MARCUS J. SCHRENK

9208 South Channel Dr. Harsens Island, MI 48028 (248) 505-0357

marcus.schrenk@insgroup.com λ **Webpage: www.insgroup.com** λ linkedin.com/in/marcus-schrenk-89b42218

Extensive experience as a leader whose management of strategic technical projects have delivered the deployment and support of advanced networking environments throughout North America, Mexico, Canada and Europe. Multiple diverse roles as network applications architect, manager, business owner, test/validation engineer, software engineer, and PMO/PM are required. This background has enabled the implementation of many critical large scale initiatives within manufacturing plants, data centers, medical centers/hospitals, warehousing, food processing, construction and other industries. The Integrated Network Solutions Group (INS Group) was founded in 1996, which has provided me a wide range of leadership opportunities and enhanced ability to simultaneously take on many large scale turn key projects.

PROFESSIONAL EXPERIENCE:

March 1996 to Present (President/Owner The Integrated Network Solutions Group (INS Group))

1. 2019 – 2020 INS Group Lab Data Center Enhancement:
   a. Upgraded and built out the INS Group lab with four new F5 BigIP Virtual Edition (VE) ADC's in a VMWare VSphere 6.0 environment. The four ADC's are broken out into a FW, a GTM and two LTM's in an HA active/standby setup. Setup an Ubuntu Linux server (bare metal) used primarily for DNS/Bind and Apache web services. There are also MS windows server 2003/2008/2012 running on VMWare VSphere 6.0 for application testing and simulating various data center test scenarios. The 2nd phase will be to integrate the lab with the AWS cloud to create a hybrid cloud environment. The lab is used to test/validate/stage customer environments.
2. 2016 – 2019 F5 LB Engineer:
   a. Used Kubernetes and Pivotal to help automate LB functions
   b. Have installed and setup LB VE edition LTM and GTM instances
   c. Have developed and deployed custom iRules
   d. Create custom profiles for monitoring, persistence, security protocols and services.
   e. Have used iApps templates to create custom application solutions
   f. Trouble-shooting complex application issues using tcpdump and Wireshark with the F5 plugin enhancement. Utilizing QKView/iHealth, Bash/Linux and TMOS to capture and evaluate system diagnostics and if necessary, engaging F5 support to help resolve more complex issues.
   g. Received many recognition awards from colleagues at GM for my dedication and flawless deployments, and even a couple from the Change Administration Board (CAB) manager. Giving kudo's for following the CAB process with excellent documentation, making their job much easier.
3. 2014 - 2016 GM Data Center Resource Manager:
   a. Developed a new service delivery system for Data Center service requests. Shortly after that led an initiative to migrate the DC, LB, DDI and WAN services to the GM's new Galileo system. Was also responsible for developing and managing a Cross Functional Red Team (CFRT) review process. DC Resource Manager responsible for assigning service requests to the engineering team and documenting the request metrics. Developed and maintained a Resource Tracker tool that was an integral part of our DC operations and reporting functions for Global Telcom. The Tracker tool played a key role in helping to manage the day to day DC operations.

4. 1996 – 2014 *Owner/President of The Integrated Network Solutions (INS) Group Inc. with Service Contracts at GM:*
   a. At its peak in 2010 and for several years after that The INS Groups gross revenue was over $4,800,000.00/yr.
   b. Account Manager on a *Tier 1 contract services account with GM*: On site at The GM Network Engineering Center (NEC) for fifteen years. At its peak The INS Group had fourteen full time and seven part time contract services people on this account, myself included as the Network Architecture Team (NAT) Lead. The INS Group also provided fixed price contract services for software and networking projects.
      i. **Six Senior Network Engineers (85% of the GM NAT team)**
      ii. **Four Project Managers**
      iii. **One Logistics Manager**
      iv. **Two Logistics/Warehouse support personnel**
      v. **One Senior financial controller**
      vi. **Three software developers (T&M and Fixed Price Projects)**
      vii. **Four WLAN surveyors (T&M and Fixed Price Projects)**
      viii. **Network Engineers responsibilities:**
         1. **Network architecture,**
         2. **Template development: configuration/testing/deployment/Gold Build/design templates,**
         3. **Standards development**
         4. **Network staging**
         5. **Network deployments**
         6. Logical and physical gold build documents (GBD's).
      ix. The NAT team also supported and monitored GM's North American networks.

x. Software development:
   1. VB for Excel programs that automated the entire Cabletron design template.
   2. VB for Excel program that took raw location data and assigned end devices to telecommunications closets (TCs) and charted the locations.
   3. Automated bill of materials (BOM) written in VB
   4. Numerous other programs to help automate and manage NEC processes.

c. *Hospitals & Medical Center WLAN and Switch Route network deployments/upgrades*
   i. Architected, surveyed, designed, configured and deployed WLAN WVoIP capable networks in over 60 hospitals and medical centers. Many of these projects also required LAN/FW, WAN and physical layer upgrades as well. The networks deployed also met the stringent WLAN requirements of the Paragon HMS (hospital management system) that was used at the majority of these hospitals (McLaren Healthcare). The Paragon system as well as the WVoIP phones are production critical pieces of these health care facilities.
   ii. Total WLAN coverage square footage deployed - over 90 million square feet

d. *GloStream Health Care EMR (electronic medical records)/HMS systems*
   i. *Designed deployed these systems at physician offices and medical centers.*

e. *Designed and deployed more than 60 WLAN and switch route based networks in Manufacturing, Warehouses, Office Buildings, Food Processing, outdoor WLAN mesh and other environments.*
   i. *Indoor/outdoor WLAN coverage deployed - over 75 million square feet*

f. *Total employees twenty five*

5. 2012 – 2013 GM Push to Talk (PTT) Over WLAN/Cellular:
   a. This was a high visibility strategic initiative to replace the existing legacy production critical PTT Sprint/Nextel Motorola radio systems at 30 US manufacturing facilities. AT&T's 4G LTE/WLAN PTT solution was selected to replace the EoL Sprint/Nextel system. The AT&T solution used standard ruggedized PTT capable Smartphones that could run over 4G, WLAN, DAS or Metro-Cells. GM's manufacturing production critical WLAN networks at that time were autonomous (non-controller based) and not WVoIP capable. So the key deliverable for this project was to convert all 30 facilities to controller based WLAN WVoIP capable networks, a requirement of AT&T's 4G LTE PTT solution. Since the Sprint/Nextel solution was being totally abandoned/replaced the project also required over 20,000 new smart phones. The project started in 10/2012 with an immoveable end date of 6/30/2013, when the Sprint/Nextel service contract ended. When the project was completed the PTT Team had deployed over 180,000,000 square feet of controller based WLAN WVoIP coverage, 20,000 AT&T Smartphones, 4200 AP's, 60 WLAN Controllers, 800,000' of Cat 6 cabling and many long weeks and weekends were put in by the PTT Team, with ZERO downtime or lost units! This was a dual role project in which I was the Technical architect/lead and PMO with a team of six network engineers and six PM's. Monthly reporting of this project went to the board level.

6. 2000 – 2007 Kentshire Classic Homes (KCH) Owner/Builder:
   a. This was a family owned construction business that at its peak had $25,000,000.00 of properties and existing homes under construction.

7. **1996 – 2014 GM Senior Network Architecture Team (NAT) Lead**:
   a. **For the last eighteen years as the NAT lead element owner (EO)/SME successfully deployed of over 400 network projects with no outages or lost units!** NAT team lead responsible for developing and validating the network architecture of advanced technology networks to be deployed throughout NA, Mexico, Canada and Europe. These projects included Assembly, Powertrain and Stamping plants, Parts Warehouses, Global Data Centers and Caching Centers, Renaissance Center, GM Tech Center, Milford Proving Grounds, Toluca (Mexico) and Russelsheim (Germany) campuses, GM NY Treasurer's Office, and Product Development/Engineering sites. Many of these projects replaced/updated the sites entire network. As lead EO/SME was responsible for all technical aspects of a project. A typical project includes requirements gathering, network design, design validation testing, detailed design reviews, physical infrastructure, WLAN, VoIP/WVoIP, routing/switching, WAN, security, load-balancing (layers 4-7) network services, industrial networking, integration with plant floor controls networks, application integration, deployment technical cut-over support, system staging (at NEC staging center), UAT (performed by NEC lead, PM, build staff and customer before shipping to site), audits of site physical and logical wired/wireless infrastructure.

   b. A secondary but no less important role was develop/test/validate/approve new network technologies and the architectures to be deployed at GM manufacturing facilities worldwide. Lead IT industrial controls architect working in concert with the manufacturing Conveyors Controls Robots and Welding (CCRW)/Industrial Ethernet Controls Network (IECN) team to develop/validate/approve EthernetIP technologies and products that would be deployed first in North America and then globally in all GM manufacturing facilities.

8. **Network architecture, template and standards development**:
   a. Developed logical and physical gold build documents (GBD's).
   b. Developed CCRW plant floor industrial switch to IT backbone architecture validation/POC testing templates
   c. Developed NEC architecture validation/POC testing templates

9. **1996 – 2014 Functional/Validation/Proof of Concept (POC)/Regression testing**: This is a critical/integral part of developing and validating network architecture before release to production. As a NAT engineer assigned to validate a new architecture responsible for creating the test plans, setup/configuration of all electronics, test hardware (sniffers, Chariot traffic generation/simulation tools), PLC's, IT Applications, executing the test plans, and project management. Following are some examples of testing/validation projects.
    a. Meraki Cloud Controller and AP feature validation testing: The goal is to test the functionality and operation of the Meraki MCC. The scope of this testing is to verify all functionality/features called out in the Meraki Cloud Controller Product Manual (MCC-PM) operate as described.
    b. GM CCRW Global Common Components List (GCCL) evaluation testing, POC and RFQ development: This was a high visibility project (board level) that would determine which industrial Ethernet switch vendors would be on the GM GCCL for manufacturing. The primary purpose of this testing is to assist CCRW in the selection of a switch vendor for plant floor controls Ethernet networks that can seamlessly interface (no gateways, protocol convertors, etc.) to the IT backbone network. This testing was done three years after the NACCL testing and essentially follows the same format and scope as the NACCL testing project in the next section. There were improvements made to the test plan and environment that resulted in more efficient execution of the GCCL testing. Aside from that it was essentially the same.
    c. GM CCRW North American Common Components List (NACCL) evaluation testing, POC and RFQ development: This was a high visibility project (board level) that determined which industrial Ethernet switch vendors would be allowed to bid on the GM NACCL for manufacturing. The primary purpose of this testing was to validate that a switch vendors industrial Ethernet networks seamlessly interoperate (no gateways, protocol convertors, etc.) with CCRW controls and the IT backbone network. Following is the project scope of work:
        i. Developed the project time-line and managed all aspects of the project.
        ii. Created the industrial switch requirements document.
        iii. Pre-evaluation and selection of industrial switches for evaluation and testing
        iv. Developed an industrial to enterprise switched Ethernet architecture for NA manufacturing.
        v. Setup the NEC Lab for industrial Ethernet validation testing.
        vi. Develop test plans to validate the architecture in Cisco, Cabletron and combined Cisco/Cabletron environments; These tests validated that each network protocol was implemented per the protocol specifications. sniffer traces were used extensively to prove this.
        vii. Setup and configure the test environment
        viii. Assist switch vendors in setting up their equipment, understanding the test plans and how they will be evaluated.
        ix. Execute the Test Plan for each vendor.
        x. Develop an Industrial Switch Management Process
        xi. Evaluate and Recommend Support Tools for the industrial network switches.
        xii. Perform Cost Analysis of EthernetIP vs. ControlNet.
        xiii. Develop Industrial Switch Bid Package
        xiv. Compile Lessons Learned, Best Practices and project documentation.
    d. Multicast Testing to develop multicast architecture for GM manufacturing: Prior to this project GM networks didn't utilize multicasting so applications that required group communication typically used broadcasting. This type of environment required helper addresses to span VLANs and were becoming increasingly difficult to manage and degraded plant floor communications. It had become clear that a multicast solution was required. Multicasting is a much more efficient means of communication but a multicast architecture has not been developed within GM at this time. However additional challenges could also be encountered when deploying multicast in a mixed network vendor environments. New product programs Orion, Lordstown, Oshawa Assembly Lansing Campus and Tonawanda Powertrain had mixed legacy vendor networks that need to share application data. These are much more complex environments that are not fully understood and needed to be evaluated. The primary purpose of this testing was to develop an efficient and robust multicast architecture for GM manufacturing facilities.

    e. VoIP Testing: Ensure consistent voice quality for IP Telephony under maximum network load and/or resource constrained conditions. Document quality improvements with QoS policy vs. a non-QoS enivrement. Measure and evaluate the impact of prioritized VoIP traffic on the performance of existing application traffic. The end goal of this testing is to come up with the proper setup and configuration for VoIP in GM office environments and develop deployment templates.

1983 – 1996 Software Systems Development, Engineering, Design & Deployment:

11/1995 – 03/1996 Independent Contractor to ImageTech Inc. Southfield, Mi. 48034:

Senior Project Engineer: Responsible for imaging systems software development, hiring personnel, Administering a Novell LAN and Wildcat BBS, customer support, and configuring imaging hardware (scanners, optical drives, CD-ROMS, etc.). ImageTech is a developer and supplier of scanning/imaging/OCR software for high speed scanning/imaging equipment.

01/1991 - 08/1995 Independent Contractor to Beta Tech Inc. Roseville, Michigan 48066:

Lead Senior Software Project Engineer: Solely responsible for the software design, development and implementation of GM's MAP/OSI Alignment Information System (AIS). There were many technical pieces required in development of this application. Custom network protocols for communication between AIS MAP to TCP/IP based apps, AIS MAP to GM FLEX, user interface was developed with X windows, ORACLE DB, ISI Unix and C were required to develop the GM AIS system. AIS gathers front end alignment data from various systems on the plant floor and interacts with the controls PLC's that ultimately install/align a vehicles front end. This system operated in

three modes; auto, semi-auto and manual, and required real time communications to GM's FLEX vehicle sequencing application and the AIS PLC's. Configuration and Reporting is done from remote access terminals (RAT's) that are PC's running windows 3.1 with X emulation software.
The pre-production functional test plan for the AIS required over 600 test scenarios to pass before the system could be approved for operation in GM FLEX based Assembly plants. The GM test lab only had two connections available to the FLEX system which was affecting our timeline. So in order to get back on track and be able to test the program/application logic, I wrote a FLEX and PLC simulator. This enabled testing the majority of the test scenarios and saved a significant amount of time on testing by enabling many of the scenarios to be grouped and run in batches, essentially automating the testing process.
Lead Senior Software Project Engineer: Responsible for the software design, development and implementation of Chrysler's new ANDON line stop light system at their Sterling Heights Assembly Plant (SHAP). The system runs on a VAX/VMS 8600 and was written with C and RMS. The ANDON system gives people on the line the ability to stop the line and repair problems or report a defect to be repaired later. The system is made up of several hundred ten button pendants spread throughout stations on the assembly line. Several times a day the system will pull down all the station trouble codes from the SHAP mainframe to the local DB and associate the codes with the proper buttons on each pendant. So during normal operation a line worker that discovers a production related issue will select/press an appropriate button to trigger a trouble message on the ANDON system. Depending on the issue any number of scenarios could be executed, from just reporting the issue to the ANDON system up to shutting down the section of the line that the problem occurred. In all cases other than just reporting the line worker has a fixed period of time to resolve the issue and then push the resume/complete button which will restart the line if necessary. The system also communicates to user terminals, line control PLC's, lights, Marquees and buzzers over RS232 lines using a proprietary protocol.
Lead Senior Systems Engineer: Wrote the entire user interface, database and controlled all updates to the station LCD displays (using C and DEC RMS)for Chrysler's performance feedback system (PFS), that was implemented at their new Jeep Cherokee Plant (1992). This system replaced the old track sheet system used for building vehicles in their assembly plants (similar to GM's FLEX system). The new PFS system consists of data terminals/LCD displays that have build data down loaded from the PFS DB as vehicles move from station to station through the assembly line.
Lead Senior Systems Engineer: Wrote an inter process message router that uses TCP/IP to send messages across an Ethernet network, to Beta Techs Beta Cells to pass torque data between work cells connected to a GM MAP based system. This module allows a process to pass data to other processes on remote nodes. It maintains connections and returns status to the sending process. This process acts as both client and server. When a local message is being sent it spawns a client process to handle the transaction. When an incoming message is received it spawns a server process. The connections are then maintained and future messages between these nodes are managed by these processes. The same scenario is repeated if another node needs to pass data. This was an embedded processor application that required both assembly and C software development.

03/1988 – 11/1990 Independent Contractor to **Merit Systems Inc. Troy, Michigan 48908:**

Senior Systems Analyst - Software Engineer
Developed communication applications that used the Manufacturing Automation Protocol (MAP) and also worked on the journal management part of a file server. The Manufacturing Messaging Specification (MMS) was the MAP API along with TANDEM's TAL that were used to develop the server software. This server ran on a TANDEM computer under the GUARDIAN OS. Also wrote applications on TANDEM systems that utilized the FTAM protocol.
Senior Systems Analyst - Software Engineer
On contract to GM working for the MAP/OSI group at the Warren Tech center. Wrote many applications and test routines including the entire client side of a file server using MMS and C, which ran on a DEC VAX under VMS. Was also involved in setting up, installing, and troubleshooting MAP on PLC'S, robots and PC based systems. A primary role in this position was validation testing of MAP/OSI on vendor equipment to certify those vendors for use in GM manufacturing plants.
Senior Systems Analyst - Software Engineer
On contract to a Chrysler supplier to develop an imbedded processor automotive service bay hand held diagnostic system. The handheld diagnostic device would plug into a vehicles communications bus/network from which engine, transmission, and body diagnostics could be run. This system was built around a Motorola M68HC11 (6800 series processor) and the core applications were written using assembly language. My part of this project was to write the assembly code to create a fully functional transmission diagnostic module. The module required sophisticated highly efficient internal data structures and control functions to attain the desired system performance.

10/1983 – 02/1988 SOFTWARE ENGINEER Babcock & Wilcox Naval Nuclear Fuel Division (NNFD) Lynchburg, Va.

NNFD builds nuclear power generation units for 90% of the US Naval fleet. Some of the most sophisticated nuclear test equipment in the world was designed and built at this facility. Quality control is a paramount part of all processes and makes up 50% of the budget at NNFD. This was necessary in order to accurately verify/validate that the power generation units worked flawlessly. Failure was not an option!

*** Senior Automated Systems Analyst/Auditor Software Engineer:**
Responsible for verification and validation of automated QC for manufacturing systems. This position included writing functional and technical test plan, system diagnostics, reviewing system design from preliminary through final for accuracy and completeness, writing test software (typically assembly code) to validate manual and automated quality control systems/applications, and overseeing final systems/applications acceptance testing during deployment and system audits. A couple of the most interesting systems I worked extensively with were the X-Ray Photometry, Gamma scan systems, Water Void/Volume and programming coordinate measuring machines (CMM's) and CNC machining centers to share data to automate the machining process.

*** System Manager DEC (Digital Equipment Corp).**
Responsible for writing software utilities for file backup, system protection, system start-up, system generation and other daily requirements DEC PDP 11 series mid size computers.

*** Senior Automated Systems Software Engineer:**
Responsible for the all aspects of the software/electronics/controls design, development and commissioning of an automated water void/volume (AWVV) inspection system. This system was used to determine the amount of void and volume (material) in various sections of nuclear fuel cells/sub-assemblies. The mechanical piece of the system was a large structure with some similarities to a common CNC machining center. There was a superstructure with dual precision lead screws (positioning accuracy to .0001") that move a tooling plate/mounting device. The nuclear sub-assemblies would be attached to the tooling plate and readied for the inspection process. The basic inspection process was for the system to lower the sub-assembly into a large tank of water (3.5' X 14' which weighed about 2000 kilograms and sat on a highly precise weight scale accurate to +/- 3 grams) until the part touched the water and changed the weight on the scale by less than 10 grams. At this point the system would zero out all readings and the inspection process would begin. The system would move the component to various locations where weight readings would be taken. Each location was required to be located to within +/- .003" of the previous location and another weight reading would be taken. This process would repeat until weight readings were taken at all required locations.
There were no off the shelf solutions for measuring water level to a +/- .003 inch, so a method of measuring the water level in the tank to +/- .003" would require a custom solution. So after a couple weeks of serious head scratching the solution was to use a laser to measure the water level and tooling plate position. This was accomplished by directing the laser beam into a beam splitter which directed one beam to a retro-reflector attached to the tooling plate and the other beam to another retro-reflector set in a floating cone inside of a pitot tube that was mounted to the water tank that allowed water to flow into the tube.

Following are some of the compute, software and electronics components that made up this system:

a. DEC PDP 11/24 used for the user interface, communication to mainframe for dload of test scripts and uploading test results.
b. DEC PDP 11/21 (Falcon) single board computer and 6 slot backplane used for all controls and device communications.
c. Servo positioning motor used to drive the precision lead screws
d. HP Laser, beam splitter and retro-reflectors
a. Developed a dual axis IC counter using a wire wrap development board (The inter IC logic was then manually wire-wrapped on the board). This was used for capturing the tooling plate and water level pulse trains from the HP laser. When the count on a given axis reached +/- 270 pulses (equivalent to .0003") triggers an interrupt on the PDP 11/21 and the position value of the tooling plate or float would be +/- incremented by .0003".
e. Highly precise electronic weight scales accurate to +/- 2 grams, initial pre-test weight of ~4,000 lbs of water and tank.
f. Up/down counter displays for each axis driven by the PDP 11/21.
g. Speaker array mounted to the pitot tube used to induce minor vibrations to overcome viscosity.
h. Custom software developed at the ASCII and pixel level to create a fully interactive user interface to run/control this system.
i. Software was developed with Fortran and DEC PDP 11 Assembly Language.

*** Automated Systems Software Engineer:**
Wrote software applications for real time and manual data acquisition/control systems. These systems required - software to hardware interface with off the shelf and in house designed PCB's (printed circuit boards, typically made in house with wire wrap development boards), analog devices, motor controllers, encoders, lasers, etc. Special purpose editors, efficient data structures and interactive data input screens were also required. Application of advanced data structure/DB design within Fortran, and assembly language programs to improve program response time and memory storage requirements in tightly time constrained real time controls environments. Automated machining processes by going directly from coordinate measuring machines (CMM's) to coordinate numerical control (CNC's) machining centers.

EDUCATION:

Michigan State University East Lansing, Michigan -	**BS Mechanical Engineering**
Lawrence Institute of Technology Southfield, Michigan -	**BS Computer Science/Math**
Lynchburg College Lynchburg, Virginia	**Additional work related courses in advanced data structures/data base design and assembly language programming.**

Professional Certifications:

CCNA Wireless, CCNP (50%) – Route/Switch, CCNA – Route/Switch, CAWLSS - Cisco Advanced Wireless LAN Sales Specialist, CAWFS - Cisco Advanced Wireless LAN Specialist, CEFFE - Cisco Express Foundation for Field Engineers, CWNA - Certified Wireless Network Administrator, Cisco Advanced Router Configuration, Intro to Cisco Router Configuration, Installation & Maintenance of Cisco Routers, Advanced Cabletron Monitoring Spectrum 5.0, Cabletron Fore ATM Certificate, Cabletron Customized Hardware Certificate, Network General Ethernet Network Analysis and Troubleshooting Certificate, Brown & Sharpe Advanced Validator CMM Certificate, ICS Software Requirements Specifications & Tests Certificate Yourdon Structured Analysis and Design for Real-Time Systems Certificate

SECURITY CLEARANCES: **Department of Defense - SECRET** **Department of Energy - SECRET**

Cisco Network Hardware LAN/FW: Nexus 7010, Nexus 5500, Nexus 2200, 65XX/Sup720, 3750X, 3750G, 3750V2, 65XX/Sup1&2, 55XX/Sup1&2, RSM's, 3550, 2950, 3560, 7200, 4500, 2600, 7300, ASA 5510

Cisco Network Hardware Wireless: **Controllers** - 5508, WISM, WISM2, 4402, 4404, 3750G Integrated RF LAN Ctrl
Access Points – 3702, 2600, 3602, 3502, 1142, 1252, 1242, 1131

Other Network Hardware WLAN/Wireless: Zebra/Motorola, Aruba, Aerohive, Meru and **Meraki**

F5 LoadBalancers: **BigIP Viprion, BigIP 4200, BigIP VE**

VMWare: **VSphere 6.0, VCenter, VMWare VSphere Client**

Industrial Switches: **Cisco** - 2955, 3000, **RuggedCom** - RS 900G, RSG 2100, RS 969, RS 8000T, **Hirschmann** - MACH4000, PowerMICE, OCTOPUS, MS30, MS20, RS20, **Phoenix Contact** - FL Switch MMHS, **Siemens** - X414-3E

Application/DB Servers Hardware: Dell PE R620, R720, 2650's & 2850's, HP DL585, MOTOROLA 6800 & 68,000, Z80, Intel, DEC VAX 780, 750, 8600, PDP 11: 21, 23, 24, 44, 73, CNC's, CMM's

Operating Systems: Cisco IOS & CatOS, ISI Unix, BSD Unix Ubuntu Linux, Sun Solaris/Unix, MS Server 2003/2008/2012VMS, DOS, IXIA OS, Hirschmann OS, Windows 3.1, RT/11, RSX/11M PLUS, OS/2, VAX 11 and PDP 11 ASSEMBLY, GUARDIAN

Programming Languages: **TCL, Python,** C/C++, VB/Excel, Chariot scripts, X Windows, SQL, FORTRAN, TAL, PASCAL, DEC RMS, ACCESS BASIC, EXCEL, MOTOROLA 6800 and 68,000, MMS, FTAM, (PL/1), COBOL, GPSS, CSMP, VFORTRAN, EASYCASE

Networking Protocols: TCP/IP, MAP/OSI, IPv4, IGMP V2/V3, IP PIM Sparse/Dense, MSDP, Anycast-RP, CDMA, OFDM, CSMA, ATM, IPT/VoIP, QoS, MPLS, IGRP, EIGRP, BGP, RIP V2, OSPF, DHCP, DNS/Bind, AD, NTP, Securefast, TCP/IP, MAP/OSI, Novell 3.12 and 4.1, Proprietary Protocols

Security Protocols: RADIUS/Dot1X, WPA/WPA2, WEP, EAP/PEAP, VPN, IPSEC

Relational Data Base Systems: ORACLE, INGRESS, ACCESS, PARADOX, Raima, Proprietary
Test Equipment/Software/Tools: Wireshark, TCPdump, Tableau, Fluke Airmagnet, Fiddler**,** IXIA Chariot, Network General Sniffer, Infinistream Multiport Sniffer, Solar Winds Toolseet-v10.6, AeroScout,