for research and education. In the early ARPANET days, Merit developed and operated one of the first packet-switched data networks for computer timesharing. From 1987 to 1995, under contract from the National Science Foundation and in partnership with IBM and MCI, Merit engineered and operated the NSFNET backbone for research and education organizations throughout the United States. The success of the NSFNET led directly to the growth of the commercial Internet. Merit's regional research and education network is largest IP network in Michigan, and is a major resource for targeted research deployments. Merit's IP network provides Internet service to nearly one million individuals and transmits 1.1 billion packets per month. The Merit network includes a wide range of link types that include link speeds from T1 thru 10Gbps, a range of technologies and optical equipment such as CWDM and DWDM, and equipment from a wide array of network equipment vendors. The network backbone consists of a 10G fiber ring, which passes through the cities of Ann Arbor, Detroit, Lansing, Grand Rapids, Chicago, and Kalamazoo. The network is currently undergoing extensive expansion due to Merit's participation in federal Broadband Technologies Opportunities Program which is funded via the American Reinvestment and Recovery Act (ARRA). The close relationship between Merit's research and development and operations groups is an important asset, which greatly benefits our team. The cross-pollination helps ensure that Merit's research and development activities are always tempered by a heavy dose of real world experience.

2. System Inventory

Merit Network, Inc.

- Cloud Storage Service:
 - o Total storage: about 400 TeraBytes distributed to 4 storage gateways as follows:
 - o Scgw-1: 97TB,
 - o Scgw-2: 96TB,
 - o Scgw-3: 97TB,
 - o Scgw-4: 96TB
 - o Software: NFS/CIFS

- Data Collection Server
 - o OS: CentOS x86 64
 - o CPUs: 8 Cores (Dual Intel Xeon E5506 @ 2.13GHz, no HT)
 - o Memory: 32GB Storage: 200 GB HD (RAID 1)
 - o Description: Netflow collector. Storage of archival Netflow data.
 - o Software: flow-tools
- Data Collection Server
 - o OS: CentOS x86 64
 - o CPUs: 8 Cores (Dual Intel Xeon E5506 @ 2.13GHz, no HT)
 - o Memory: 32GB Storage: 200 GB HD (RAID 1)
 - o Description: Darknet, BGP, DNS collector. Storage of archival Darknet, NTP DDoS, BGP, DNS, darkhex, IMS-datasets, Departmental Netflow, syn-flood attack, SKAION, and other.
 - o Software: libpcap-based tool, quagga, rsyslog
- Data Analysis Server
 - o OS: CentOS x86 64
 - o CPUs: 24 Cores (Intel(R) Xeon(R) CPU X5675 @ 3.07GHz)
 - o Memory: 94GB
 - o Storage: 32TB (RAID6)
 - o Description: Data and analyzer
 - o Software: libpcap-based tool
- Disaster Recovery Server
 - o OS: CentOS x86 64
 - o CPUs: Virtual Server, 8 Cores Intel(R) Xeon(R) CPU E5-2665 0 @ 2.40GHz
 - o Memory: 8GB
 - o Storage: 10TB
 - o Description: Disaster Recovery server for Netflow, DNS, BGP.
 - o Software: flow- tools, quagga, rsyslog
- Data Monitor Server
 - o OS: CentOS x86 64
 - o CPUs: Virtual Server, 2 cores, Intel(R) Xeon(R) CPU X5650 @ 2.67GHz
 - o Memory: 8GB
 - o Storage: 50GB
 - o Description: Monitor and dashboard of PREDICT collection
 - o Software: Python programs, apache server, PHP, MySQL
- SPAN server
 - o OS: CentOS x86 64
 - o CPUs: 16 cores, Intel(R) Xeon(R) CPU E5530 @ 2.40GHz
 - o Memory: 64GB
 - o Storage: 300GB
 - o Description: Netflow packet tap, Chicago
 - o Software: fprobe, flow-tools
- SPAN server
 - o OS: CentOS x86 64

- CPUs: 16 cores, Intel(R) Xeon(R) CPU E5530 @ 2.40GHz
- Memory: 6GB
- Storage: 300GB
- Description: Netflow packet tap, Chicago
- Software: fprobe, flow-tools
- SPAN server
 - OS: CentOS x86 64
 - CPUs: 4 cores, Intel(R) Core(TM)2 Quad CPU Q6600 @ 2.40GHz
 - Memory: 3GB
 - Storage: 450GB
 - Description: Netflow packet tap, Chicago
 - Software: nprobe, flow-tools
- SPAN server
 - OS: CentOS x86 64
 - CPUs: 12 cores, Intel(R) Xeon(R) CPU E5-2630 0 @ 2.30GHz
 - Memory: 64GB
 - Storage: 1000GB
 - Description: Netflow packet tap, Chicago
 - Software: nprobe, flow-tools
- SPAN server
 - OS: CentOS x86 64
 - CPUs: 16 cores, 2 Intel(R) Xeon(R) CPU E5-2665 0 @ 2.40GHz 8 Core(2 threads per core)
 - Memory: 66GB
 - Storage: 1000GB
 - Description: Netflow packet tap, Detroit
 - Software: fprobe-olog, flow-tools

University of Michigan

- Storage Server: SILO
 - Model: Dell C2100
 - OS: RHEL
 - MEM: 92GB
 - CPU: 2x (Xeon X5670 @2.93Ghz 6core)
 - Local Storage: 12x 2TB SAS Disks Attached
 - Disk Arrays: 4x (Dell MD1200 w/ 12x 2 or 3TB SAS Disks)
 - Total Usable Storage: 107TB
 - Description: Misc. storage and analysis server
- Storage Server: SILO2
 - Model: Dell R720xd
 - OS: CentOS
 - MEM: 128GB
 - CPU: 2x (Xeon E5-2670 @2.6Ghz 8core)
 - Local Storage: 12x 3TB SAS Disks
 - Attached Arrays: 4x (Dell MD1200 w/ 12x 3 or 4 TB SAS Disks)

- Total Usable Storage: 154TB
- Description: Misc. storage, backup, and analysis server

UMICH 2014

1. Description

- To support the requirements that come with the roles of PREDICT Data Host (DH) and Data Provider (DP), the University of Michigan and Merit Network, Inc. maintain numerous computers in disparate locations. Our system administrators have designed, configured and deployed these hosts to provide high availability for data collection, indexing, curation, and distribution to researchers approved via the PREDICT vetting mechanism. As a general strategy, we separate collection, storage, and research infrastructure. Five span port network taps collect data from the Michnet Infrastructure (Merit Network). Data from these taps is aggregated at our collection infrastructure. Storage is provided by Merit cloud storage services attached to these collection boxes. A separate server is responsible for monitoring the collection and storage infrastructure. A limited storage and processing infrastructure is used for temporary storage and computation of datasets for researchers at the University of Michigan.
- Facilities/Resources: Merit Network, Inc.
 - o Merit Network, Inc. was founded in 1966 to develop and promote advanced networking services for research and education. In the early ARPANET days, Merit developed and operated one of the first packet-switched data networks for computer timesharing. From 1987 to 1995, under contract from the National Science Foundation and in partnership with IBM and MCI, Merit engineered and operated the NSFNET backbone for research and education organizations throughout the United States. The success of the NSFNET led directly to the growth of the commercial Internet.
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2. System Inventory

Merit Network, Inc.

- Cloud Storage Services:
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- Software: NFS/CIFS
- Data Collection Server
 - OS: CentOS x86 64
 - CPUs: 8 Cores (Dual Intel Xeon E5506 @ 2.13GHz, no HT)
 - Memory: 32GB
 - Storage: 200 GB HD (RAID 1)
 - Description: Netflow collector. Storage of archival Netflow data.
 - Software: flow-tools
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 - OS: CentOS x86 64
 - CPUs: 8 Cores (Dual Intel Xeon E5506 @ 2.13GHz, no HT)
 - Memory: 32GB
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 - Description: Darknet, BGP, DNS collector. Storage of archival Darknet, NTP DDoS, BGP, DNS, darkhex, IMS-datasets, Departmental Netflow, syn-flood at- tack, SKAION, and other.
 - Software: libpcap-based tool, quagga, rsyslog
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- Memory: 6GB
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- Description: Netflow packet tap, Chicago
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 - Memory: 66GB
 - Storage: 1000GB
 - Description: Netflow packet tap, Detroit
 - Software: fprobe-ulong, flow-tools

University of Michigan

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UMICH 2015

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2. System Inventory

Merit Network, Inc.

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 - o scgw-2: 96TB

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- scgw-4: 96TB
- scgw-5: 96TB
- Software: NFS/CIFS
- Data Collection Server
 - OS: CentOS x86 64
 - CPUs: 8 Cores (Dual Intel Xeon E5506 @ 2.13GHz, no HT)
 - Memory: 32GB
 - Storage: 200 GB HD (RAID 1)
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 - Software: flow-tools
- Data Collection Server
 - OS: CentOS x86 64
 - CPUs: 8 Cores (Dual Intel Xeon E5506 @ 2.13GHz, no HT)
 - Memory: 32GB
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 - Description: Darknet, BGP, DNS collector.
 - Storage of archival Darknet, NTP DDoS, BGP, DNS, darkhex, IMS-datasets, Departmental Netflow, syn-flood at- tack, SKAION, and other.
 - Software: libpcap-based tool, quagga, rsyslog
- Data collection server
 - OS: CentOS x86 64
 - CPUs: 12 cores, Intel(R) Xeon(R) CPU E5-2630 0 @ 2.30GHz
 - Memory: 64GB
 - Storage: 1000GB
 - Description: Darknet data (v6)
 - Software: libpcap-based tool,
- Data Analysis Server
 - OS: CentOS x86 64
 - CPUs: 24 Cores (Intel(R) Xeon(R) CPU X5675 @ 3.07GHz)
 - Memory: 94GB
 - Storage: 32TB (RAID6)
 - Description: Data and analyzer
 - Software: libpcap-based tool
- Disaster Recovery Server
 - OS: CentOS x86 64
 - CPUs: Virtual Server, 8 Cores Intel(R) Xeon(R) CPU E5-2665 0 @ 2.40GHz
 - Memory: 8GB
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 - Description: Disaster Recovery server for Netflow, DNS, BGP.
 - Software: flow- tools, quagga, rsyslog
- Data Monitor Server
 - OS: CentOS x86 64
 - CPUs: Virtual Server, 2 cores, Intel(R) Xeon(R) CPU X5650 @ 2.67GHz

- Memory: 8GB
- Storage: 50GB
- Description: Monitor and dashboard of PREDICT collection
- Software: Python programs, apache server, PHP, MySQL
- SPAN server
 - OS: CentOS x86 64
 - CPUs: 16 cores, Intel(R) Xeon(R) CPU E5-2667 v3 @ 3.20GHz
 - Memory: 64GB
 - Storage: 100GB
 - NIC: Accolade Technologies, 4x10GE card
 - Description: Netflow packet tap, Chicago Equinix
 - Software: fprobe, flow-tools
- SPAN server
 - OS: CentOS x86 64
 - CPUs: 12 cores, Intel(R) Xeon(R) CPU E5-2643 v3 @ 3.40GHz
 - Memory: 64GB
 - Storage: 100GB
 - NIC: Intel XL710, 4x10GE
 - Description: Netflow packet tap, Chicago
 - Software: nprobe, flow-tools
- SPAN server
 - OS: CentOS x86 64
 - CPUs: 16 cores, 2 Intel(R) Xeon(R) CPU E5-2665 0 @ 2.40GHz 8 Core(2 threads per core)
 - Memory: 66GB
 - Storage: 1000GB
 - Description: Netflow packet tap, Detroit
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