DetNet Security Considerations

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draft-sdt-detnet-security-01

IETF 99, Prague, July 2017

Draft Outline

- Background

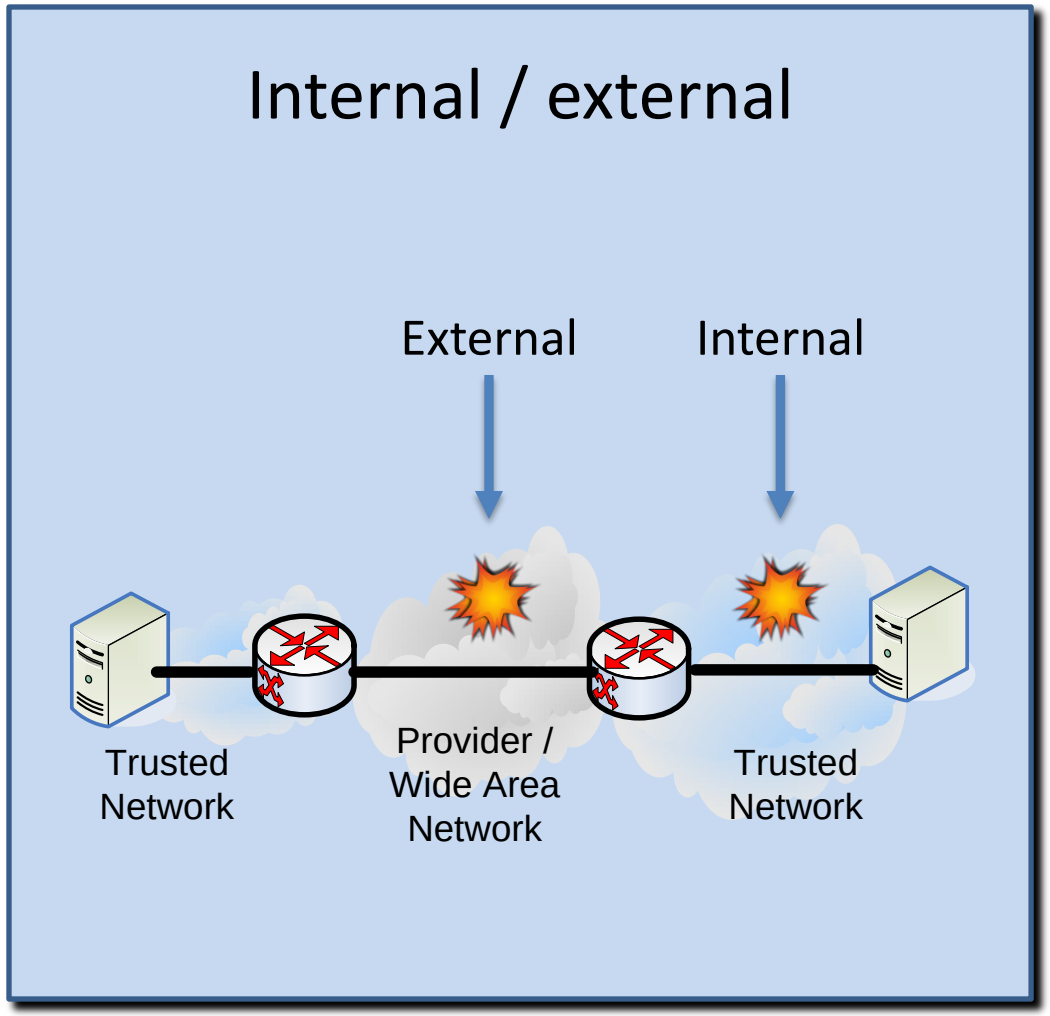
- Security threats
- Impact of security threats
- Mitigations
- Association of attacks to use cases

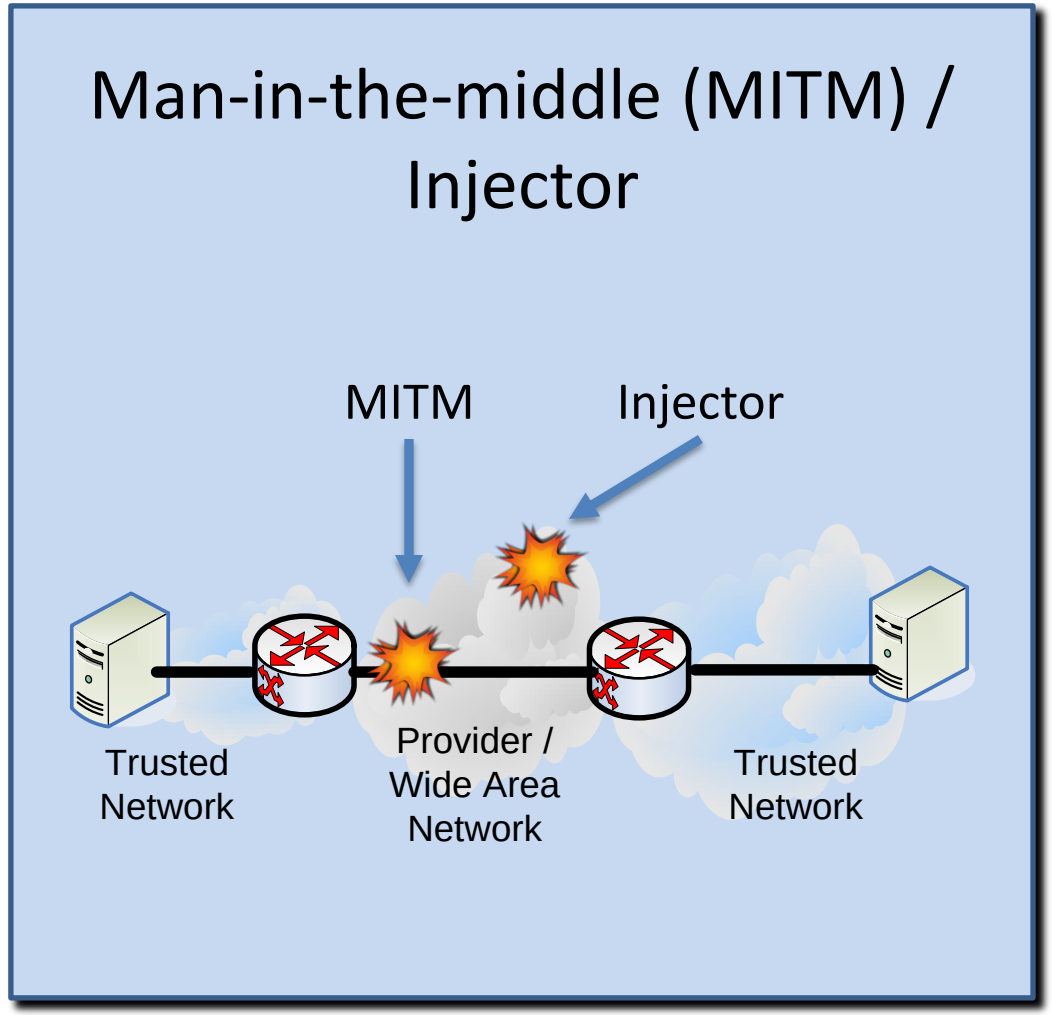
Added in version 01

Security Threats

Attacker Types

[Based on RFC 7384]





Summary of Threats

Attack	Attacker Type			
	Internal MITM	Internal Inj.	External MITM	External Inj.
Delay attack	+		+	
DetNet Flow Modification or Spoofing	+	+		
Inter-segment Attack	+	+		
Replication: Increased Attack Surface	+	+	+	+
Replication-related Header Manipulation	+			
Path Manipulation	+	+		
Path Choice: Increased Attack Surface	+	+	+	+
Control or Signaling Packet Modification	+			
Control or Signaling Packet Injection		+		
Reconnaissance	+		+	
Attacks on Time Sync Mechanisms	+	+	+	+

Impact

Impact

	Control Plane	Data Plane

Impact of Recon and Delay Attacks

	Control Plane	Data Plane
Reconnaissance	• Monitor changes in the network • Monitor flows and their IDs • Identify controllers	• Identify active targets • Determine type of targets based on observed stream parameters. • Find opportune moment to conduct final attack

Impact of Recon and Delay Attacks

	Control Plane	Data Plane
Reconnaissance	• Monitor changes in the network • Monitor flows and their IDs • Identify controllers	• Identify active targets • Determine type of targets based on observed stream parameters. • Find opportune moment to conduct final attack
Delay attacks	• Resource exhaustion (removing old links delayed) • Reduces QoS (creating new links delayed) • Denial of Service (due to exhaustion, not enough to form new link) • Loss of privacy (data sent to old target)	• Increased buffering in bridges • Elimination nodes consume more resources • Skew path metrics • Outage (single path)

Impact of Spoofing and Modification Attacks

	Control Plane	Data Plane
Modification / spoofing	• Create/Remove/Modify streams • Modify network paths	• Skew path metrics • Consume resources • Disrupt links • Affect voting at elimination bridges • Crash application

Mitigations

Mitigations

Mitigation Method	Relevant Attack(s)
• Path redundancy	• Man-in-the-middle attacks

Mitigations

Mitigation Method	Relevant Attack(s)
• Path redundancy • Integrity protection • DetNet node authentication • Encryption	• Man-in-the-middle attacks • Modification/tampering • Spoofing • Recon

Mitigations

Mitigation Method	Relevant Attack(s)
• Path redundancy • Integrity protection • DetNet node authentication • Encryption • Control message protection • Performance analytics	• Man-in-the-middle attacks • Modification/tampering • Spoofing • Recon • Control plane attacks • Resource exhaustion attacks

Mapping Attacks to Impacts / Mitigations

Attack	Impact	Mitigations
Delay Attack	-Non-deterministic delay -Data disruption -Increased resource consumption	-Path redundancy -Performance analytics
DetNet Flow Modification or Spoofing	-Increased resource consumption -Data disruption	-Path redundancy -Integrity protection -DetNet Node authentication
Inter-Segment Attack	-Increased resource consumption -Data disruption	-Path redundancy -Performance analytics
Replication: Increased attack surface	-All impacts of other attacks	-Integrity protection -DetNet Node authentication
Replication-related Header Manipulation	-Non-deterministic delay -Data disruption	-Integrity protection -DetNet Node authentication
Path Manipulation	-Enabler for other attacks	-Control message protection
Path Choice: Increased Attack Surface	-All impacts of other attacks	-Control message protection
Control or Signaling Packet Modification	-Increased resource consumption -Non-deterministic delay -Data disruption	-Control message protection
Control or Signaling Packet Injection	-Increased resource consumption -Non-deterministic delay -Data disruption	-Control message protection
Reconnaissance	-Enabler for other attacks	-Encryption
Attacks on Time Sync Mechanisms	-Non-deterministic delay -Increased resource consumption -Data disruption	-Path redundancy -Control message protection -Performance analytics

Use Case Themes

Association of Attacks to Use Cases

- A set of use case themes
- For each theme: a discussion about specific security considerations
  - Network Layer - AVB/TSN Ethernet
  - Central Administration
  - Hot Swap
  - Data Flow Information Models
  - L2 and L3 Integration
  - End-to-End Delivery
  - Proprietary Deterministic Ethernet Networks
  - Replacement for Proprietary Fieldbuses
  - Deterministic vs Best-Effort Traffic
  - Deterministic Flows
  - Unused Reserved Bandwidth
  - Interoperability
  - Cost Reductions
  - Insufficiently Secure Devices
  - DetNet Network Size
  - Multiple Hops
  - Level of Service
  - Bounded Latency
  - Low Latency
  - Symmetrical Path Delays
  - Reliability and Availability
  - Redundant Paths
  - Security Measures

Mapping Attacks to Use Case Themes

Theme	Attack									
	1	2	3	4	5	6	7	8	9	10	11
Network Layer - AVB/TSN Eth.	+	+	+	+	+	+	+	+	+	+	+
Central Administration						+	+	+	+	+	+
Hot Swap		+	+								+
Data Flow Information Models											
L2 and L3 Integration					+	+					

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Summary

Next Steps

- March 2017 – draft 00
  - Good feedback
  - Wide support
- July 2017 – draft 01
  - Significant progress
- Next steps:
  - Call for working group adoption

Thanks!

References

[1] T. Mizrahi, E. Grossman, A. Hacker, S. Das, J. Dowdell, H. Austad, K. Stanton, N. Finn, “Deterministic Networking (DetNet) Security Considerations”, draft-sdt-detnet-security-01 (work in progress), 2017.

[2] E. Grossman, C. Gunther, P. Thubert, P. Wetterwald, J. Raymond, J. Korhonen, Y. Kaneko, S. Das, Y. Zha, B. Varga, J. Farkas, F. Goetz, J. Schmitt, X. Vilajosana, T. Mahmoodi, S. Spirou, and P. Vizarreta, "Deterministic Networking Use Cases", draft-ietf-detnet-use-cases-12 (work in progress), 2017.

[3] T. Mizrahi, "Security Requirements of Time Protocols in Packet Switched Networks", RFC 7384, 2014.