



Threat Model for Designers Electronic Payment Server

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API Version 1.0

Document Summary

This document contains known threats and countermeasures necessary to keep an Electronic Payment Server (EPS) secure. It is not a comprehensive assessment of any specific implementation. Keeping the EPS secure is the responsibility of each implementer.

Contributors

Clerley Silveira, PDI

Kim Seufer, Conexus

Chuck Young, Impact 21

Mark Carl, PDI

Sue Chan, W. Capra

Linda Toth, Conexus

Casey Brant, Conexus

Revision History

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10/24/2022	Draft 1.0	Kim Seufer, Conexus	Resolved comments from legal review
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12/30/2021	Draft 0.2	Clerley Silveira, PDI	Updates requested during the last meeting: <ul style="list-style-type: none">• Add Double arrow between the OPT controller and the OPT• Second diagram representing the Cloud risk• Annotate the description of the diagrams. Add reference to TLS, RSA

			encryption and OAuth.
12/03/2021	Draft 0.1	Clerley Silveira, PDI	Initial Document

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Project

Electronic Payment Server

Subtitle

EPS Threat Model

1 Introduction and Overview

Threat modeling is a process to assess and document the security risks associated with an application. This modeling is used to help a development team identify security strengths and weaknesses of a system and serve to identify, categorize, and prioritize threats as well as how to mitigate them.

There are a variety of methods for conducting threat modeling. Merely responding to the questions in this document does not produce a formal threat model, but it is meant to help a development team to think, consider, and address the kinds of harmful things that can be done to an application or system before it is built. The goal is to design security into the product before any coding is done. The information in this document should be used by standards groups, system architects, designers, and the specific development team to help build a formal threat model or at least evaluate a design to ensure adequate security.

An implementer of an API should use this document as a foundation for a threat model. The individual should use the Threat Model Document for Implementers as needed for his/her internal use. If there are conflicts between the originally published document and the resulting implementer threat model, the implementer should bring back to the working group/committee those specific differences for resolution.

Note: An implementer should take care when sharing his/her completed threat model document with third parties. It contains sensitive/confidential information detailing vulnerabilities of the implementer's system.

Since the EPS deals specifically with the information that has value to an attacker, some extra precaution beyond this document is recommended.

2 API Description

2-1. What is the name of the application/service?

Electronic Payment Server (EPS) API Standard

2-2. Which of the following applies to this application/service?

This is a new project

This is a new feature or function to an existing system

Backwards compatibility is required to interface with legacy systems

2-3. Briefly describe the application/service. For more details, consult the companion documentation for this specification.

3 Use Cases

There are four transaction types, (Use cases), that puts the EPS at high risk.

ID#	Short Name	Description
01	Card Payment	User submits personal credit card information for payment
02	Card Pre-Authorization	User submits personal credit card account for authorization
03	Refund	User submits personal credit card account for refund.
04	Reconciliation Reporting	Authorized user can retrieve partial or complete account information. Note that is highly recommended that all the personal data be truncated and masked once the payment is collected.

4 Asset Identification

ID#	Asset Description	Criticality	Potential Attacker	Potential Harm	Proposed Protection Method
01	Payment Card Data	Critical	Criminal, Employee	Catastrophic for large amount of data; significant for small amount of data.	Work to implement industry standard guidelines. Make sure the software is always up to date. Work with Cybersecurity experts to make sure the system is secure and data is protected.

5 Data Identification

					Proposed Data Protection		
ID#	Data Description	Data Classification	Compliance and/or Regulatory Requirements	Is data stored after use?	Storage	Transmission	Processing
01	Personal Identification Information	Sensitive.	Yes	Partially	Encrypted	Encrypted	Yes

- 5-1. Which of the following sensitive/confidential data is stored, transmitted, or processed by this application/service?
 N/A – Please explain _____
 Encryption Keys
 Intellectual Property (IP)
 Passwords
 Sensitive Data (e.g., transaction log data, first 6 and last 4 digits of PAN, last 4 digits of PAN + ZIP Code)
 Proprietary data (e.g., fuel control data, authorization, completion)
 Trade Secrets (e.g., price book data)
 Other – Please specify _____

- 5-2. Which of the following PCI data is stored, transmitted, or processed by this application/service?
 N/A – Please explain _____
 Cardholder data
 Cardholder name
 CAV2, CVC2, CVV2, CIDE
 Expiration date
 Full magnetic stripe data or chip equivalent
 PIN/PIN Block
 Primary Account Number (PAN)
 Service Code
 Other – Please specify _____

5-3. Which of the following PII data is stored, transmitted, or processed by this application/service?

N/A – Please explain _____

Account number

Address (including all geographic subdivisions smaller than state)

Biometric identifiers including voice or fingerprint

Birthdate

Certificate or License number (including driver's license number)

Email address

Fax number

IP Address

Name

Photographic image

Social security/social insurance number

Telephone number

Vehicle or device serial number

Zip or postal code

Any other characteristic that could uniquely identify an individual

Other – Please specify _____

5-4. Which of the following retail fuel/convenience store data is stored, transmitted, or processed by this application/service?

N/A – Please explain _____

Command and control systems data

Fuel and product pricing

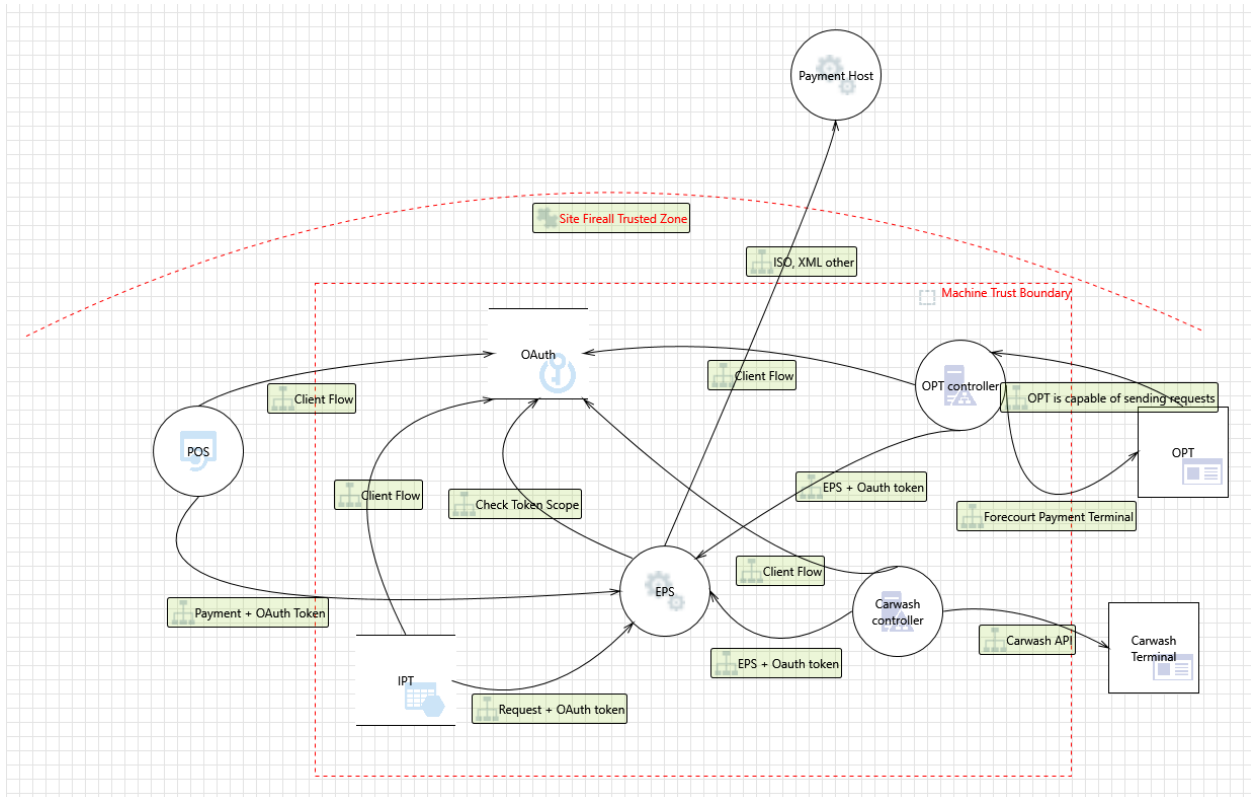
Industrial Control System (ICS) data

Life-safety control systems data

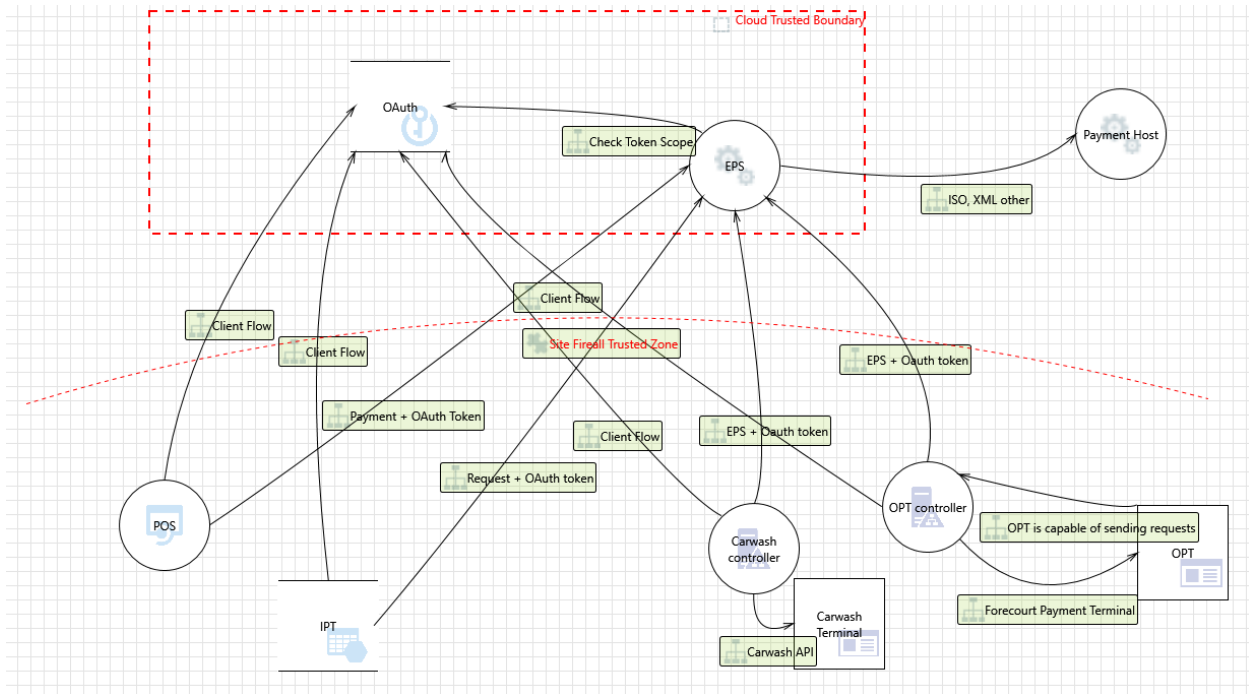
Payment data

Sales data

Other – Please specify _____



- All communication is assumed to take place over TLS
- Whenever sensitive information is present, there is an assumption that the data will be encrypted using the RSA public key provided by the EPS
- The systems depicted in the diagram assume the use of OAuth for authentication and authorization.



6 API Consumers

ID#	API Consumer	Description	Trust Level
01	POS	No admin account	No admin user
02	OPT	No admin account	No admin user

7 Data Protection

This section focuses on how data is protected. There are several sub-sections that focus on specific data protection concerns.

7.1 Data Confidentiality

This section focuses on what is done to protect the confidentiality of the data.

7.1-1. Which of the following controls are used to ensure data confidentiality? (Select all that apply.)

- This application/service does not store, transport, or process any sensitive information.
- Access to data is limited by a need-to-know or need-to-use and access controls
- Data is encrypted at rest
- Data is encrypted during transmission
- Passwords are hashed with a one-way function
- Data is stored, processed, and transmitted on a protected network
- Data is stored, processed, and transmitted in a protected facility
- Other – Please specify _____

7.2 Data Encryption

This section focuses on encryption and hashing and how they are used to protect data.

7.2-1. What is encryption used for? (Select all that apply.)

- N/A – No sensitive data is stored, transported, or processed
- Protecting payment card industry (PCI) data
- Protecting personally identifiable information (PII)
- Passwords are stored using reversible encryption
- Other – Please specify _____

7.2-2. Which of the following describes how data at rest is protected? (Select all that apply.)

- N/A – No sensitive data is stored
- None – Sensitive data is not encrypted at rest
- Encrypted and stored in a file
- Encrypted and stored in a database
- Encrypted while in memory
- Sensitive data is stored in an encrypted database
- Other – Please specify _____

7.2-3. When is encryption used to protect data during transmission? (Select all that apply.)

- N/A – No sensitive data is transmitted
- All of the sensitive data is encrypted on **trusted** networks
- Only some (or none) of the sensitive data is encrypted on **trusted** networks
- All of the sensitive data is encrypted on **untrusted** networks
- Only some (or none) of the sensitive data is encrypted on **untrusted** networks
- Other – Please specify _____

7.2-4. What encryption methods are used to protect data during transmission? (Select all that apply.)

- N/A – No sensitive data is transmitted
- Point-to-point encryption
- VPN
- IPsec
- TLS
- SSL
- Digital certificates (e.g., X.509)
- Other – Please specify _____

7.2-5. Which of the following cryptographic algorithms are used by the application/service? (Select all that apply.)

- N/A – No sensitive data is stored, transmitted, or processed
- Some (or none) of the sensitive information is encrypted
- Well-vetted, industry standard cryptography (e.g., TLS, AES, ECC, RSA, WPA2)
- Cryptographic algorithms that are deprecated or insecure (e.g., SSL, TLS 1.0, WEP, 3DES, DES, RC4)
- Custom or “home-grown” cryptography
- Other – Please specify _____

7.2-6. Which of the following hashing algorithms are used by the application/service? (Select all that apply.)

- N/A – The application/service does not require the use of hashing.
- Well-vetted, industry standard hashing algorithms (e.g., SHA-256, SHA-384, SHA-512)
- Hashing algorithms that are deprecated or insecure (e.g., MD4, MD5, SHA-1)
- Custom or “home-grown” hashing algorithm
- Other – Please specify _____

7.2-7. Which of the following is hashing used for? (Select all that apply.)

N/A – The application/service does not require the use of hashing.

Data/message integrity

Digital signatures

Index and retrieve database items

Password storage/verification

Passwords are stored using special password hashing algorithms resistant to brute force attacks (e.g., Argon2, PBKDF2, bcrypt, scrypt)

Message signing

Other – Please specify _____

7.3 Data Integrity

This section focuses on what controls are used to protect the data integrity and detect unauthorized changes to the data. Put a “?” if the answer is unknown.

7.3-1. Which of the following controls are used to ensure data integrity? (Select all that apply.)

N/A – The application/service does not store, transport, or process any information that requires data integrity controls.

Audit trails

Backup and recovery mechanisms

Change control systems

Data is digitally signed

Data is encrypted at rest

Data is encrypted during transmission

Input validation

Physical and logical access controls

Restricted system access for records

Other – Please specify _____

7.3-2. Which of the following mechanisms are used to protect data and prevent tampering? (Select all that apply.)

There are no controls used to protect data and prevent tampering

API Gateway

Certificate pinning (i.e., force use of a given certificate)

Chain of custody

Change management process

Digital signatures

Encryption

Endpoint security

Key rotation processes

Network security

Physical security

Request signing

Secure key management processes

Security code review

Third-party vulnerability assessment

Other – Please specify _____

8 Logging and Auditing

This section focuses on the security controls for auditing and logging to ensure the appropriate information is logged and adequately secured from adversaries.

- 8-1. Which of the following controls are used to restrict access and protect the contents of logs and audit trails? (Select all that apply.)
- N/A – The application/service does not support audit trails and/or application logs
 - Access to logs is controlled by access controls
 - All sensitive/confidential data that gets logged is first encrypted or anonymized
 - Each audit record is digitally signed
 - Each audit record is digitally signed after concatenating the hash of the previous record
 - Log entries are synchronized with other applications and systems using NTP/SNTP to ensure accurate date and time stamps
 - Log entries capture enough data to allow debugging and forensic analysis
 - Log/audit data is written to another secure logging server
 - Log/audit data is written to another system
 - Logs are regularly monitored for evidence of security incidents and other unexpected behavior
 - Logs are retained in accordance to policy and compliance requirements
 - Multifactor authentication is required to access the logs/audit trail
 - No confidential or sensitive information is captured in a log or audit trail
 - Rely on operating system security provides the protection to the logs/audit trail
 - Sensitive/confidential data that gets logged is not encrypted or anonymized
 - The entire log/audit trail is encrypted
 - Other – Please specify _____

9 Compliance

This section focuses on compliance requirements and how they are fulfilled.

9-1. What policies or obligations govern the use or function of the application/service? (Select all that apply.)

N/A – Please explain _____

Customer contract

Employee handbook

Licensing agreement

Payment Card Industry (PCI)

Privacy policy

Security policy

Terms of use

Vendor contract

Vendor or Partner as a business associate

Other – Please specify _____

10 Common Threat Examples

The following table consists of examples of common threats arranged by Attack Category and Security Control Category. Based on your understanding of the current or planned architecture and design, select the applicable threats by entering “X” in the “Is Threat a Concern” column. Note: Bolded threats/attacks are commonly considered for API implementations that implement strong authentication and access control (e.g., OAUTH v 2.0).

Although this section is to be filled in by the API Implementor, the API Designer must consider and be aware of the potential threats/attacks against the API due to architectural and design decisions.

Attack Category	Security Control Category	Is Threat a Concern?	Threats/Attacks
Broken access control	Access control/authorization	X	Data tampering
		X	Disclosure of confidential data
			Forced browsing (attack by guessing URI)
			Horizontal privilege escalation
			Insecure Direct Object Reference
		X	Lack of individual accountability
		X	Missing access control/authorization
		X	Over-privileged process and service accounts
		X	Unauthorized access to administration interfaces

Attack Category	Security Control Category	Is Threat a Concern?	Threats/Attacks	
		X	Unauthorized access to configuration stores	
			Vertical privilege escalation	
Broken Authentication	Authentication		Authentication bypass	
			Brute force guessing attacks	
			Cookie replay attacks	
		X	Credential interception	
		X	Credential theft/leakage	
			Dictionary attacks	
			Failing to identify the user/entity	
			Failing to maintain the user/entity	
		X	Failure to limit excessive authentication attempts	
		X	Hard-coded password, secrets	
			Missing authentication	
			Password guessing	
			Predictable session IDs	
		X	Session hijacking	
			Session replay	
		X	Spoof endpoint, user, system, etc.	
			Weak or unsalted password hashes	
			Weak password initialization process (first use)	
	Weak password reset process			
	Weak session management			
Business logic flaw	Secure design	X	Client-Side Enforcement of Server-Side Security	
Code tampering				Security by obscurity
				Workflow out of sequence
				Binary patching
				Dynamic memory modification
		X		Local resource modification
				Method hooking
				Method swizzling
Data leakage	Cryptography	X	Disclosure of confidential data	
		X	Information disclosure	
		X	Man-in-the-middle attacks	
		X	Missing encryption of sensitive data	
		X	Network eavesdropping	
		X	Side channel attack	
		X	Sniffing/eavesdropping unencrypted network traffic	
	X	Unauthorized access to stored sensitive data		
		Error handling & Exception management		Revealing sensitive system or application details
		Secure coding	X	Verbose error messages and stack traces
				Information leakage from programming comments left in code
	Secure configuration		Information leakage from test code	
			Retrieval of clear text configuration secrets	
Data tampering	Input validation		Canonicalization attacks	
			Cookie poisoning/manipulation	
			Form field manipulation/parameter tampering	

Attack Category	Security Control Category	Is Threat a Concern?	Threats/Attacks
Denial of Service			Hidden form field manipulation/parameter tampering
			HTTP header manipulation
			Overwrite file with attacker's file
			Path traversal
			Query string manipulation/parameter tampering
			Unvalidated input used by the application
			Upload of a dangerous filetype
			Denial of Service (DoS) attacks
			Distributed Denial of Service (DDoS) attacks
			Cross-site scripting (XSS)
			Injection attacks
			LDAP injection
			Operating System command injection
Injection			SQL injection
			XML injection
Insecure communication	Cryptography	X	Clear text communication of sensitive assets
		X	Weak or broken ciphers such as SSL
Insecure development practices	Secure coding		Clickjacking
			Cross-Site Request Forgery (CSRF)
			Reverse engineering
		X	Running outdated software
			Unhandled error/exception
			Use of dangerous functions
			Using components with known vulnerabilities
Malware			Viruses and Rootkits
Memory manipulation			Accessing sensitive data in memory (including process dumps)
			Buffer overflows
			Format string vulnerabilities
Misconfiguration	Secure configuration		Directory listing enabled on the web server
		X	Not changing default keys and passwords
		X	Running the application with debug enabled in production
Repudiation	Auditing and Logging		Running unnecessary services
			Attacker covers his tracks
			Attacker exploits an application without trace
Weak Cryptography	Cryptography		User denies performing an operation
			Encryption cracking (cryptanalysis)
			Encryption of sensitive data with weak or broken algorithm
		X	Loss of decryption keys
		X	Missing encryption of sensitive data

11 Additional Threats

API is intended to implement the exchange of highly sensitive payment card information between systems. Particular attention should be applied to encryption, authentication and authorization for all systems deployed in a production environment. Consider engaging cybersecurity professionals inside or outside the organization prior to production implementation. Consider penetration testing for all client and server applications implementing the API.

A.References

A.1 Normative References

MITRE ATT&CK is a globally-accessible knowledge base of adversary tactics and techniques based on real-world observations. The ATT&CK knowledge base is used as a foundation for the development of specific threat models and methodologies in the private sector, in government, and in the cybersecurity product and service community. <https://attack.mitre.org/>

Common Weakness Enumeration (CWE) is a community-developed list of common software security weaknesses. It serves as a common language, a measuring stick for software security tools, and as a baseline for weakness identification, mitigation, and prevention efforts. <https://cwe.mitre.org/index.html>

Common Attack Pattern Enumeration and Classification (CAPEC) helps organizations understand how an adversary operates. This understanding is essential to effective cybersecurity. CAPEC helps by providing a comprehensive dictionary of known patterns of attack employed by adversaries to exploit known weaknesses in cyber-enabled capabilities. It can be used by analysts, developers, testers, and educators to advance community understanding and enhance defenses. <https://capec.mitre.org/>

A.2 Non-Normative References

None