Securing Communications for SCADA and Critical Industrial Systems

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Summary

- Communications as popular target
- More sophisticated criminals
- Threat vectors
- Mitigation
- New technology
SCADA and ICSs

- SCADA and ICS communications are used to move electric power, gas, oil, water, petrochemicals, and transportation
- Protocols are in use today that rarely use authentication
- Energy sector is a popular avenue for attacks
Threat Vectors

- Replay attacks
- Man-in-the-middle attacks
- Brute force attacks
- Dictionary attacks
- Denial of service (DoS) attacks
- War dialing
- Default passwords
- Data modification
Securing Internet Protocol

- IPsec
- Encryption and authentication
- Logging
Replay Attack With Encryption

Attacker is able to see encrypted command
Successful Replay Without Authentication

Attacker replays command
Unsuccessful Replay With Authentication

Attacker replay command is rejected
Encrypt WAN Connections

Multiplexer

SONET Ring

Multiplexer

Multiplexer

Multiplexer
Encrypted WAN Connections
Stop Interception

Multiplexer
SONET Ring
Multiplexer
Multiplexer
Multiplexer
Ethernet Communications

- Replay attack prevention via encryption and authentication
- MAC address count lock
- MAC address time lock (capture endpoints during commissioning)
- Tamper detection using link status in new technology
Wireless Communications

- Bluetooth® keeps cabinet doors closed
- New radio transceivers support encryption and authentication
Serial Communications

- Serial communications are still widely used
- Serial encryption devices provide secure wrapper
Precise Time

- Critical component in power systems
- Precision time and date-stamped logging
- Distribution over SONET networks
Password Management

Security Gateway

User Accounts

Encrypted

Security Gateway

Ethernet Switch

Relay / IED

Relay / IED
Password Management

Security Gateway

User Accounts

Encrypted

Security Gateway

Ethernet Switch

Username: johntyler
Password: $P = F \times V$ (Velocity)

“johntyler authenticated”
Backdoor Passwords and Maintenance Accounts

• Cause significant threat exposure
• Are used for equipment access

Insist that your devices have no such mechanisms in place!
Engineering Access

- Utility engineer – engineering access is biggest risk
- Endpoints must be firewalled
Dial-Up Modems Still Widely Used

- Disconnect when not in use
- Whitelist inbound numbers
- Use modem call-back feature
Secure Dial-Up Engineering Access

- Secure dial-up access protects serial communications
- Field engineers are given unique cryptographic identities
Whitelist Technology

- Was developed by U.S. Department of Energy and several partners
- Is based on whitelist malware protection
- Monitors system services
- Mitigates malware, rootkits, and zero-day exploits
- Eliminates frequent antivirus signature patches
Tamper Detection

- New technology detects break-in or tampering
- Sensors detect movement, light levels, and binary sensors
Tamper Detection

• Optical sensor or binary input detects door opening
• Accelerometer detects jolt or movement
• Tilt sensor detects someone physically handling device
• Combination of sensors reduces false alarms
• Alarms are sent out-of-band
Establish Zones of Protection

Secure Channels to SCADA / EMS / EA

Data Concentration

Intelligent Devices

Ethernet

Serial

Relays, Controllers, and Machines

Ethernet Switch

Data Security Access Management

Access
New Generation of Computers

- MTBF many times that of typical industrial computers
- SCADA, automation, data concentration, monitoring, and control
New Generation of Computers

- No moving parts (spinning drives, fans)
- Error-correcting memory
- Harsh environments
- Operation when exposed to ESD, vibration, shocks, bumps, EMI fields, and RF interference
- Wide range of applications (LDAP, automation, network intrusion detection)
Network Intrusion Detection

- Reliable option with new rugged computers
- Important piece in security framework
- Detection of network breach provided
Network Intrusion Detection

- Monitors inbound and outbound traffic
- Records access attempts, port scans, probes, buffer overflow attempts, and more
- Provides deep packet inspection and rule-based alerts
Rule Determines How to Inspect Each Packet

```
alert tcp any any -> any 23 (msg: "Telnet connection";)
```
Network Intrusion Detection

- Detects traffic from within (i.e., between devices)
- Example – Modbus® TCP buffer overflow

```
alert tcp $MODBUS_Client any -> $MODBUS_Server 502 \n   dsize: >300;  msg: "Illegal Modbus TCP Packet Size"; )
```
Network Intrusion Detection

Diagram:
- Internet
- Gateway / Firewall
- VLAN
- Managed Switch
  - SCADA RTU
  - SCADA RTU
  - SCADA RTU
- Sniffing Interface
- Rugged Computer
- Remote Management
- Port Mirroring
Best Practices

- Know your system endpoints
- Have USB flash drive policy
- Review logs periodically
- Lock down engineering access
- Consider insider threats (access rights)
- Keep device firmware up to date
Conclusion

• Communications require end-to-end authentication to be secure
• Compensating controls are available for legacy protocols
• Layered security should be established
• Many new technologies are available
Questions?