Technical Instructions for E-SDC Developers

Version 2.6

Change Log

Author	Change	Date
Ivan Pavlović Srboslav Subotić	Review of the initial version of the document	15 Sep 2017
Ivan Pavlović	User Manual for Taxpayer Administration Postal is added to the document	28 Sep 2017
Lena Stamenković	1. USB cable changed from type A and B to USB Type B female 2. Added > Wireless connection should be optional 3. Added max time a device should work in case of a power outage 4. Obsolete commands removed 5. Added > E-SDC shall store in its memory up to 50.000 Audit packages.	05 Oct 2017
Lena Stamenković	Revision and update	09 Oct 2017
Srboslav Subotic	1. Added Status and Error Codes 2. Common JSON Based Protocol for both HTTP and Serial connection 3. Added Hash field into Sign Invoice request and response 4. Added commands Attention and Get Signed Invoice 5. POS to E-SDC Communication over Serial Port is JSON based	10 Oct 2017
Srboslav Subotić	TaxOnTotalAmount field removed from TaxCategory, enumeration Type added instead, with examples.	
Lena Stamenkovic	Review and update	25 Oct 2017
Lena Stamenkovic	Rename Cashier and Total Amount fields in textual representation of the invoice	16 Nov 2017
Lena Stamenkovic	Cashier TIN optional changed to mandatory Authority > Service	29 / 30 Nov 2017
Ivan Pavlović	1. SDC returns four additional fields in **InvoiceFiscalizationResult**	01 12 2017

Srboslav Subotić	Added and removed Error Codes	05 Dec 2017
Lena Stamenkovic	Province > District	08 Dec 2017
Lena Stamenkovic	Swagger > OpenAPI-Specification	18 Dec 2017
Lena Stamenkovic	Added Optional | Mandatory Table to Anatomy of an Invoice	22 Dec 2017
Aleksandar Radovanovic	• Create Verification Url | Total Amount from 4 to 8 bytes int32 to Uint64 bit • Create Verification Url | Changed default version from 1 to 0x02	26 Dec 2017
Ivan Pavlović	Expected frequency of submission of new ARPs to Tax Service's system is described in Audit section	28 Dec 2017
Lena Stamenkovic	Added Error code: 2400 Device is not configured	28 Dec 2017
Srboslav Subotic	Modified description for Error code 0220 and 0210	28 Dec 2017
Ivan Pavlović	- Statuses of call to SubmitauditPackage are now documented - /api/SDC/StartProofOfAudit is documented	02 Jan 2018
Srboslav Subotić	Added section Error Response for Serial protocol	09 Jan 2018
Srboslav Subotić	Replaced `InvoiceFiscalizationRequest` with `Request` and `InvoiceFiscalizationResponse` with `Result` as per the Model	10 Jan 2018
Srboslav Subotić	- Added description for APDU protocols and IsoCases - Added field UnitPrice to InvoiceFiscalizationRequest - Added decimal format for InvoiceFiscalizationRequest	18 Jan 2018
Srboslav Subotić	- Added description for MRC in `InvoiceFiscalizationResponse` - Added Payment Method in Receipt example	22 Jan 2018
Srboslav Subotić	Added definition for Get Secure Element Version APDU command	22 Jan 2018
Aleksandar Radovanovic	Changed Item Name length from 2gb to 2kb	07 Feb 2018
Lena Stamenkovic	Deleted **E-SDC shall Sign invoice...** from High-level requirements	16 Feb 2018
Lena Stamenkovic	Removed 384 px x 384 px dimensions for QR code	21 Feb 2018

Lena Stamenkovic	Renamed Commands.json > *UID.commands + example	06 March 2018
Srboslav Subotić	Date and time - added definition for daylightsaving Tax amounts - added new section Fiscal invoices - improved definition and description Ordinal_Number - added definition Removed Optional | Mandatory Table to Anatomy of an Invoice Anatomy of fiscal receipt - improved definition and description Added new examples for NR, Training and Proforma Format of audit package - improved definition JSON based protocol - improved definition for Sign Invoice Added mapping Fiscal invoice to Fiscal Receipt	16 03 218
Lena Stamenkovic	APDU commands update	29.06.2018
Lena Stamenkovic	DateTimeDisplayFormat - "dd/MM/yyyy HH:mm:ss" (e.g. 15/10/2018 14:28:24)	15.10.2018
Lena Stamenkovic	Removed all instances: E-SDC shall keep an audit data locally until a proof of audit (PoA) has been received from the Tax Service's system. Submitted Audit Package should be deleted from E-SDC if Api/SDC/SubmitAuditData returns `OperationSuccess` is `true`	02 nov 2018
Ivan Pavlović	• Non-Empty Collection of Tax Labels is required field for each Invoice Item • Discount is removed as obsolete • UnitPrice is required field	18 jan 2019
Srboslav Subotić	Fixed values in section Calculate Taxes, example 5	21 May 2019
Lena Stamenkovic	Added new Response APDU error codes	28 Jun 2019
Ivan Pavlović	• RSA is added to description of Audit Package creation process • E-SDC should run initialization each time new smart card is inserted into reader • Relation between POA and E-SDC is explained in more detail	04 July 2019

	• `MRC` is added to the interpretations list	
Goran Todorov	• Recommendation on Request size added to table Sign Invoice Command/invoice request/data fields	09 July 2019
Srboslav Subotić	• Added Card Locked error code	23 July 2019
Ivan Pavlović	• If invoice type is Refund Total label on journal should be `Total Refunded` instead of `Total Purchase`. Examples are updated	24 July 2019
Ivan Pavlović	• Referent Document Number field maximum length should be set to 50 Unicode characters	15 August 2019
Ivan Pavlović	• `GetTaxAuthorityParams` method is added to POS interface. It returns environment-specific information to invoicing system	4 September 2019
Srboslav Subotić	• Added TaxGroupRevision to Model and Example	14 September 2019
Aleksandar Radovanovic	• Extedned Iso 8061 format examples and information under Date And Time section	12-12-2019
Nenad Nikic Marko Denic	• Updated URLs	06-03-2020

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Introduction

E-SDCs are software applications or hardware devices whose main function is to safeguard an invoice in offline mode and deliver audit packages to Tax Service. From the technical point of view, E-SDC is a middleware component that connects a POS system to a Secure element and enables standardized communication with TaxCore Backend.Api.

This document is based on several researches performed in different environments because technical specification has to be open and applicable to organizational and technological constraints and anticipated changes and to keep security tight in order to perform fiscalization of an invoice in a safe and secure fashion.

The result is a rather complex set of rules and protocols E-SDC has to comply with in order to become an integral part of the fiscalization system. The good news is that most of the rules are straightforward and simple to implement using any platform or programming language.

This Guideline sets standards that will enable a simple integration of accredited E-SDCs with the Tax Service's system. E-SDCs shall comply with the protocols described in the document.

Interpretations

Accredited POS (POS) is a computer program, electronic device or information system for receipt issuing, in compliance with the requirements of the Regulation.

AES256 is a specification for the encryption of the electronic data established by the U.S. National Institute of Standards and Technology (NIST) in 2001.

APDU command (application protocol data unit) is the communication unit between a smart card reader and a smart card. The structure of the APDU is defined by ISO/IEC 7816-4 Organization, security and commands for interchange.

Audit Data – textual representation and machine-readable representation of a fiscal invoice with associated metadata.

Audit Package – encrypted Audit Data ready to be sent to the Tax Service System.

Electronic Fiscal Device (EFD) is composed of a POS and an E-SDC connected into one system. EFD produces fiscal receipts and reports audit data to a Tax Service.

GUID is a Globally Unique Identification Number. In its canonical textual representation, the sixteen octets of a UUID are represented as 32 hexadecimal (base 16) digits, displayed in five groups separated by hyphens, in the form 8-4-4-4-12 for a total of 36 characters (32 alphanumeric characters and four hyphens). For example: 123e4567-e89b-12d3-a456-426655440000

HTTP (Hypertext Transfer Protocol) is an application protocol for distributed, collaborative, and hypermedia information systems.

HTTPS is a communications protocol for secure communication over a computer network which is widely used on the Internet. HTTPS consists of communication over Hypertext Transfer Protocol (HTTP) within a connection encrypted by Transport Layer Security.

Invoice, see Receipt.

Machine Registration Code (MRC) is a unique number assigned by the Accreditation team and it is specific for each version of E-SDC. It is assigned when E-SDC developer notifies Accreditation Team that a new version of E-SDC is under development.

Non-volatile memory is a type of computer memory that can retrieve stored information even after having been power cycled (turned off and back on) e.g. USB Flash drive.

Proof of Audit (**PoA**) is a confirmation generated by a Tax Service System once all expected audit packages have been received from an E-SDC. It is not related to POS.

Public Key Infrastructure (PKI) is a set of roles, policies, and procedures needed to create, manage, distribute, use, store, and revoke digital certificates and manage public-key encryption.

Receipt is a digitally signed acknowledgment that a specified payment has been received. A receipt records the sale of goods or the provision of a service. In this document, the receipt is used interchangeably with the term invoice.

RSA (Rivest–Shamir–Adleman) is a public-key cryptosystem and is used for secure data. In such a cryptosystem, the encryption key is public and it is different from the decryption key which is kept secret (private).

RS232 is a standard for serial communication transmission of data. It formally defines the signals connecting between a DTE (data terminal equipment) such as a POS, and a DCE (data circuit-terminating equipment or data communication equipment), such as an E-SDC.

Sales Data Controller (SDC) contains a Secure element and is used to generate an invoice by signing request data received from a POS and to produce audit data. It stores audit data on its own non-volatile memory and enables a local and remote audit. There are two implementations of SDC:

a) **External SDC (E-SDC)** is a black box that contains Secure element and enables semi-connected fiscalization scenarios;
b) **Virtual Sales Data Controller (V-SDC)** is a web service operated by a Tax Service that exposes an SDC functionality to the authorized taxpayers via the Internet. It contains and uses a Secure element to sign invoices.

Secure element (SE) is a fiscal component implemented as a special software or device designed to receive a specific receipt data, to perform signing and data processing and to generate response data, which is sent back to the caller for further actions. The Response data provides the authenticity of a receipt data. The Secure element is issued and controlled by a Tax Service. The main purpose of the Secure element is to sign invoices using a taxpayer's digital certificate, to control audits and maintain a set of fiscal counters.

TaxCore is a set of web services, sites, databases and management software installed on the tax Service side, designed for communication with POS and SE devices.

UID – Unique Identifier (8 alphanumeric characters) assigned to each Smart card and embedded in the subject field of a digital certificate.

USB is an industry standard that defines cables, connectors and communications protocols for connection, communication, and power supply between computers and devices.

UTP is also the most common cable used in computer networking. Modern Ethernet, the most common data networking standard, can use UTP cables.

Verification URL is a unified resource location used to verify a particular invoice using a service provided by a Tax Service.

Volatile memory is computer memory that requires power to maintain the stored information; it retains its contents while powered on but when the power is interrupted, the stored data is lost immediately or very rapidly e.g. RAM.

High-Level Requirements

This section describes high-level requirements to consider when designing an E-SDC.

1. E-SDC shall be able to generate an invoice without the Internet connection.
2. E-SDC shall rely on a Secure Element (delivered as Smartcard) to safeguard an invoice.
3. E-SDC shall calculate tax liabilities based on received Invoice items and defined tax rates.
4. Initial E-SDC configuration could be performed via a file (e.g. on USB disk) or the Internet connection.
5. E-SDC shall expose at least one standardized protocol to a POS (JSON via HTTP or serial).

6. E-SDC shall process all commands received from the Tax Service's system in a consecutive order. These commands can include time synchronization, update of tax rates, and so forth.
7. E-SDC shall encrypt an audit data and store it locally in an encrypted form.
8. E-SDC shall periodically send stored audit data to a Tax Service and this process is called an audit.
9. E-SDC does not have to keep an audit data submitted and successfully stored on the Tax Service's system.
10. E-SDC shall submit a proof of audit (PoA) generated by the Tax Service's system to the Secure Element as soon as the E-SDC receives it.
11. E-SDC shall not store the Secure Element's PIN code except in the working memory. Once the E-SDC is restarted, the cashier will be required to enter the PIN code again.
12. E-SDC shall store in its memory up to 50.000 Audit packages.

Figure 1 shows the high-level architecture of Fiscalization System, involving an Accredited POS, E-SDC and Tax Service's system (TaxCore).

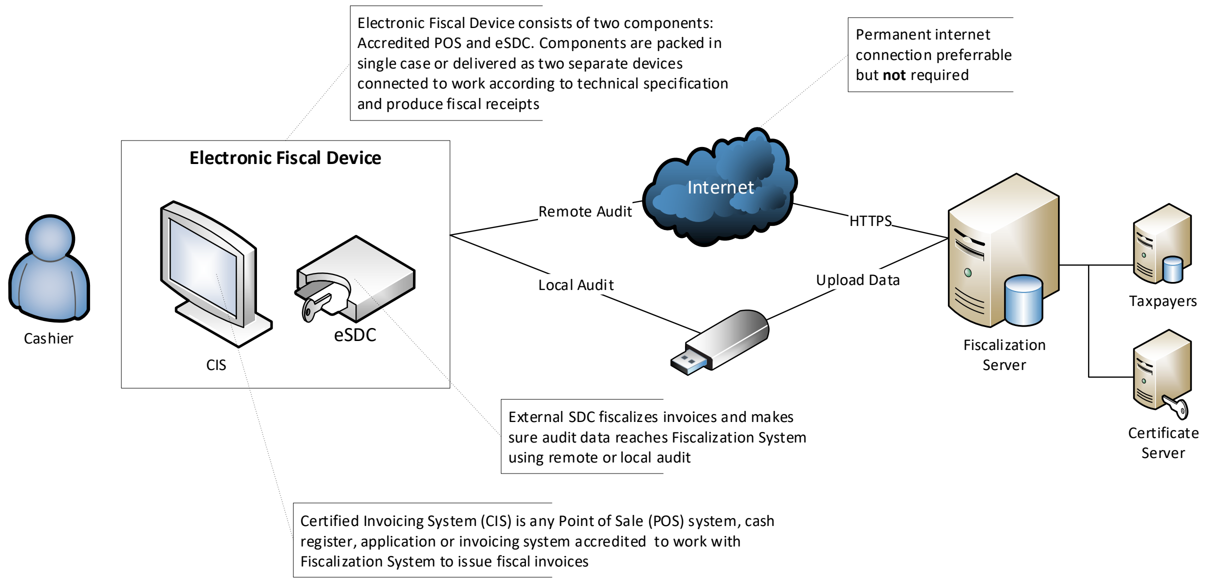

Electronic Fiscal Device consists of two components: Accredited POS and eSDC. Components are packed in single case or delivered as two separate devices connected to work according to technical specification and produce fiscal receipts
Permanent internet connection preferrable but **not** required
Electronic Fiscal Device
Internet
Remote Audit
HTTPS
Local Audit
Upload Data
Cashier
CIS
eSDC
Fiscalization Server
Taxpayers
Certificate Server
External SDC fiscalizes invoices and makes sure audit data reaches Fiscalization System using remote or local audit
Certified Invoicing System (CIS) is any Point of Sale (POS) system, cash register, application or invoicing system accredited to work with Fiscalization System to issue fiscal invoices

Figure 1 Fiscalization System high-level overview

Connectivity

External Sales Data Controller (E-SDC) device exposes serial and/or Ethernet-based protocols for communication with an Accredited POS via RS232, USB-to-serial or UTP cable. E-SDC uses a Secure Element to digitally sign invoices received from the Accredited POS and to produce audit data. The Audit data is stored on the E-SDC's internal non-volatile memory, which enables a local and a remote audit.

Multiple POSs can be connected to a single E-SDC. However, this shall be avoided as multiple devices could send the data simultaneously, and since Smart card has its own limitations (resources, processing speed), that could slow down the overall process.

Modes of Operation

Taxpayers are encouraged to use an online mode whenever it's possible – V-SDC service will be widely available and accessible for a variety of Accredited POS devices and software solutions. But, in order to rollout, a fiscalization system needs to have the ability to close any possible gap in the fiscal discipline due to poor network coverage or the Internet unavailability.

E-SDC can work in the following modes:

Offline (Required)

Offline mode is the only mode of operation required by these Instructions. In the offline mode, the Secure Element signs an invoice and the E-SDC device stores an audit package locally in a secure manner.

Semi-offline (Optional)

In the semi-offline mode, the Secure Element signs an invoice and the E-SDC device will immediately try to contact the Tax Service's system and perform a remote audit. If the Service's system is not accessible, the E-SDC will switch to the offline mode.

In case the Internet connection is interrupted, the E-SDC switches to the Offline mode.

Development Environment

Development environment is accessible to all developers of the Accredited E-SDCs. Development Environment exposes the same APIs and uses the same protocols as a production environment.

Obtaining Test Certificates

Every developer or a company registered as a developer of an Accredited E-SDC on Tax Service's web site shall receive a set of test certificates and technical documentation. Test certificates shall make it possible to test both successful and failing scenarios, like trying to fiscalize an invoice with the expired certificate.

Obtaining Smart Cards

Accredited E-SDC vendors will be able to apply to a Tax Service and get test smart cards to use for development, integration and testing purposes. The process for obtaining smart cards is the same as the process for the actual taxpayers:

1. Primary contact registers with a Tax Service using the application form published on the web site
2. Tax Service verifies the application and sends enrolment request to the primary contact by e-mail or SMS
3. Primary contact enters the desired PIN code for their smart card
4. Tax Service delivers the smart card to the Primary contact
5. If additional smart cards are required, the Primary contact can submit a request using the TaxPayer Admin portal in the staging environment (URL shall be published on the Tax Service Web Site)

Identification of the Environment

The staging environment is a testing environment that exactly resembles a production environment and is used to test all the installation/configuration/migration scripts and procedures before they're applied to a production environment.

The production environment is also known as live, particularly for servers, as it is the environment that users directly interact with.

The demo environment is primarily for showcasing the product to key stakeholders and potential or existing customers.

A sandbox is a testing environment that isolates untested code changes and outright experimentation from the production environment or repository.

NOTE: Development, testing and technical review are all done in **SandBox** environment. The next step is the administrative review process which enables getting accreditation for a specific country. Different countries have different system names, and every environment has its own URL.

System name by country, state, jurisdiction or managing organization:

1. Fiji – VAT Monitoring System (VMS)
2. Samoa – Tax Invoice Monitoring System (TIMS)
3. Washington – TaxCore

For this reason, URLs in your documentation and implementation should not be hardcoded but configurable or extracted from digital certificate on Secure Element to allow usage of E-SDCs with different environments.

Using Taxpayer Admin Portal

Once a test smart card is delivered to a Primary Contact you can use it to log in to the Taxpayer Admin portal to search and view invoice details submitted to the backend of the staging environment.

Architecture

Figure 2 shows the components of a fiscalization system and their mutual relationship.

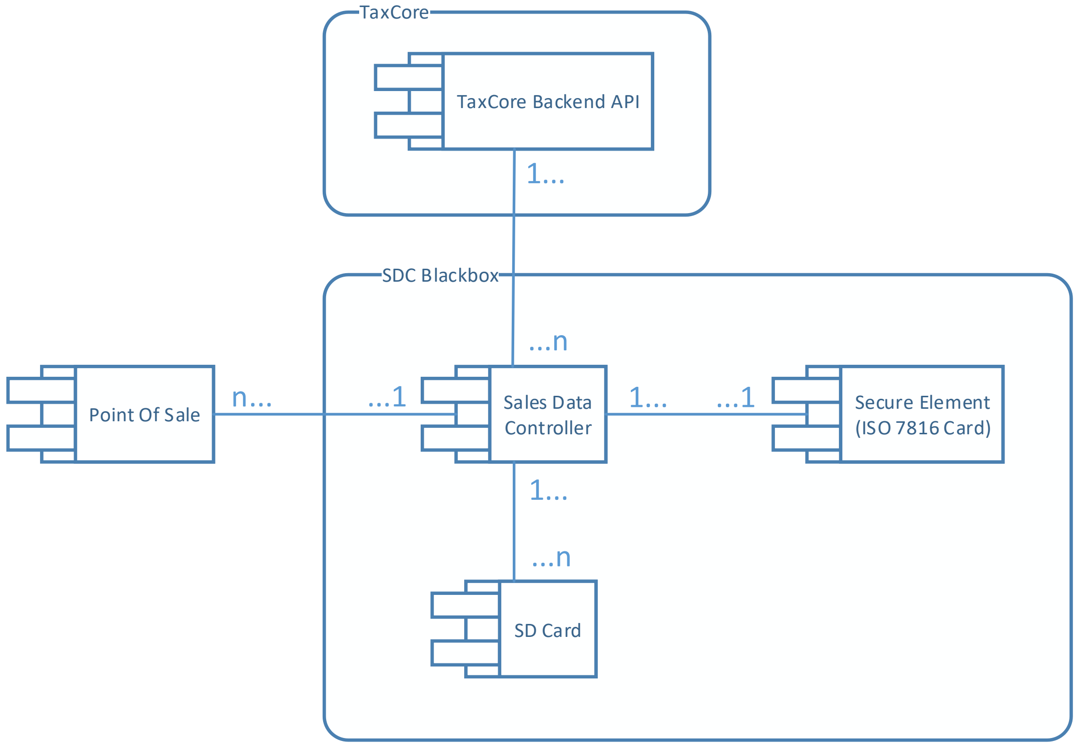


Figure 2 Fiscalization system component diagram

E-SDC Implementations

E-SDC can be implemented as a hardware device or a software service depending on the E-SDC manufacturer's decision and clients' infrastructure. E-SDC can also be implemented as an integral part of a POS.

In any of those cases, the E-SDC component has to pass the same accreditation process and prove that E-SDC is implemented according to the instructions described in this document.

Standards

E-SDC device shall comply with all current local regulations regarding safety usage, electromagnetic compatibility, temperature range and power supply.

Particularly, in terms of electromagnetic compatibility, a product shall comply with the following standards EN 55022:2010, EN 55032:2012 and EN 55024:2010 A1:2015.

A device operational temperature range shall be 0° - 70° C (Commercial range).

Power supply

It is allowed to use both AC and DC voltage for power supply. In the case of the AC voltage, a device shall work with the frequency range 50-60 Hz. The power supply circuit used by the E-SDC shall be protected with an automatic circuit breaker, suitable for electronic devices (type I).

In order to protect sensitive electronic components, the smart card and data stored on non-volatile memory, besides the mandatory basic protection, it is recommended that device is equipped with the additional fast overcurrent protection in the form of a fast fuse, e-fuse or similar device with the short time of operation.

When the DC voltage is used, protection against the reverse polarity shall be applied.

If the power supply voltages are higher than 75 Vdc or 50 Vac, a manufacturer shall obtain the appropriate certificate from a local authority, or represent a certificate valid in the country of use.

Ports

POS Communication

POS shall be able to connect to the E-SDC using **at least one** of the following ports:

Ethernet

Ethernet port in compliance with IEEE 802.3 standard, present on an E-SDC device. The minimum speed of the Ethernet port is at least 10 Mb/s.

Wireless

Wireless connection in compliance with IEEE 802.11 to a POS device and a local network.

Serial

For the serial communication with a POS, an E-SDC shall have one connector with a minimum of 3 pins: Tx, Rx and GND. The preferred type of connector is DE-9 connector compliant with standards IEC 60807-3 / DIN 41652. Alternatively, Euro Style Connectors, pin header connectors, or similar can be used. In that case, PIN usage shall be clearly specified.

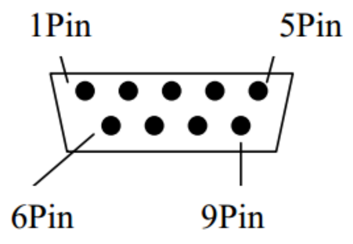


Figure 3 Serial port pinout

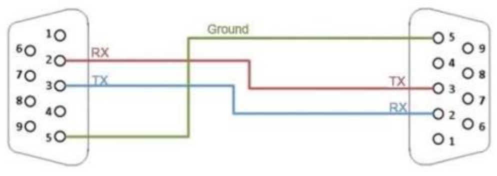


Figure 4 Serial port wiring

Pin Number	Pin Function
1	Unused
2	RXD
3	TXD
4	Unused
5	Logic GND
6	Unused
7	Unused
8	Unused
9	Unused

Table 1 Serial port pin description

The Accredited POS and the E-SDC shall be able to communicate via a «Null modem» cable.

Audit

If the E-SDC device uses a USB flash drive for a Local Audit, USB connectors "USB Type B female" shall be used. If a serial over USB protocol is used for communication between a POS and an E-SDC, an additional USB port of the same type shall be available. Applied USB communication protocol shall be

“USB 2.0” or higher. The same USB port shall not be used for a Local audit and serial communication with a POS.

In case when an SD Flash memory card is used for a Local audit, a device shall have an easily accessible Micro SD card connector.

For Remote audit, these Instructions do not limit a manufacturer in choosing a communication port as long as the invoice signing is not interrupted.

Smart Card

E-SDC shall have a smart card reader in compliance with ISO/IEC 7810 and ISO/IEC 7816 standard. Supported Smart Card sizes are 1FF (credit card size) and 2FF (mini SIM card size)

SIM card	Standard reference	Length (mm)	Width (mm)	Thickness (mm)	Volume (mm^3)
Full-size (1FF)	ISO/IEC 7810:2003, ID-1	85.60	53.98	0.76	3511.72
Mini-SIM (2FF)	ISO/IEC 7810:2003, ID-000	25.00	15.00	0.76	285.00

TaxCore Backend.Api

TaxCore Backend.Api is a REST API exposed by a Tax Service’s system to E-SDC devices. It provides services used by the E-SDCs to submit Audit Packages, to notify TaxCore if the online status has been changed and to receive configuration commands.

E-SDC is authenticated by Backend.Api using a client digital certificate and an authentication Token.

Smart Cards

For standard operations, each E-SDC shall require a Smart card issued by a Tax Service, which consists of two applets:

- Secure element Applet, used to apply digital signature and maintain a set of fiscal counters in the offline mode
- PKI Applet, used to authenticate and establish a secure connection with the TaxCore Backend.Api web service.

Both applets share the same PIN code. PIN is chosen by a Taxpayer’s authorized person on a Tax Service’s portal during the fiscalization enrolment process or while requesting an additional POS Smart cards.

Each smart card is uniquely identified by UID - Unique Identifier. Each digital certificate issued for E-SDCs has UID embedded in the certificate’s subject field.

Secure element Applet

Secure element (SE) is a fiscal component implemented as a special software or a device designed to receive invoice data, perform signing and data processing and generate a response which is sent back to the caller for further actions. Response provides the authenticity of invoice data. Secure Element is issued and controlled by the Tax Service. The main purpose of the Secure element is to sign invoices using a taxpayer’s digital certificate, to control audits and to maintain a set of fiscal counters.

Each taxpayer is uniquely identified using digital certificates based on the Public Key Infrastructure (PKI).

Secure element will stop issuing invoices if the maximum allowed amount for that particular fiscal device is exceeded – this facilitates the regular audit and forces taxpayers to report back to the Tax Service system. Likewise, SE will continue to produce fiscal invoices once it receives proof from TaxCore Backend.Api that audit has been received and stored on the Tax Service's system.

PKI Applet

PKI Applet contains a digital certificate and a private key used to authenticate E-SDC to Backend.Api web services.

E-SDC States

The diagram in Figure 5 shows basic E-SDC states and transitions.

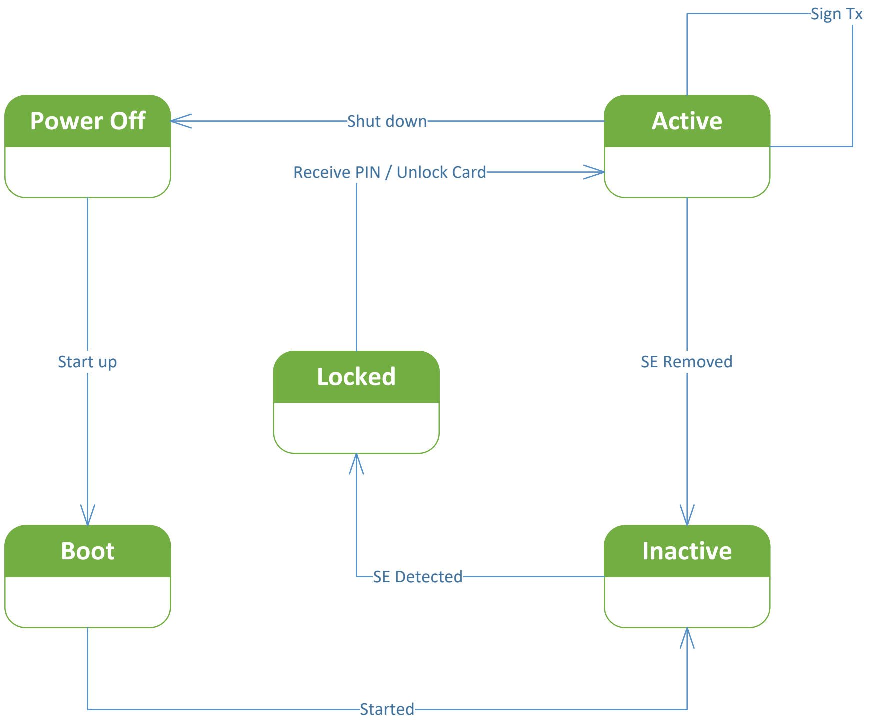


Figure 5 Basic E-SDC states

Authentication

Authentication against the Tax Service's system is performed using the taxpayer's digital certificate.

Digital Certificates and PIN Codes

The Tax Service's system issues a Secure Element to a taxpayer as follows:

1. Taxpayer's digital certificate is stored in the Secure Element.
2. The Secure Element is stored on the smart card.
3. The PIN or password is generated and printed on the PIN mailer.
4. The Secure Element and PIN code are securely delivered to the taxpayer.

Digital Certificates for Testing Purpose

The Tax Service will issue the requested number of test digital certificates to each accredited supplier and each accredited taxpayer.

Authentication Token

E-SDC uses an authentication token when calling the TaxCore API web services.

Authentication token is obtained from TaxCore API by calling the *RequestAuthenticationToken* web service and providing a Taxpayer's digital certificate.

Manuals

E-SDC shall have a user manual that explains in detail some of the following topics.

1. Installation instructions for the technicians performing the installation and integration of an E-SDC device or software on a sales point.
2. User instructions for the operator (cashier or shopkeeper) explaining normal operations in detail.
3. Local and/or remote audit instructions

Data Structures

UID

UID is a Unique Identifier (8 alphanumeric characters) assigned to each Smart card and embedded in the Subject field of a digital certificate as the SERIALNUMBER parameter.

UID can be obtained from the Secure Element Applet using the Export Certificate APDU command.

Amounts

TaxCore works with amounts presented as decimal numbers with 4 decimal places. For the sake of simplicity, all binary-based protocols (POS to E-SDC Communication over Serial Port and E-SDC to Secure element (APDU commands)) use integers representing the amount multiplied by 10,000. For example, the amount of 123,4567 will be converted into 1234567.

JSON based protocols use the standard decimal format.

Date and Time

E-SDC shall have access to the current time. Real Time Clock or similar component shall be installed and used to maintain the correct time while the power is off.

E-SDC synchronizes the time with the NTP Server, configured by the Configure Time Server URL Command.

UTC is the default time used by E-SDC for all purposes, except:

- Date and time sent by a POS to an E-SDC is the local time.
- Date and time printed on a journal (textual representation of an invoice) generated by an E-SDC is local time. (Fiji Winter Time is used as a local time if E-SDC cannot track daylight saving time).
- Date and time sent by an E-SDC to a POS is the local time (Fiji Winter Time is used as a local time if E-SDC cannot track daylight saving time).

JSON based protocols use date and time according to ISO 8601 where applicable (for example:

Date: **2019-12-11**

Date and time in UTC: **2019-12-11T10:06:33+00:00**

2019-12-11T10:06:33Z

20191211T100633Z

Week: **2019-W50**

Date with week number: **2019-W50-3**

Date without year: **--12-11[1]**

Ordinal date: **2019-345**

Time offsets are represented in format “**LocalTime+/-Zone**” as in case of **2019-12-11T10:06:33+00:00**).

Note: Date and Time display format on all TaxCore portals is: DateTimeDisplayFormat - "dd/MM/yyyy HH:mm:ss" (e.g. 15/10/2018 14:28:24)

All binary based protocols (POS to E-SDC Communication over Serial Port and E-SDC to Secure element (APDU commands)) use Unix Timestamp format formatted as a 64bit unsigned integer Big Endian (for example: 1495018011910 is 2017-05-17T10:46:51.910Z).

In case of a power outage, the Real Time Clock shall be able to operate uninterruptedly up to 6 months.

Tax Rates

Tax rate is a sales tax expressed as a percentage on the sale of goods and services (for a proportional tax), or fixed tax amount, as imposed by the government. One tax rate is uniquely identified by the tax label – a string (usually only one letter) which represents one tax rate. One label is related to one category, and it will never reappear within another category.

Tax category: one or more tax rates are grouped into a tax category – a group of different rates for the same tax type (e.g. VAT, Consumption, ECAL, etc.). If a tax rate (all rates under a category) is applied on the net price, then field *Type* for a category shall be set to 0 (proportional tax). If a tax rate (all rates under a category) is applied on the total amount (with other taxes included), the field *Type* for a category shall be set to 1 (proportional tax-on-total). If a tax (all rates under a category) is a fixed tax amount, the field *Type* for a category shall be set to 2 (amount-per-quantity).

Tax group: one or more tax categories are grouped into a **tax group** – a set of all taxes imposed by the government applied on any points of sale within a period of time. A tax group consists of an ID, which represents tax revision and a date/time which defines the moment when the new taxes shall take effect.

E-SDC receives the tax groups via Set Tax Rates Command on the E-SDC Initialization process or information if taxes have been changed.

Model

Field	**Type**	**Description**
TaxRateGroup		
ValidFrom	Date time	Date when a tax rates group shall enter into force
GroupId	32 bit integer	Revision number for all taxes under a tax rates group
TaxCategories	Array of TaxCategory	All tax categories under one tax rates group
TaxCategory		
CategoryId	32 bit integer	Unique ID of a category (system-wise)
Name	Unicode String	Name of a tax (tax category).
Type	32 bit integer	One of the following tax category types: 0 (tax-on-net) - all tax rates from this category are proportional, and shall be applied on the net price; 1 (tax-on-total) - all tax rates from this category are

		proportional, and shall be applied on the total amount; 2 (amount-per-quantity) - all tax rates from this category are fixed tax amounts, which shall be multiplied with item quantity.
OrderId	32 bit integer	Order number for a tax category. It uniquely identifies the tax. It is related to the category Name meaning even if the name changes for the tax category, it's OrderId will remain the same, pointing to the same tax. It is crucial for Sign Invoice APDU command
TaxRates	Array of TaxRate	All tax rates for a tax (category)
TaxRate		
RateId	32 bit integer	Unique ID of a tax rate (system-wise)
Label	Unicode String	Label for a tax rate, unique within a tax group, always belongs to one tax category.
Rate	Decimal	Rate percentage for a proportional tax, or tax amount for a fixed tax.

Table 2 Tax rates data structure

Example

```
"TaxRateGroup": {
       "ValidFrom": "2017-07-02T00:00:00",
       "GroupId": "1",
       "TaxCategories": [{
              "CategoryId": 1002,
              "Name": "VAT",
              "Type": 0,
              "TaxRates": [{
                     "RateId": 1002,
                     "Rate": 6.0,
                     "Label": "A"
              },
              {
                     "RateId": 1003,
                     "Rate": 10.0,
                     "Label": "B"
              },
              {
                     "RateId": 1004,
                     "Rate": 20.0,
                     "Label": "C"
              }],
              "OrderId": 1,
       },
       {
              "CategoryId": 1003,
              "Name": "STT",
              "Type": 1,
            "TaxRates": [{
                    "RateId": 1005,
                    "Rate": 25.0,
                    "Label": "D"
            }],
            "OrderId": 2,
        },
        {
            "CategoryId": 1004,
            "Name": "ECAL",
            "Type": 2,
            "TaxRates": [{
                    "RateId": 1006,
                    "Rate": 10.0,
                    "Label": "E"
            }],
            "OrderId": 3,
        }]
}
```

Tax Amounts

It is essential to note, that POS never uses other taxes except the ones received from SDC. POS displays the total prices and only the tax values received from SDC device, in the format described in previous section.

A tax label can fall into one of the three tax types: Tax, Tax on Total and Amount per Quantity.

Tax amount for a tax label is calculated per the following formulas:

Tax Type	Formula	Explanation
Tax	**Tax Amount** = ∑(Base price * (**Rate/100**))	for each item with this label
Tax on Total	**Tax Amount** = ∑(Total price * (**Rate/100**))	for each item with this label (Total price here is item base price with all other regular taxes included)
Amount per Quantity	**Tax Amount** = ∑(Fix amount * quantity)	for each item with this label, item quantity is multiplied with fix amount as defined by tax Service. If other tax labels are defined on item, those taxes are calculated on the remainder

Fiscal Invoices

This section defines the minimum set of attributes required to produce a fiscal invoice.

Fiscal invoice is, by definition, a digitally signed acknowledgment that a specified payment has been received or refunded. Fiscalization of an invoice is a process of applying a digital signature on the electronic content of the invoice by the Secure Element

Each invoice is associated with one of the following invoice types:

- “Normal”, as a result of a normal operation consisting of receiving the transmission of goods and provision of services;
- “Training”, for limited use in the training environment. It may be generated on the basis of information from a simulated receipt in “Normal” fiscal mode;
- “Copy”, re-issuing of a normal type receipt

- “Pro-forma”, which has the characteristics of an original receipt. However, such receipts are not fiscally usable for proof of transmission of goods and services.

Each invoice type is associated with one of the following transaction types:

- sale;
- refund.

Each invoice type is associated with one of the following payment types:

- Cash
- Card
- Check
- Wire transfer
- Mobile money
- Voucher
- Other

Unique Identification of a Fiscal Invoice

A fiscal invoice is uniquely identified by Invoice number - the combination of the invoice ordinal number and the Secure Element identification number (UID). Invoice number is defined in the following format:

UID1-UID2-Ordinal_Number

Where:

- **UID1 and UID2** are identical for the invoice issued by E-SDC and
- **Ordinal_Number** is a number generated by the Secure Element, after each invoice signing, representing a total count of invoices signed by that Secure Element.

Key Elements

A fiscal invoice must contain the following parts (it may also contain additional data if it is required by a specific industry):

Invoice Request

Invoice Request is created by an Accredited POS and it contains the usual invoice information like items, tax labels and invoice number. The invoice request is submitted by the Accredited POS using standard, publicly available protocol for communication to E-SDC, using the preferred technology of the POS system.

Invoice Response

Invoice Response is generated by E-SDC after data validation. It is an integral part of any fiscal invoice. Without this information, an invoice could not be considered a legal fiscal invoice.

Signature

Digital signature applied on the content of an electronic invoice by the Secure Element.

Internal Data

Internal data contains encrypted fiscal data. The content of the internal data is readable by the Tax Service system only.

Verification URL

URL of verification service is used to verify the authenticity of the particular fiscal invoice for customer convenience. It shall be represented as a QR code on a printed receipt or as a hyperlink in an electronic document (e.g. an email).

Json Representation of the Invoice

As previously described, each Invoice consists of two separate data structures.

`InvoiceFiscalizationRequest` – this object is created by POS and submitted to E-SDC

`InvoiceFiscalizationResponse` – this object is created by E-SDC and returned to POS

Model

This Model is designed and based on OpenAPI-Specification V2 (https://github.com/OAI/OpenAPI-Specification).

```
Invoice {
       Request (InvoiceFiscalizationRequest),
       Result (InvoiceFiscalizationResult)
}
```

Anatomy of Fiscal Receipt

A receipt records the sale of goods or the provision of a service. The table below explains the structure of a fiscal receipt. All elements are mandatory unless specified otherwise in the column Explanations. POS is free to print any content (coupons, logos, etc.) before the beginning and after the ending mark of the fiscal invoice.

Textual representation of Fiscal Invoice	Explanations
`============ FISCAL INVOICE ============`	**Title line** – marks the beginning of the fiscal part of receipt

`TIN: 502579006`
`Company: Golf V`
`Store: Sun Store`
`Address: 7 Someplace`
`District: Suva`
	Header data is provided by E-SDC during fiscalization of the invoice and returned to POS as part of the *InvoiceFiscalizationResult* object (explained in section Invoice Response).
	Values are extracted from the subject field of the digital certificate stored in the Secure Element Applet.

`Cashier TIN: 1234567890`	Cashier's identification. Local regulations might mandate POS to send particular data instead of cahier's name like Employee ID or some other information that uniquely identifies the POS cashier.

`Buyer TIN: 5123456789`
`Buyer Cost Centre: 123`
`POS number: POS2017/998`
`POS time: 15/6/2017 8:56:23AM`
	Buyer TIN is mandatory only in case of B2B transaction and in that case, it must be printed on the receipt. **Buyer Cost Center** is optional and reserved for further use, it must be present only for B2B transactions. **POS (Invoice) Number** and **POS (Invoice) time** are optional fields.

`Ref no: P22VC8VR-JTJC5V65-114906`	**Reference (Document) Number** is required only for Refund or Copy invoice type. In that case, **Ref no** must be printed on the receipt (and on the journal), containing **SDC Invoice No** of any issued Invoice or Refund, in format RequestedBy-SignedBy-Ordinal_Number. For any other invoice/transaction type (for example Normal Sale invoice referencing to Proforma Sale invoice) this field is optional.
`--------------NORMAL SALE---------------`	**Invoice** and **transaction type** description. Normal Sale and Normal Refund are the most common types. Other types of transactions and

	invoices are defined in section Fiscal Invoices.

`Items`
`========================================`
`Name        Price       Qty.       Total`
`Sport-100 Helmet, Blue (E)`
`          34.99          10       349.90`
`Mountain Bike Socks, M (A)`
`           9.03           4        36.12`
`HL Road Frame - Red, 58 (F, A)`
`        1431.50           2      2863.00`
`Plastic bag (P)`
`           0.10           5         0.50`
	List of items with **gross price**, **tax labels**, **unit price** and **quantity**.
	
	Tax Labels and their validity dates shall be published by Tax Service.

`----------------------------------------`
`Total Purchase:                  3249.52`
`Payment Method:                     Cash`
`========================================`
`Label        Name      Rate          Tax`
`E             STT     6.00%        19.81`
`A             VAT     9.00%       219.51`
`F            ECAL    10.00%       240.59`
`P              PB     0.10$         0.50`
`----------------------------------------`
`Total Tax:                        480.41`
	Total Purchase, **Tax items** and **Total Tax** are calculated by V-SDC or E-SDC during fiscalization of the invoice and are returned to POS as a part of the response.
	Payment Method: Cash, Card, Check, Wire Transfer, Voucher, Mobile Money, or Other.
	Taxpayer's tax liability is based on these tax amounts, calculated by V-SDC or E-SDC.
	
	The calculation is explained in the section Tax Amounts.
	
	In the case of Refund, Total Refunded should be printed instead of Total Purchase.

`========================================`
`SDC Time:            2017-06-15 08:56:25`
`SDC Invoice No:    7AF4D923-E3B30A31-234`
`Invoice Counter:               230/234NS`
`========================================`
	Fiscal metadata added to the invoice through fiscalization.
	SDC Invoice No - Combination of Requested By (7AF4D923), Signed By (E3B30A31) and Ordinal Invoice Number (234) is a system-wide unique identification of fiscal invoice. It may be used instead of the current receipt/invoice number generated by POS.
	SDC Time is the official date and time relevant to the tax calculation and reporting.
	Invoice Counter is generated by V-SDC or E-SDC and explained in section Invoice Response, field IC.

	QR Code contains Invoice verification URL. QR Code also contains Internal data and digital signature used for the invoice verification. Invoice is verifiable by the customer immediately after fiscalization. In case an invoice/receipt is delivered as an electronic document (email), QR Code shall be substituted with Invoice verification URL in (clickable) hyperlink format. **NOTE:** This is just a sample QR code image, not an actual URL.
`======== END OF FISCAL INVOICE =========`	**Title line** – marks the end of the fiscal part of a receipt
`This is a custom message`	Custom message returned from V-SDC or E-SDC

Normal Refund Receipt

Receipt for Normal Refund Invoice must contain visible markings “REFUND”, below the receipt header and above the item description section. Totals on the refund receipt are displayed as negative values, starting with (-), except for Total Refunded. Tax Items are displayed as positive values.

For Refund transaction type **Ref no** element is mandatory.

Example:

```
============ FISCAL INVOICE ============
TIN:                           502579006
```

```
Company:                          Golf V
Store:                         Sun Store
Address:                     7 Someplace
District:                           Suva
Cashier TIN:                   123456789
POS number:                89347415-2017
POS time:            2018-03-09 14:57:25
Ref no:            7AF4D923-E3B30A31-234
-------------NORMAL REFUND--------------
Items
========================================
Name    Price        Qty.          Total
Sport-100 Helmet, Blue (E)
        34.99         10         -349.90
Mountain Bike Socks, M (A)
         9.03          4          -36.12
----------------------------------------
Total Refunded:                   386.02
Payment Method:                     Cash
========================================
Label        Name     Rate           Tax
E             STT    6.00%         19.81
A             VAT    9.00%          2.98
----------------------------------------
Total Tax:                         22.79
========================================
SDC Time:            2018-03-09 14:57:46
SDC Invoice No:    7AF4D923-E3B30A31-235
Invoice Counter:                4/235NR
========================================
---- QR code omitted for simplicity ----
======== END OF FISCAL INVOICE =========
```

Training or Proforma or Copy Receipt

Receipt for Training or Proforma or Copy Invoice must contain visible markings "TRAINING" or "PROFORMA" or "COPY", below the receipt header and above the item description section.

Receipt must also contain **"THIS IS NOT A FISCAL INVOICE"** below the total amount payable. Font size is at least twice the size of the text on the receipt that specifies the total amount payable.

Training or Proforma or Copy receipt is produced in the same way as normal, with an exception that totals are not accounted for.

For Copy invoice type **Reference Document Number** element is mandatory.

Example:

```
===== THIS IS NOT A FISCAL RECEIPT =====
TIN:                           502579006
Company:                          Golf V
Store:                         Sun Store
Address:                     7 Someplace
District:                           Suva
Cashier TIN:                   123456789
POS number:                89347415-2017
POS time:            2018-03-09 14:57:25
-------------TRAINING SALE--------------
Items
========================================
Name    Price        Qty.          Total
Sport-100 Helmet, Blue (E)
        34.99         10          349.90
Mountain Bike Socks, M (A)
         9.03          4           36.12
----------------------------------------
Total Purchase:                   386.02
Payment Method:                     Cash
```

```
========================================
      THIS IS NOT A FISCAL INVOICE
========================================
Label         Name     Rate          Tax
E              STT    6.00%        19.81
A              VAT    9.00%         2.98
----------------------------------------
Total Tax:                         22.79
========================================
SDC Time:            2018-03-08 14:57:46
SDC Invoice No:    7AF4D923-E3B30A31-236
Invoice Counter:                1/236TS
========================================
---- QR code omitted for simplicity ----
===== THIS IS NOT A FISCAL RECEIPT =====
```

Audits

Audit data represents machine readable formatted fiscal invoice signed by a taxpayer's private key followed by journal data. Journal data is textual representation of a fiscal invoice generated by E-SDC.

Content of audit data is kept in encrypted form (audit package) ensuring no changes have been made and that no one has been able to access its content after creation, except the Tax Service's system, after a successful audit process.

Encryption of Audit Data

Encryption of audit data prevents access to sales data by unauthorized persons. The only one that can decrypt audit data is the Tax Service's system software running on the Tax Service premises and used by the authorized personnel only.

Format of the Audit Package

The Audit Package is a textual file in JSON format

```
AuditData {
        Key (string),
        IV (string),
        Payload (string)
}
```

Field	Type	Description
Key	Base64 Encoded String	One-time symmetric key (256Bit long) encrypted using RSA with Taxcore public key
IV	Base64 Encoded String	Initialization vector Key encrypted using RSA and TaxCore public key
Payload	Base64 Encoded String	Base64Encoded JSON format of an invoice, as described in section Json Representation of the Invoice, encrypted with **Key** and **IV** using AES256 algorithm.

Commands

Commands are a means of communication between the Tax Service's system and E-SDCs. Commands are stacked in the queue list on the server for a specific E-SDC and submitted to the E-SDC as a part of the response once it reports to the Tax Service's system using a remote or a Local audit.

Commands are always delivered as an array structure. Commands shall be executed in a consecutive order, starting from the first one in the array.

Below is the data structure of a single command:

```
Command {
   "CommandId": (GUID),
   "Type": (enum CommandsType),
   "Payload": (Json string)
 }

enum CommandsType
 {
     UpdateTaxRates = 0,
     UpdateNTPServiceUrl = 1,
     UpdateVerificationURL = 2,
     UpdatePAC = 3, // reserved for later use
     TaxCorePublicKey = 4 // deprecated,
     EndProofOfAudit = 5
 }
```

CommandId is a unique identifier assigned by Tax Service's system. Once a command is successfully executed, Backend.Api shall be notified as described in the **Error! Reference source not found.** section of this document.

Type defines the type of command and a format of a Payload as described in the following sections. Valid values are defined by `CommandsType` enum.

Payload transfers the information form Backend.Api to an E-SDC in Json format. The format of each type is described in the following sections.

Configure Time Server URL Command

E-SDC shall update the URL of the time server used to keep a local clock in sync. Payload is the URL of the target NTP server.

Set Tax Rates Command

Payload contains a group of all new tax rates which shall be applied from the specified date and time. The structure of a group is defined in section Tax Rates. The date can be in the past or (more likely) in the future. Tax rates with the future date shall be stored in non-volatile memory and applied starting from the specified moment. If more than one group has the same date, the one with higher GroupId shall be applied.

The payload of the command is structured as follows:

```
{
       "TaxRateGroup": {
              "ValidFrom": "2017-07-02T00:00:00",
              "GroupId": "1",
              "TaxCategories": [{
                     "CategoryId": 1002,
                     "Name": "VAT",
                     "Type": 0,
                     "TaxRates": [{
                            "RateId": 1002,
                                "Rate": 6.0,
                                "Label": "A"
                        },
                        {
                                "RateId": 1003,
                                "Rate": 10.0,
                                "Label": "B"
                        },
                        {
                                "RateId": 1004,
                                "Rate": 20.0,
                                "Label": "C"
                        }],
                        "OrderId": 1,
                },
                {
                        "CategoryId": 1003,
                        "Name": "STT",
                        "Type": 1,
                        "TaxRates": [{
                                "RateId": 1005,
                                "Rate": 25.0,
                                "Label": "D"
                        }],
                        "OrderId": 2,
                }]
        }
}
```

Update Verification URL Command

As a part of the invoice fiscalization, an E-SDC creates a unique URL for generating a QR code and validates an invoice. Verification URL is returned to the POS as a part of the Response. This command tells the E-SDC which URL will be used to Create Verification URL.

Payload is a URL of the server used to verify invoices. Detailed instructions for Verification URL creation are explained in the Create Verification URL section.

Example: https://fe.staging.vms.frcs.org.fj/v/?vl={Query String Parameter Constructed By E-SDC}

Proof of Audit Command

Proof of audit command payload is transmitted to the Secure Element applet on the smart card (End Audit APDU command) once the audit process is completed successfully on the Tax Service's system.

The payload is a byte array encoded as a base64 string.

Commands Results

Commands Results is a confirmation to Backend.Api that a certain command is executed.

Model

```
CommandResults {
      "CommandId": (GUID),
      "Success": (boolean),
      "DateAndTime": (string)
    }
```

Example

```
{
  "CommandResults": [
    {
      "CommandId": "945bb863-5c7f-4826-9ae3-26debcac331a",
      "Success": 1,
      "DateAndTime": "2017-06-17T04:33:47+00:00"
    }
  ]
}
```

Processes

This section describes processes performed by an E-SDC.

E-SDC Initialization

Prior to the first use, the E-SDC has to be initialized. E-SDC shall have access to the Secure Element during the initialization process in order to establish a secure connection with the TaxCore Backend.Api to obtain a set of initialization commands. Commands are explained in the section Commands. In case of the poor or no internet connection, configuration commands can be uploaded via file-based communication as explained in section E-SDC Stores Audit Files on SD Card.

Initialization of E-SDC has to be performed each time a new smart card is inserted into the reader.

Standard Operation

Enter PIN to Unlock Secure element

Before the Secure Element applet can be used, a valid PIN code shall be supplied from the POS using the serial or the Ethernet connection. Once the E-SDC receives a PIN code, it will try to execute *Pin Verify* APDU command. Depending on the provided PIN, the SE will remain either unlocked for further use or locked until a valid PIN is entered. E-SDC will send a response to the POS based on the result of the *PIN Verify* command execution.

It is important to note the SE interprets data as byte containing digits, so appropriate conversion shall be done by E-SDC before data is sent to the Secure element. For example, if a PIN transmitted from a POS is “2017” (0x32 0x30 0x31 0x37 in ASCII hexadecimal representation), data sent to the SE shall be 0x02 0x00 0x01 0x07.

Fiscalization of an Invoice

Invoice fiscalization is the main function of an E-SDC. The following steps shall be executed by the E-SDC once a request data is received from an Accredited POS:

1. POS generates a request data and sends it as a request to the E-SDC using Json via HTTP or Serial protocol;
2. E-SDC verifies format of the invoice;
3. E-SDC calculates taxes based on the current tax rates;
4. E-SDC sends the invoice data to the Secure Element for fiscalization providing current date and time and PIN code/password if required;
5. Secure element signs the invoice and returns the data to the E-SDC;
6. E-SDC produces a journal file – a textual representation of an invoice;
7. E-SDC generates a verification URL
8. [optionally] E-SDC creates QR Code – a graphical representation of a verification URL;
9. E-SDC creates an invoice with all mandatory elements (receipt data, previously generated signature, verification URL and journal), generates a one-time key and encrypts the invoice using a symmetric algorithm. The E-SDC encrypts a one-time symmetric key using the Tax Service’s system public key and adds it to the package so the Tax Service’s system shall decrypt the symmetric key and access the package content once it arrives to the Service’s system.
10. E-SDC returns response to the POS and optionally generated journal data.

The previous process is illustrated on Figure 6.

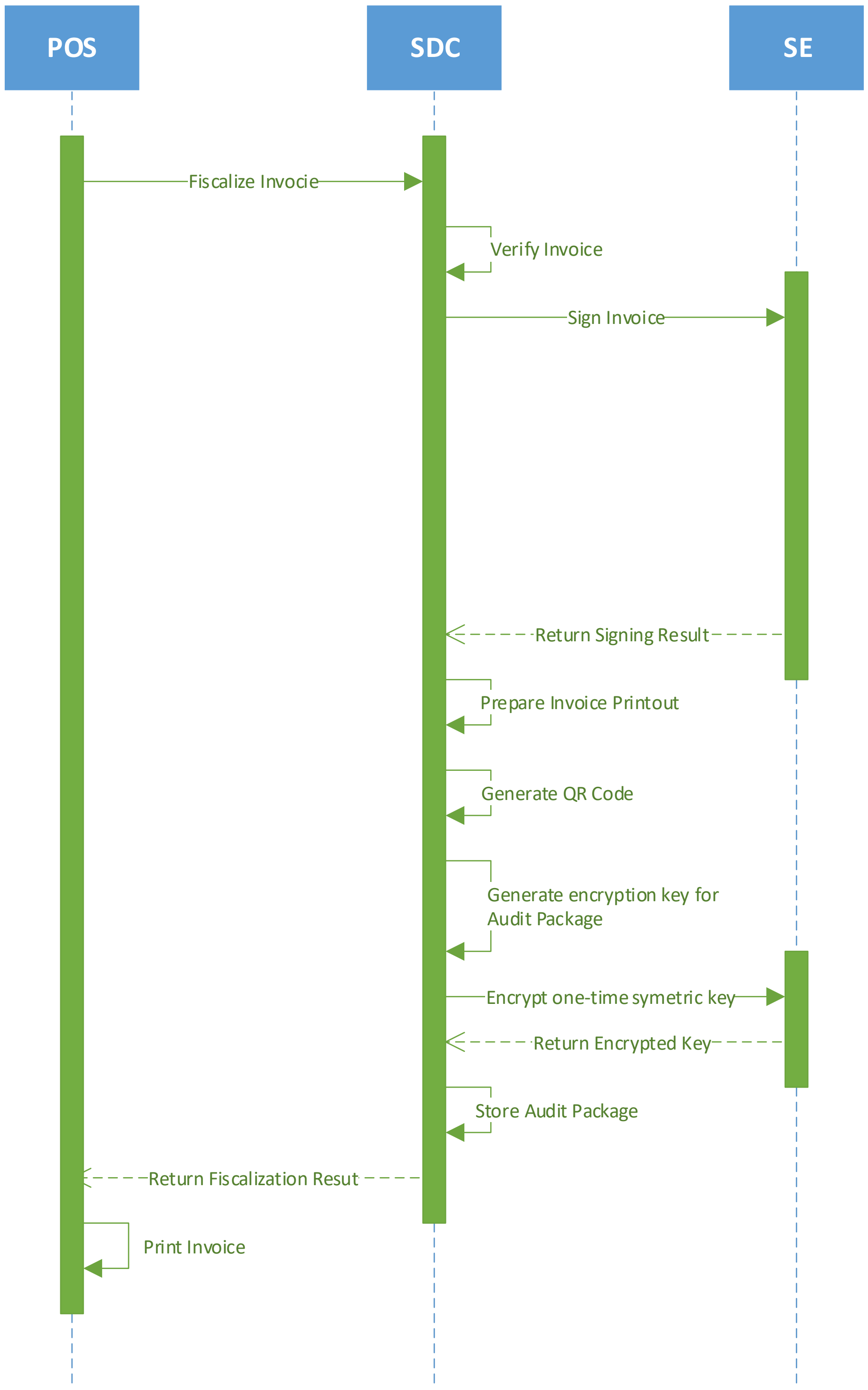


Figure 6 Invoice fiscalization sequence diagram

Calculate Taxes

Taxes are calculated by an E-SDC after a POS has sent a valid request. Tax amount for particular items on an invoice is defined by the tax labels associated with an item.

Process of a tax calculation depends on:

- Invoice and Transaction Type
- the tax rates for each label associated with an item on an invoice
- the *Type* value of tax category to which the label belongs

A POS sends an invoice fiscalization request with the line items. Items are sent with the total amounts (taxes included) and zero or more tax labels associated with them, which participated in the total price calculation.

In order to calculate a tax, the following algorithm shall be implemented:

1. Make an array of distinct tax labels associated with the items in the POS request (e.g. A, B, C, F, …).
2. Calculate the tax amount for each individual label in the array:
   a. Iterate through all items in the POS request
   b. For each item, calculate tax amounts. One item has one or more tax labels, and each label represents a tax amount. Each tax amount is a part of an item's total price. These tax amounts are calculated as follows:
      i. If an item has a label from the **amount-on-quantity** category applied, subtract the tax rate amount for that label, multiplied with quantity, from the item total price. The resulting amount (the remainder), is used in all further calculation steps instead of item total amount.
      ii. If none of the labels' tax category type is ***tax-on-total*** (category 1):
         - Tax amount for one label is: $\frac{item\ total\ amount * label\ rate}{(100+\Sigma(all\ tax{-}on{-}net\ rates\ on\ item))}$

         Example 1: An item has a total price of 10$ and applied labels: A(5%) and B(6%).
         $A = \frac{10\$ * 5}{(100+\Sigma(5+6))}$ $B = \frac{10\$ * 6}{(100+\Sigma(5+6))}$
         Tax amount for label A=0.4505$ and for label B=0.5405$.

      iii. If any of the labels' tax category is ***tax-on-total*** (category 1):
         - Tax amount for every label whose category type is ***tax-on-total*** (category 1) is: $\frac{item\ total\ amount}{(1+\Sigma(all\ tax{-}on{-}total\ rates)/100)} * \frac{label\ rate}{100}$
         - Tax amount for every other label from category 0 is: $\frac{item\ total\ amount}{(1+\Sigma(all\ tax{-}on{-}total\ rates)/100)} * \frac{label\ rate}{(100+\Sigma(all\ tax{-}on{-}net\ rates\ on\ item))}$

         Example 2: Item has a total price 10$ and applied labels: A(5% tax-on-net), B(6% tax-on-net), C(3% tax-on-total) and F(4% tax-on-total).
         $C = \frac{10\$}{(1+\Sigma(3+4)/100)} * \frac{3}{100}$ $F = \frac{10\$}{(1+\Sigma(3+4)/100)} * \frac{4}{100}$
         $A = \frac{10\$}{(1+\Sigma(3+4)/100)} * \frac{5}{(100+\Sigma(5+6))}$ $B = \frac{10\$}{(1+\Sigma(3+4)/100)} * \frac{6}{(100+\Sigma(5+6))}$
         Tax amount for label A=0.4210$, for label B=0.5052$ for label C=0.2804$ and for label F=0.3738$.

      iv. Add calculated labels' tax amounts to the label's total amount sum.

Example 3: the request contains two items from Example 1 and Example 2, the total sum for labels are: A=0.8715$, B=1.0457$, C=0.2804$, F=0.3738$.

v. Add fixed tax amounts, multiplied with quantity, to the respective labels' total amount sum.
Example 4: An item has quantity 2 with total price 10$ and applied labels: A(5% tax-on-net) and E(0.10$ fixed tax) , total sum for labels are: A=0.4667$, E=0.2000$.
Example 5: An item has quantity 2 with total price 10$ and applied labels: A(5% tax-on-net), C(3% tax-on-total) and E(0.10$ fixed tax) , total sum for labels are: A=0.4531$, C=0.2854$, E=0.2000$.

3. After all of the items have been processed, calculate the tax amount for all tax categories found in the request. One tax category can consist of one or more tax labels (e.g. A, B…). The tax amount for a tax category is a sum of all label tax amounts related to the category.
Example 6: the request contains two items from Example 1 and Example 2. Labels A and B are VAT category, C is STT category and F is ET category. Total VAT=1.9172$, STT=0.2804$, ET=0.3738$.

Once the Tax calculation is completed, assign GroupId of the active tax rate group to the field TaxGroupRevision of InvoiceFiscalizationResult.

Rounding

E-SDC shall round all amounts to 4 decimal places using the half-round up method.

Examples:

```
3.44445555666  -> 3.4445
3.4440012345   -> 3.4440
3.44466012345  -> 3.4447
3.444116012345 -> 3.4441
```

Create Verification URL

Verification URL is created based on values submitted by a POS to an E-SDC and values returned to the E-SDC from APDU commands as follows:

1. Byte array is created:

Start	Offset (Bytes)	Invoice Field	Description
0	1	Version	Current version is 0x02
1	8	RequestedBy	UID, ASCII encoding (e.g. JKGB3K14)
9	8	SignedBy	UID, ASCII encoding (e.g. JKGB3K14)
17	4	TotalCounter	Int32 Little Endian
21	4	DocTypeCounter	Int32 Little Endian
25	8	TotalAmount	TotalInvoiceAmount * 10000 as Uint64 bit Little Endian
29	8	DateAndTime	Unix Timestamp (number of milliseconds), 64bit unsigned integer Big Endian
37	1	InvoiceType	0x00 (Normal), 0x01 (Pro Forma), 0x02 (Copy), 0x03(Training)

38	1	TransactionType	0x00 (Sale), 0x01 (Refund)
39	1	BuyerId Length	Buyer ID length in bytes
40	?	BuyerId	ASCII Encoding
?	?	EncryptedInternal Data	Encrypted Internal Data received from SE after Invoice Sign APDU command, 256 or 512 bytes long
?	256	Signature	Signature received from SE after Invoice Sign APDU command, 256 bytes long

2. Created byte array is encoded as base64 string, which is additionally encoded, to comply with the URL standards.
3. Encoded string is appended to the verification URL received from the Update Verification URL Command

Create QR Code

1. QR code contains a verification URL created in the previous section (Create Verification URL)
2. Base64 encoded string is created from GIF image bytes and attached to the Response

Create a Textual Representation of an Invoice (Receipt)

A textual representation of a Receipt shall be created as described in the chapter Anatomy of Fiscal Receipt. One row on a receipt is 40 characters long to fit 2.25 inch / 58 mm wide paper roll commonly used in thermal printers.

SDC Date and Time field printed on a journal (textual representation of an invoice) generated by E-SDC are **local time-based**.

Any amount shall be rounded to 2 (two) decimal places using the half-round up method only on the textual representation of an invoice.

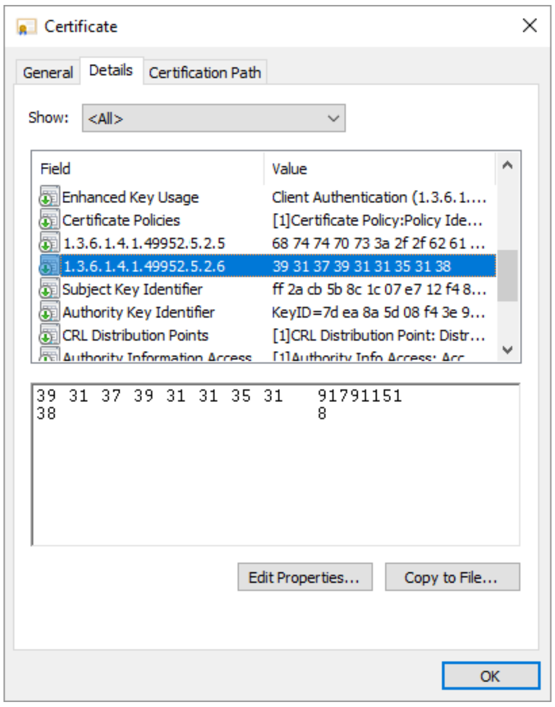
How to Obtain a Tax Identification Number (TIN)

Digital certificate exported using Export Certificate APDU command (in DER format) contains taxpayer TIN and POS location (Shop or HQ Address that shall appear on the textual representation of the invoice).

TIN is stored in the digital certificate as an OID value. OID is dynamically created during a smart card personalization and depends on the target environment. The Test and Production environments will have different OIDs.

In order to use the same E-SDC with the Test and Production environments, the correct OID has to be constructed using the following procedure:

1. Get the certificate using Export Certificate APDU command;
2. Read value of EnhancedKeyUsage (for example, 1.3.6.1.4.1.49952.**5**.**2**.3.3);
3. The fourth and the third integer to the right identify the environment;
4. Construct the OID that contains TIN, by replacing stars with the numbers using the following pattern - 1.3.6.1.4.1.49952.*****.*****.6;
5. For this example, resulting OID will be 1.3.6.1.4.1.49952.**5**.**2**.6;
6. Read the value of resulting OID containing Taxpayer TIN.


Certificate

General | Details | Certification Path

Show: <All>

Field	Value
Enhanced Key Usage	Client Authentication (1.3.6.1....
Certificate Policies	[1]Certificate Policy:Policy Ide...
1.3.6.1.4.1.49952.5.2.5	68 74 74 70 73 3a 2f 2f 62 61 ...
1.3.6.1.4.1.49952.5.2.6	39 31 37 39 31 31 35 31 38
Subject Key Identifier	ff 2a cb 5b 8c 1c 07 e7 12 f4 8...
Authority Key Identifier	KeyID=7d ea 8a 5d 08 f4 3e 9...
CRL Distribution Points	[1]CRL Distribution Point: Distr...
Authority Information Access	[1]Authority Info Access: Acc

```
39 31 37 39 31 31 35 31   91791151
38                        8
```

Mapping Subject to Invoice fields

Digital certificate exported using the Export Certificate APDU command (in DER format) contains taxpayer TIN and POS location (Shop or HQ Address that shall appear on the textual representation of the invoice).

This example shows mapping between a subject name/value pairs and invoice fields.

Subject Field (**bolded** parameters are always present in the subject):

```
E = someone@test.taxcore.dti.rs
CN = P22V International Trek Center
SERIALNUMBER = P22VC8VR
G = Albert
SN = Mungin
OU = International Trek Center
O = International Trek Center
STREET = 8844 Garcia
L = West Covina
S = California
C = US
```

Invoice Field	Subject Parameter Name	Note
TIN	N/A	obtained by OID as explained in How to Obtain Tax Identification Number (TIN)
Business Name	O	Legal name under which business operates
Shop Name	OU	It may be the same as Business Name if the Company HQ and sales location are the same.
Address	STREET	Street name and number

State	S	State, District or Region
Country	C	ISO 2-letter Country Code. Optional field on the textual representation of the invoice

Creating an Audit Package

Once an invoice is created (InvoiceFiscalizationRequest and InvoiceFiscalizationResult) the E-SDC is ready to create an audit package and store it in the non-volatile memory. In order to achieve that, follow these steps:

1. Convert all Date and Time data to UTC;
2. Generate a random one-time symmetric key for AES256;
3. Encrypt string JSON representation of the invoice using the one-time key;
4. Convert the encrypted invoice to base64 string and store it in the Payload field of Json Representation of the Invoice;
5. Get the TaxCore Public key using Export TaxCore Public Key APDU command.
6. Encrypt the one-time key using RSA with TaxCore public key, convert it to base64 string and store it in the Key field;
7. Encrypt Initialization Vector (IV) using RSA with TaxCore public key, convert it to base64 string and store it in the IV field;
8. Save the Audits as an Audit Package file, named as {**UID**}-{**Ordinal_Number**}.json;
9. (Optionally) Generate a QR code, and attach it to InvoiceFiscalizationResult (<u>make sure that the QR code is not stored in the Audit Package</u>);
10. Return InvoiceFiscalizationResult to the POS;
11. If the internet connection is available try to send the Audit Data to Backend.Api as explained in the section Remote Audit;

Audit Process

An audit is a process of sequential transferring of audit packages from an E-SDC to the Tax Service's system and handling the response generated by the Service's system for the specific device.

There are two specific scenarios: Remote Audit and Local Audit. Basic rules and processes described in this section apply to both scenarios. Details will be explained in the separate sections.

An audit is always a synchronous process. Depending on the amount of data and means of communication, it can take from less than a second to a couple of hours.

Once the E-SDC receives a response (signed invoice and journal) from the Secure Element, it shall be encrypted and stored in the non-volatile memory.

An E-SDC device shall be fully functional during an audit. The POS shall be able to sign new invoices as long as the Secure Element permits. There shall be a mechanism in place that is responsible for the continuous operation of the Secure Element and E-SDC while audit packages are on its way to the Tax Service's system.

Depending on the connection availability, an audit may be triggered by the arrival of a signed invoice from the Secure Element or upon the insertion of an external memory device into the E-SDC. Regardless of the event which has triggered the audit, the following conversation shall take place between the E-SDC, the Tax Service's system and the Secure Element:

1. E-SDC signals the beginning of the audit to the Secure Element (Invokes Start Audit APDU command);

2. The Secure Element returns ARP (256 bytes) to the E-SDC;
3. E-SDC starts the audit by sending audit data (over HTTPS) or dumping them on external memory (e.g. SD card, USB flash drive), starting with the oldest unaudited package, in a piecemeal fashion. ARP is sent to the Tax Service's system using the same communication channel;
4. If verification is successful, the Tax Service's system shall generate a proof of audit (PoA) and return it as a Proof of Audit Command;
5. E-SDC receives the proof of audit command and passes the payload to the End Audit APDU command;
6. The Secure Element verifies if proof of audit is valid, meaning the audit data has been successfully received by the Tax Service's system;
7. If proof of audit is valid, the Secure Element will conclude the audit process;

ARP should be generated and sent to Tax Service's system periodically (for example, after each 200 audit packages are submitted to backend API or once per day regardless of the number of submitted audit packages) if HTTP-based communication is used to submit audit packages.

ARP should be generated and saved as file each time at least one audit package is submitted to the Tax Service's system using USB memory stick (File-based communication).

The audit process sequence is illustrated on Figure 7.

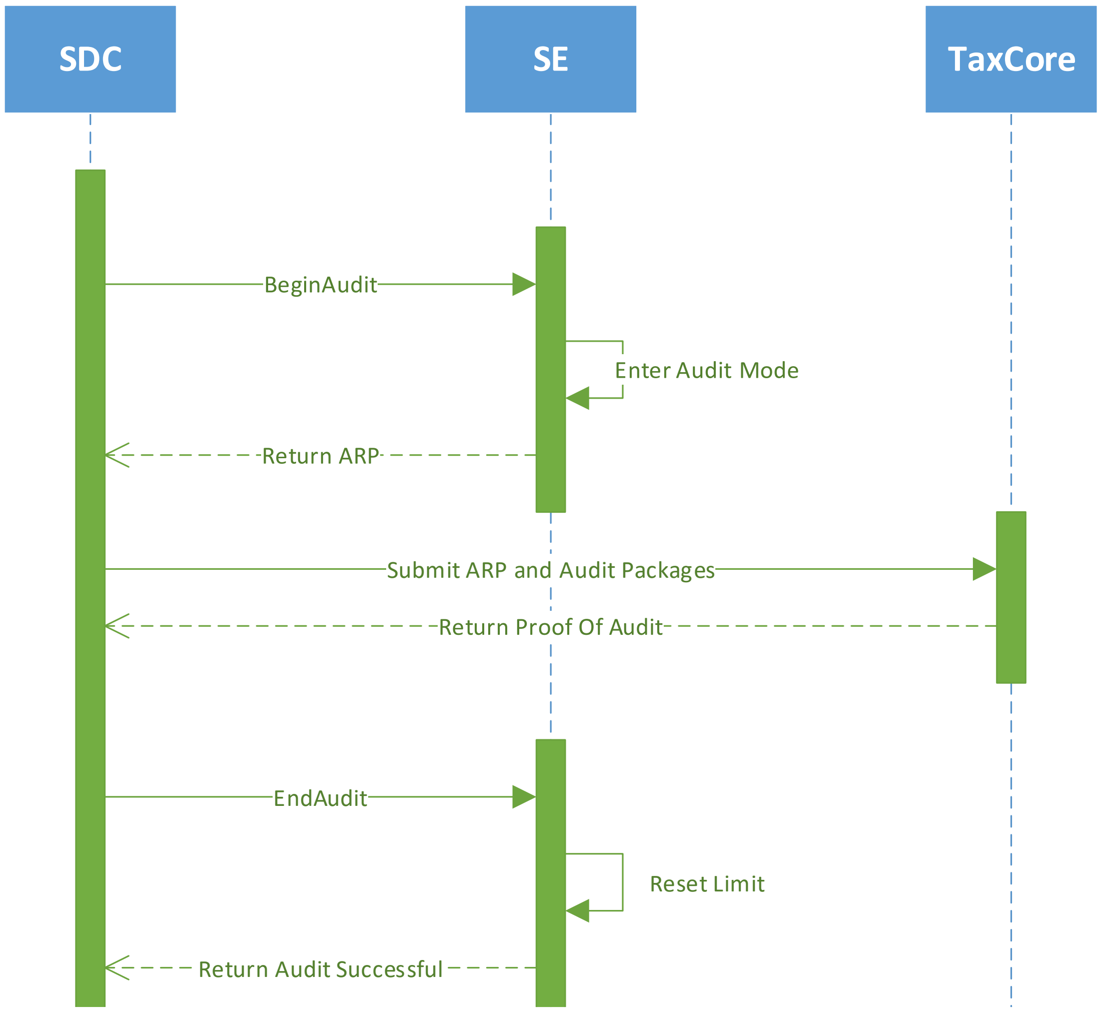


Figure 7 Audit process sequence diagram

Remote Audit

Remote audit is the process of transferring data to the Tax Service's system using the internet connection. It is the most common way to perform audits for any occasionally connected device.

An E-SDC checks if Backend.Api is reachable. If Backend.Api is reachable, the E-SDC authenticates the Tax Service's system by using a server-side certificate installed on the Backend.Api endpoint, enabling HTTPS protocol. The Tax Service's system authenticates the E-SDC using a digital certificate issued on the Secure Element. The E-SDC starts sending audit packages, performing a series of audits until no more unaudited data is stored on its non-volatile memory.

Not all E-SDC devices are required in order to perform a remote audit. If the network connection is not available due to the interruption of the service or a missing GPRS modem or network card, E-SDC will still be able to perform a Local audit.

Local Audit

Local audit initiated by a taxpayer is a common scenario for devices that lack the ability to connect to the internet due to the technical limitations of the devices or limited infrastructure.

An audit is initiated by plugging an SD card or a USB Flash drive to an E-SDC device.

During the Local Audit, the E-SDC performs the same steps as the Remote audit, but instead of submitting the ARP and Audit packages to Backend.Api, those files are saved to an SD Card or a USB Flash Drive.

Data formats for the file-based Local audits are described in section File-Based Communication.

Submitting Data Using a Web Application

Audit packages (up to 30Mb) could be sent to a Tax Service using a public web site. The Service's system shall verify received audit packages and generate the proof of audit as a response. A user will be required to manually delete audit packages from the media and save received proof of audit for later use.

Completing an Audit in Progress

A taxpayer inserts media with proof of audit file into an E-SDC. The E-SDC loads proof of audit and verifies if the format is valid. If the format is valid, proof of audit is sent to the Secure Element for processing.

If the format is invalid or the E-SDC and the Secure Element cannot process proof of audit for any reason, the E-SDC signals error message to the operator.

Proof of Audit

Proof of audit is generated by the Tax Service's system once all expected audit packages have been received and securely stored on the Tax Service's system.

Case 1 – Audit is performed after the creation of each audit package

Figure 8 illustrates the simplest case, where no additional audit packages are generated during the whole audit process, as following:

1. Create an audit package
2. Initiate the Audit process by invoking BeginAudit APDU command
3. Receive a proof of audit and pass it to EndAudit APDU command
4. If EndAudit returns value true you can safely delete the audit package
5. If EndAudit returns value false, continue until a valid proof of audit is received

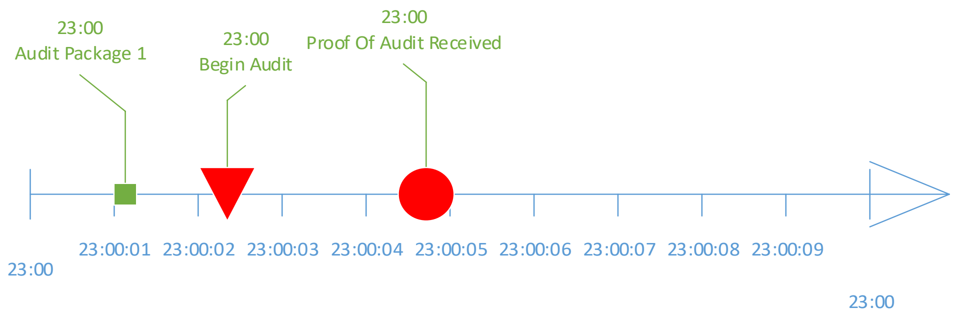


Figure 8 Simple audit process timeline

Case 2 – Audit is performed after multiple audit packages have been created (Figure 9 Audit process timeline with packages created after an audit start)

1. Create audit packages 1-3
2. Initiate the audit process by invoking BeginAudit APDU command
3. Continue to fiscalize invoices and create audit packages 4-6
4. Receive a proof of audit and pass it to EndAudit APDU command
5. If EndAudit APDU command returns value true you can delete remaining audit packages 1-3 because it is the last initial audit being invoked by E-SDC. Audit packages 4-6 are created after the call to BeginAudit APDU command so they are not audited in this cycle
6. If EndAudit APDU command returns value false, continue (return to point 1) until a valid proof of audit is received

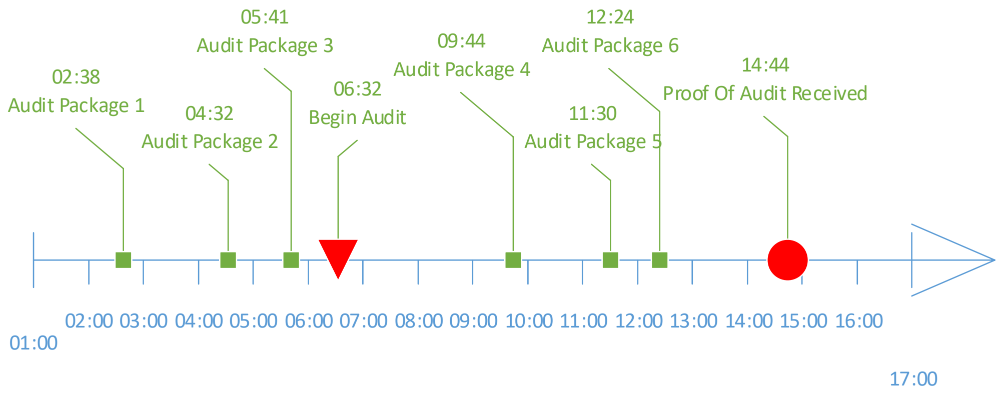


Figure 9 Audit process timeline with packages created after an audit start

Case 3 – Audit is started multiple times before the first proof of audit arrived (Figure 10 Audit process timeline with multiple audit starts)

1. Create Audit Packages 1-3
2. Initiate the Audit process by invoking BeginAudit APDU command
3. Continue to fiscalize invoices and create Audit Packages 4 and 5
4. Initiate another audit process by invoking BeginAudit APDU command – the previous audit is canceled
5. Continue to fiscalize invoices and create Audit Package 6
6. Receive the Proof of Audit and pass it to EndAudit APDU command
7. If EndAudit returns value true you can delete remaining audit packages 1-5 because it is the last BeginAudit being invoked by E-SDC. The Audit package 6 is created after the last call to BeginAudit APDU command so it is not audited in this run
8. If EndAudit APDU command returns value false, continue until a valid proof of audit is received.

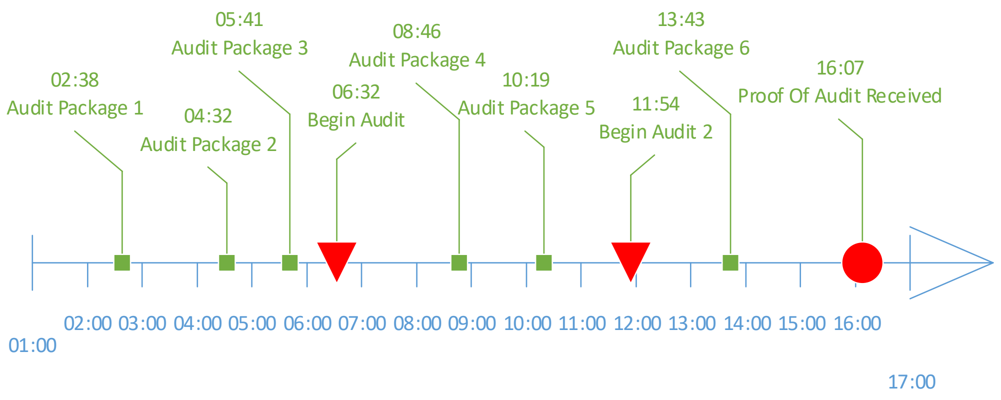


Figure 10 Audit process timeline with multiple audit starts

Notifications

E-SDC device shall have an appropriate way to show the status of the device, information about the smart card and processes running on the E-SDC.

The cashier could get the device notifications by receiving an onscreen message, by observing the colors from the light-emitting diodes (LED) or any other similar component set for displaying the visual notifications.

The following visual notifications shall be available to a cashier:

1. Smartcard is inserted but the E-SDC is not yet configured with the tax rates, verification URL or NTP service address. This is a common situation before initialization commands are executed by E-SDC;
2. Enter PIN Code for the Secure element – Smart card is inserted but E-SDC has not received PIN Code from POS;
3. E-SDC is ready to sign an invoice;
4. Smart card is missing or unavailable;
5. Audit package transfer is in progress (Local audit on an SD card or USB flash drive, or an online audit);
6. Firmware update is in progress (if applicable);
7. Audit data storage is almost full;
8. Audit data storage is full;
9. Time for audit;
10. Commands in progress (currently running)

Sync Date and Time

As an E-SDC is the source of date and time for the invoices, it is of the utmost importance to keep the device clock in sync.

If the internet connection is available, the E-SDC shall sync time with the recommended NTP service at least once every 48h.

If the E-SDC does not support online or semi-connected operation modes, the manufacturer shall provide and document a simple way to check, set and keep date and time in sync on the E-SDC.

Malfunctions and Non-serviceable devices

Dump Audit Packages Kept on E-SDC when Secure element is damaged

If the Secure Element is damaged and its data cannot be restored from the card, but the E-SDC is operational, the Tax Service system shall be able to dump data from the E-SDC device and upload the audit packages using the same application used to upload audit packages submitted by a taxpayer.

Protocols

This section describes Application Programming Interfaces (API) and protocols exposed by an E-SDC or used by an E-SDC to communicate with the other components (Backend.Api, Secure element Applet, PKI Applet or SD Card/USB Flash Drive) required to fulfill its primary role – to safeguard a transaction and to transfer the audit packages to the Tax Service's system.

Accredited POS systems can communicate with the E-SDC using the Serial protocol or JSON via HTTP protocol. It is up to an E-SDC developer to choose if only one or both of these protocols will be implemented by an E-SDC.

Status and Error Codes

All protocols share the same Info, Error and Warning codes.

Code	0-Info 1-Warning 2-Error	Description
	INFO	
0000	All OK	Command is executed without warnings or errors
0100	Pin OK	This code indicates that the provided PIN code is correct
0210	Internet Available	Internet connection to Backend.Api is available (optional)
0220	Internet Unavailable	Internet connection to Backend.Api is not available (optional)
	WARNINGS	
1100	Storage 90% Full	Storage used to store audit packages is 90% percent full. It is time to perform the audit.
1300	Smart Card is not present	Secure element card is not inserted in the E-SDC smart card reader
1400	Audit Required	Total Sale and refund amount reached 75% of the SE limit. It is time to perform the audit.
1500	Pin Code Required	Indicates that POS shall provide the PIN code
1999	Undefined Warning	Something is wrong but specific warning is not defined for that situation. Manufacturer can use manufacturer-specific codes to describe warning in more details

	ERRORS	
2100	Pin Not OK	PIN code sent by the POS is invalid
2110	Card Locked	The number of allowed PIN entries exceeded. The card is locked for use.
2210	SE Locked	The secure element is locked. No additional invoices can be signed before the audit is completed
2220	SE Communication Failed	E-SDC cannot connect to the Secure element applet
2230	SE Protocol Mismatch	Secure element does not support the requested protocol version (reserved for later use)
2310	Invalid tax labels	Tax Labels sent by the POS are not defined
2400	Not configured	The device is not configured
2800	Field Required	The field is required
2801	Field Value Too Long	The length of the field value is longer than expected
2802	Field Value Too Short	The length of the field value is shorter than expected
2803	Invalid Field Length	The length of the field value is shorter or longer than expected
2804	Field Out Of Range	The field value out of expected range
2805	Invalid Field Value	The field contains an invalid value
2806	Invalid Data Format	The data format is invalid
2807	List Too Short	The list contains less than minimum required elements count
2808	List Too Long	The list exceeds the maximum allowed elements count.

Table 3 Status and error codes

JSON Based POS to E-SDC Protocol

There are 5 types of Commands (request/response) that can be used for communication between a POS and an E-SDC:

- Get Status
- Verify PIN
- Sign Invoice
- Attention

- Get Last Signed Invoice

Get Status Command

This command is used to get status information from E-SDC.

Request Data

JSON data field with a predefined string value.

Example

```
{
  "GS": "GetStatus"
}
```

Response Data

JSON formatted data in accordance with Table 4 Get Status response data.

Filed	Description	Example
IsPinRequired	If PIN is not entered, or if a wrong PIN is entered in the previous attempt, this field shall be set to true; otherwise set to false	true
AuditRequired	If Audit is required, this field shall be set to true. Audit is required if the Total Amount of all invoices is 75% or more of the Maximum Limit. Maximum Limit and Total Amount are obtained from the Secure element using Amount Status APDU command	False if Total Amount is 1554879 Maximum Limit is 9000000 True If Total Amount is 7504899 Maximum Limit is 10000000
DT	Current **Local** Date and Time in ISO 8601 format	2017-08-30T11:53:05+13:00
LastInvoiceNumber	Invoice number of the last invoice signed by this E-SDC.	ORG674J1-ORG674J1-98637
ProtocolVersion	Always return 1.0.0.0	1.0.0.0
SecureElementVersion	Version obtained from the Secure element using Get Secure Element Version APDU command	1.0.0.0
HardwareVersion	Manufacturer-specific hardware version, if applicable	1.2.7.21
SoftwareVersion	Manufacturer-specific software version	1.7.6.5
DeviceSerialNumber	Manufacturer specific serial number	1289A24EB67F22C1
Make	Manufacturer-specific Make Name	Acme
Model	Manufacturer-specific Model Name	The Device 442
MSSC	Manufacturer Specific Errors, Warnings and info messages	Array of error codes
GSC	General Errors, Warnings and info messages defined in Status and Error Codes section	Array of error codes

Table 4 Get Status response data

Example

```
{
  "IsPinRequired": true,
  "AuditRequired": false,
  "DT": "2017-08-30T11:53:05+00:00",
  "LastInvoiceNumber": "ORG674J1-ORG674J1-98637",
  "ProtocolVersion" : "1.0.0.0",
  "SecureElementVersion" : "1.0.0.0",
  "HardwareVersion" : "1.2.7.21",
  "SoftwareVersion" : "1.7.6.5",
  "DeviceSerialNumber" : "1289A24EB67F22C1",
  "Make" : "Acme",
  "Model" : "The Device 442",
  "MSSC" : ["0440", "5541", "5442"],
  "GSC" : ["1100", "1101", "1102", "1103"]
}
```

Verify PIN Command

This command is used to verify a PIN entered by a cashier on a POS. Once the PIN is entered, Pin Verify APDU command shall be invoked and PIN passed to the Secure element. If command is successfully executed, the E-SDC shall store the PIN in the volatile memory (RAM) until the E-SDC is switched off or the smart card is removed from the reader.

HTTP Method

POST

Request Data

JSON string with PIN code sent from POS.

Example

```
{
  "VPIN": "1234"
}
```

Response Data

JSON string returned from E-SDC, content can be one of General Status Codes: 0100, 1300, 2100, 2210, 2220, 2230 or 2400. For more information consult Status and Error Codes section.

Example

```
{
  "VPIN_GSC": "0100"
}
```

Sign Invoice Command

Invoice Request

HTTP Method

POST

Data Fields

Field	Optional / Mandatory	Description
DateAndTimeOfIssue	Optional	Current **Local** Date and Time in ISO 8601 format.
IT	Mandatory	Invoice Type enumeration value.
TT	Mandatory	Transaction Type enumeration value.
PaymentType	Mandatory	Payment Type enumeration value.
Cashier	Mandatory	Cashier's identification.
BD	Optional	Taxpayer ID of the Buyer. **It is mandatory for B2B** transactions; otherwise, it's optional.
BuyerCostCenterId	Optional	Cost Center ID provided by the buyer to the cashier in case Buyer's company wants to track spending in Taxpayer Portal. **It is optional and may exist only for B2B transactions; otherwise, it shall be ignored by E-SDC.**
InvoiceNumber	Optional	Invoice number generated by a POS.
ReferentDocumentNumber	Mandatory for Copy and Refund	Mandatory only in case Invoice Type is **Refund** or **Copy**. In both cases, this field

		must contain Invoice Number of previously issued Invoice or Refund. In any other case (for example Normal Sale invoice) this field is optional. ASCII, in ***RequestedBy-SignedBy-Ordinal_Number*** format. Unicode MaxLength : 50
Items (n)	Mandatory	Each invoice contains at least one Item in Items collection (E-SDC should support minimum 250, recommended up to 500)
GTIN	Optional	Global Trade Item Number (GTIN) is an identifier for trade items, incorporated the ISBN, ISSN, ISMN, IAN (which includes the European Article Number and Japanese Article Number) and some Universal Product Codes, into a universal number space.
Name	Mandatory	Human-readable name of the product or service.
Quantity	Mandatory	Quantity of an item, e.g. 2 (pieces), 0.100 (grams).
UnitPrice	Mandatory	Unit price of the line item. Does not take part in tax calculation.
Labels	Mandatory	The array of labels. Each Label represents one of the Tax Rates applied on invoice item. Tax Items are calculated based on TotalAmount and applied Labels as described in the Calculate Taxes section. This field is required. The caller must submit a non-empty collection.
TotalAmount	Mandatory	Gross price for the line item.
Options	Optional	Key/value collection defines the output of V-SDC/E-SDC invoice fiscalization, to optimize resources. Key: **`OmitQRCodeGen`** Value: "1" to omit QR Code generation by E-SDC and "0" to generate and return QR code. Key: **`OmitTextualRepresentation`** Value: "1" to omit generation of textual representation by E-SDC and "0" to generate return textual representation to POS.
Hash	Optional	Base64 encoded MD5 hash of the request data. It is used only for later invoice search.

Model

```
InvoiceFiscalizationRequest {
        DateAndTimeOfIssue (string, optional),
        Cashier (string, optional) Unicode MaxLength:50,
        BD (string, optional) ASCII MaxLength:20,
        BuyerCostCenterId (string, optional) Unicode MaxLength:15,
        IT (string) = ["Normal", "ProForma", "Copy", "Training"] (int) = [0,1,2,3],
        TT (string) = ["Sale", "Refund"] (int) = [0,1],
        PaymentType  (string)  =  ["Other",  "Cash",  "Card",  "Check",  "WireTransfer",
        "Voucher", "MobileMoney" (int) = [0,1,2,3,4,5,6],
        InvoiceNumber (string, optional) Unicode MaxLength:60,
        ReferentDocumentNumber (string, optional) Unicode MaxLength:50,
        PAC (string, optional),
        Options (inline_model, optional),
        Items (Array[Item]) MinLength:1,
        Hash (string, optional) MaxLength:32
}

inline_model {
        OmitQRCodeGen (string, optional) = ["0", "1"] (int) = [0,1],
        OmitTextualRepresentation (string, optional) = ["0", "1"] (int) = [0,1]
}

Item {
        GTIN (string, optional) MinLength:8 MaxLength:14,
        Name (string) Unicode MaxLength:2048,
        Quantity (number) Decimal(14,3) MinValue:0.001,
        UnitPrice (number) Decimal(14,2),
        Labels (Array[string]) MinLength:1,
        TotalAmount (number) Decimal(14,2)
}
```

Example

```
      {
        "DateAndTimeOfIssue": "2017-06-15T08:56:23.286Z",
        "Cashier": "123456789",
        "IT": "Normal",
        "TT": "Sale",
        "PaymentType": "Cash",
        "InvoiceNumber": "POS2017/998",
        "Options": {
          "OmitQRCodeGen" : "1" ,
          "OmitTextualRepresentation" : "0"
        },
        "Items": [
          {
            "Name": "Sport-100 Helmet, Blue",
            "Quantity": 2,
            "UnitPrice": 34.23,
            "Labels": [
              "A"
            ],
            "TotalAmount": 68.46
          }
        ],
        "Hash": "W33lEEgkSRsqTFMO86a8Og=="
      }
```

Invoice Response

Data Fields

Field	Description

RequestedBy	UID of Secure Element digital certificate.
SignedBy	UID of Secure Element digital certificate.
DT	Local date and time in ISO 8601 format provided by E-SDC.
IC	Invoice Counter in format **TransactionTypeCounter/TotalCounter InvoiceCounterExtension** For Example: 14/17NS
InvoiceCounterExtension	First letters of Transaction Type and Invoice Type of the invoice. NS for Normal Sale, CR – Copy Refund, TS – Training Sale, etc.
IN	Invoice number in format **RequestedBy-SignedBy-TotalCounter**
VerificationUrl	VerificationURL generated in Create Verification URL process
VerificationQRCode	Base64 encoded byte array of GIF image created in Create QR Code process
Journal	Textual Representation of the invoice created in Create a Textual Representation of an Invoice (Receipt) process
Messages	Custom human-readable message that shall be printed or displayed by POS.
TotalCounter	Total number of invoices signed by Secure Element. Returned by Sign Invoice APDU command
TransactionTypeCounter	Total number of invoices for a requested type. Returned by Sign Invoice APDU command
TotalAmount	Sum of all Items – total payable by the customer
ID	Encrypted Internal Data - Base64 encoded byte array returned by Sign Invoice APDU command
S	Signature - Base64 encoded byte array returned by Sign Invoice APDU command
TaxItems	Array of TaxItem entities
Label	Tax Label (A, F, G, N, P…)
Name	Tax Category Name (i.e. VAT, Consumption)
Rate	Tax rate percentage for Label (i.e. 12.50%)
Amount	Tax amount calculated by E-SDC during invoice fiscalization
Hash	Hash received from POS in request field Hash
BusinessName	Taxpayer Business Name obtained from digital certificate subject field
LocationName	Location Name obtained from digital certificate subject field
Address	Street address obtained from digital certificate subject field
TIN	Tax Identification Number obtained from digital certificate subject field
District	District obtained from digital certificate subject field
TaxGroupRevision	Revision of taxes used in the calculation
MRC	Manufacturer registration code (in format MakeCode-SW-Serial), mandatory for audit package, optional for POS response. - MakeCode: unique 2 characters obtained on Tax Service Accreditation - SW: software version - Serial: manufacturer serial number (max 32 characters)

Model

```
InvoiceFiscalizationResult {
	RequestedBy (string),
	DT (string),
	InvoiceCounterExtension (string),
        TaxItems (Array[TaxItem]) MinLength:0,
        (string VerificationUrl),
        VerificationQRCode (string, optional),
        Journal (string, optional),
        Messages (string, optional),
        SignedBy (string),
        ID (string),
        S (string),
        TotalCounter (integer),
        TransactionTypeCounter (integer),
        TotalAmount (number),
        Hash (string, optional),
        BusinessName (string, optional),
        LocationName (string, optional),
        TIN (string, optional),
        Address (string, optional),
        District (string, optional),
        TaxGroupRevision (integer),
        MRC (string, mandatory for audit package, optional for POS response)
}


TaxItem {
        Label (string),
        CategoryName (string),
        Rate (number),
        Amount (number)
}
```

Example

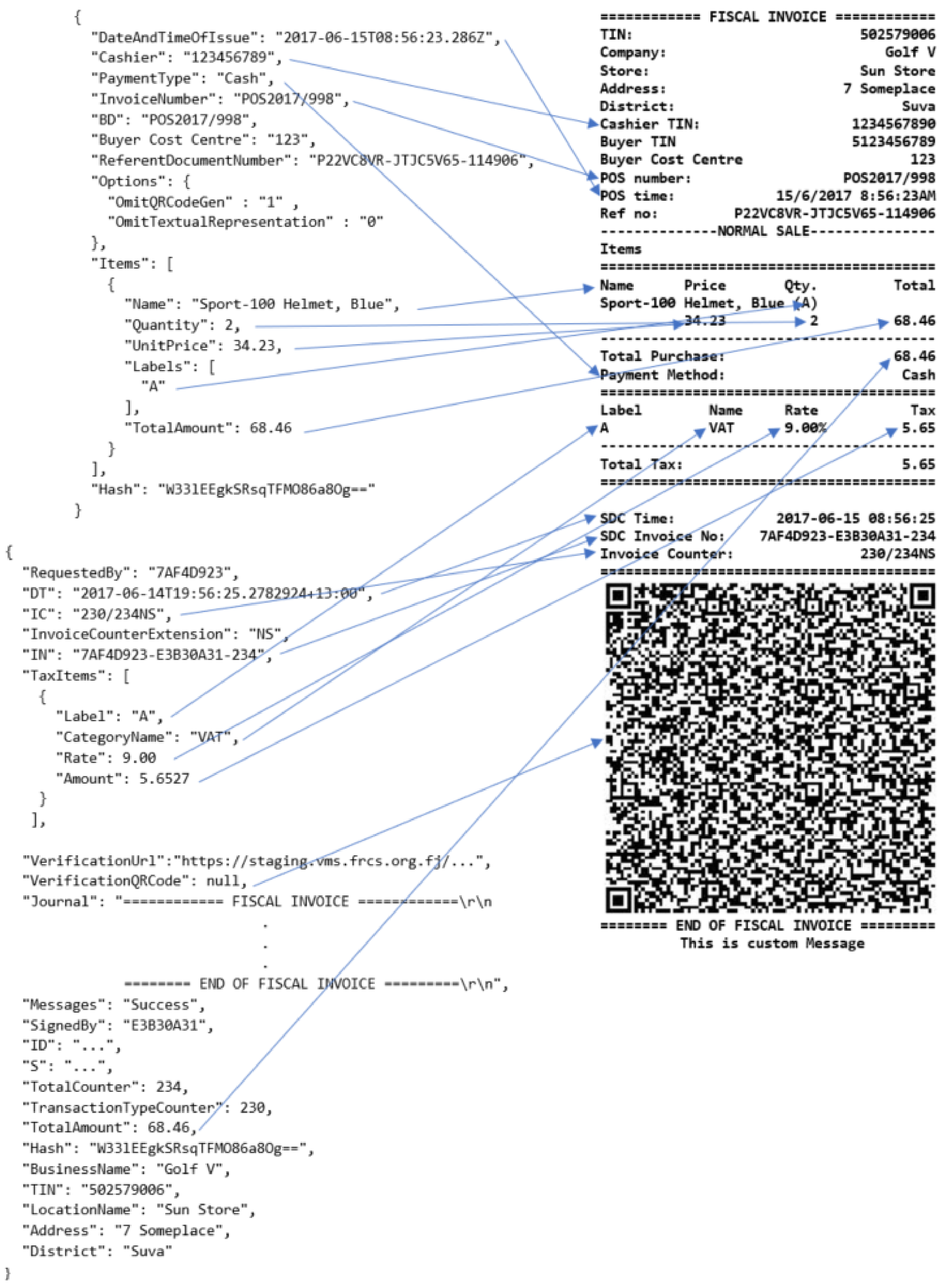
```
{
  "RequestedBy": "7AF4D923",
  "DT": "2017-06-14T19:56:25.2782924+13:00",
  "IC": "230/234NS",
  "InvoiceCounterExtension": "NS",
  "IN": "7AF4D923-E3B30A31-234",
  "TaxItems": [
    {
      "Label": "A",
      "CategoryName": "VAT",
      "Rate": 9.00
      "Amount": 5.6527
    }
   ],
  "VerificationUrl":"https://staging.vms.frcs.org.fj/v/?vl=AVAyMlZDOFZSSlRKQzVWNjUBAAAA
   AQAAAAAuGQ4AAAFeM%2BvCJgAAAAbDDPkm7R9I1NPLierP%2Bh3UQswb%2FXa8xYKiEnLjyClHqh6X26Fru
   PVNksB7wMoG2LpA85uvbG9txf2CndYl5JZshBJsq7TLF%2BqOmRs3EaykUVf05mFbTrrgQmUROZE76lciqa
   xvaVEGK83ic1q2HVz0mryqHna6Iu%2FuTn4q2wQ4gJ9bc%2BD6pvyhY%2BZB8c3SgYNGPm4Eq81%2BC8tjJ
   pPCYLlHrVKPjbQEE6FSm2II0YEeQqWEGNCHqatxHmjS8sJTT4BJJ%2FlhzTQyuFWoI5ko3oAm8AZsEdgx54
   oEENr3LUm3Jg%2Fd75tGcUoweEngRfoEP0EiqaOkt2sdSg18hrjd4PUdZ8QUksSeIDmjLMsqZoLmGiqycda
   jhMN2eMeo%2B9LZ%2FhLnxDsROkbOWlArVGfQ%2B9MfBmyJsILCEIT6myTAC2HZCvQ%2Bc0MEO%2F0euynC
   kCQO6BBv39zNn8yNRagmsEOslkQydty66gphme%2BCOx76u%2F4lCjxPOOxc%2F6zNR8SAe1MNaDPVH3PU7
   IlQdToxfXY3pvWSqtK%2FUY5JGXpvmMpLP6kUXr1qOCjt2Uj6QsH%2BbgwjEZVpHep%2Byh5myEQcI9A4ND
   UtoUjPpITbOIxPO4vyne%2Bgv4UnpAKQigAv%2FywKeD9noHDgCiFSfLZCJ0IXMSleo%2BjIf%2BIfE2YXX
   84gH7n7Ncpn",
  "VerificationQRCode": null,
  "Journal": "============ FISCAL INVOICE ============\r\n
              TIN:                           502579006\r\n
              Company:                          Golf V\r\n
              Store:                         Sun Store\r\n
              Address:                     7 Someplace\r\n
              District:                           Suva\r\n
              Cashier TIN:                   123456789\r\n
```

```
             POS number:                  POS2017/998\r\n
             POS time:             2017-06-15 8:56:23\r\n
             --------------NORMAL SALE---------------\r\n
             Items\r\n
             ========================================\r\n
             Name    Price        Qty.          Total\r\n
             Sport-100 Helmet, Blue (A)             \r\n
                     34.23           2          68.46\r\n
             ----------------------------------------\r\n
             Total Purchase:                    68.46\r\n
             Payment Method:                     Cash\r\n
             ========================================\r\n
             Label        Name     Rate           Tax\r\n
             A             VAT    9.00%          5.65\r\n
             ----------------------------------------\r\n
             Total Tax:                          5.65\r\n
             ========================================\r\n
             SDC Time:             2017-06-15 8:56:25\r\n
             SDC Invoice No:    7AF4D923-E3B30A31-234\r\n
             Invoice Counter:               230/234NS\r\n
             ========================================\r\n
             ======== END OF FISCAL INVOICE =========\r\n",
 "Messages": "Success",
 "SignedBy": "E3B30A31",
 "ID":
  "BsMM+SbtH0jU08uJ6s/6HdRCzBv9drzFgqIScuPIKUeqHpfboWu49U2SwHvAygbYukDzm69sb23F/YKd1i
  XklmyEEmyrtMsX6o6ZGzcRrKRRV/TmYVtOuuBCZRE5kTvqVyKprG9pUQYrzeJzWrYdXPSavKoedroi7+5Of
  irbBDiAn1tz4Pqm/KFj5kHxzdKBg0Y+bgSrzX4Ly2Mmk8JguUetUo+NtAQToVKbYgjRgR5CpYQY0Iepq3Ee
  aNLywlNPgEkn+WHNNDK4VagjmSjegCbwBmwR2DHnigQQ2vctSbcmD93vm0ZxSjB4SeBF+gQ/QSKpo6S3ax1
  KDXyGuN3g9Q==",
 "S":
  "HWfEFJLEniA5oyzLKmaC5hoqsnHWo4TDdnjHqPvS2f4S58Q7ETpGzlpQK1Rn0PvTHwZsibCCwhCE+pskwA
  th2Qr0PnNDBDv9HrspwpAkDugQb9/czZ/MjUWoJrBDrJZEMnbcuuoKYZnvgjse+rv+JQo8TzjsXP+szUfEg
  HtTDWgz1R9z1OyJUHU6MX12N6b1kqrSv1GOSRl6b5jKSz+pFF69ajgo7dlI+kLB/m4MIxGVaR3qfsoeZshE
  HCPQODQ1LaFIz6SE2ziMTzuL8p3voL+FJ6QCkIoAL/8sCng/Z6Bw4AohUny2QidCFzEpXqPoyH/iHxNmF1/
  OIB+5+zXKZw==",
 "TotalCounter": 234,
 "TransactionTypeCounter": 230,
 "TotalAmount": 68.46,
 "TaxGroupRevision": 21,
 "MRC": "00-0002-3257812",
 "Hash": "W33lEEgkSRsqTFMO86a8Og==",
 "BusinessName": "Golf V",
 "TIN": "502579006",
 "LocationName": "Sun Store",
 "Address": "7 Someplace",
 "District": "Suva"

}
```

Mapping Fiscal Invoice to Fiscal Receipt

In case POS does not use Journal (generated by E-SDC or V-SDC) as a content for a fiscal receipt, but it generates a custom designed receipt instead, it shall use the following element mappings:



```
{
  "DateAndTimeOfIssue": "2017-06-15T08:56:23.286Z",
  "Cashier": "123456789",
  "PaymentType": "Cash",
  "InvoiceNumber": "POS2017/998",
  "BD": "POS2017/998",
  "Buyer Cost Centre": "123",
  "ReferentDocumentNumber": "P22VC8VR-JTJC5V65-114906",
  "Options": {
    "OmitQRCodeGen" : "1" ,
    "OmitTextualRepresentation" : "0"
  },
  "Items": [
    {
      "Name": "Sport-100 Helmet, Blue",
      "Quantity": 2,
      "UnitPrice": 34.23,
      "Labels": [
        "A"
      ],
      "TotalAmount": 68.46
    }
  ],
  "Hash": "W331EEgkSRsqTFMO86a8Og=="
}
```

```
{
  "RequestedBy": "7AF4D923",
  "DT": "2017-06-14T19:56:25.2782924+13:00",
  "IC": "230/234NS",
  "InvoiceCounterExtension": "NS",
  "IN": "7AF4D923-E3B30A31-234",
  "TaxItems": [
    {
      "Label": "A",
      "CategoryName": "VAT",
      "Rate": 9.00
      "Amount": 5.6527
    }
  ],

  "VerificationUrl":"https://staging.vms.frcs.org.fj/...",
  "VerificationQRCode": null,
  "Journal": "============ FISCAL INVOICE ============\r\n
                              .
                              .
                              .
            ======== END OF FISCAL INVOICE =========\r\n",
  "Messages": "Success",
  "SignedBy": "E3B30A31",
  "ID": "...",
  "S": "...",
  "TotalCounter": 234,
  "TransactionTypeCounter": 230,
  "TotalAmount": 68.46,
  "Hash": "W331EEgkSRsqTFMO86a8Og==",
  "BusinessName": "Golf V",
  "TIN": "502579006",
  "LocationName": "Sun Store",
  "Address": "7 Someplace",
  "District": "Suva"
}
```

```
============ FISCAL INVOICE ============
TIN:                           502579006
Company:                          Golf V
Store:                         Sun Store
Address:                     7 Someplace
District:                           Suva
Cashier TIN:                  1234567890
Buyer TIN                     5123456789
Buyer Cost Centre                    123
POS number:                  POS2017/998
POS time:           15/6/2017 8:56:23AM
Ref no:          P22VC8VR-JTJC5V65-114906
--------------NORMAL SALE---------------
Items
========================================
Name       Price       Qty.        Total
Sport-100 Helmet, Blue (A)
           34.23        2          68.46
----------------------------------------
Total Purchase:                    68.46
Payment Method:                     Cash
========================================
Label        Name      Rate          Tax
A            VAT       9.00%        5.65
----------------------------------------
Total Tax:                          5.65
========================================

SDC Time:            2017-06-15 08:56:25
SDC Invoice No:    7AF4D923-E3B30A31-234
Invoice Counter:                230/234NS
========================================

======== END OF FISCAL INVOICE =========
         This is custom Message
```

Figure 11 Mapping Fiscal Invoice to Fiscal Receipt

Attention Command

This command is used by POS to verify if ESDC is available. The command shall be used prior to Sign Invoice or Send Pin requests. This significantly lowers possibility for communication errors, including timeout errors. Only if a valid response is received, the POS shall immediately send the next command.

HTTP Method

POST

Request Data

JSON data field with a predefined string value.

Example

```
{
  "ATT": "Attention"
}
```

Response Data

JSON string returned from E-SDC, content can be General Status Code: 0000. For more information consult Status and Error Codes.

Example

```
{
  "ATT_GSC": "0000"
}
```

Get Last Signed Invoice Command

Get the last signed invoice. It is used in case POS did not get a response from ESDC after Sign Invoice Command was sent. The response is the same as for Sign Invoice Command. Hash field from response shall be used to determine whether the last invoice was successfully signed.

HTTP Method

POST

Request Data

JSON data field with Hash string value of the last Sign Invoice Command request sent by POS.

Example

```
{
  "GI": "MDNDN0MwQUNFMzk1RDgwMQ=="
}
```

Response Data

Refer to response for Sign Invoice Command.

Get Tax Authority Params

This command returns environment-specific information to the caller.

HTTP Method

GET

Request Data

None

Response Data

Field	Description
UID	UID of the digital certificate stored in the Subject field
BackendEndpoint	Returns URL of the Backend API stored in the digital certificate. Check *How to Obtain a URL of the Backend.Api Service in Runtime* section for more details

TaxRateGroup	Returns current TaxRateGroup to caller

Example

```
{
     "UID": "7AF4D923",
     "BackendEndpoint": " https://vsdc.sandbox.taxcore.online/",
     "CurrentTaxRateGroup": {
        "ValidFrom": "2017-07-02T00:00:00",
        "GroupId": "1",
        "TaxCategories": [{
               "CategoryId": 1002,
               "Name": "VAT",
               "Type": 0,
               "TaxRates": [{
                      "RateId": 1002,
                      "Rate": 6.0,
                      "Label": "A"
               },
               {
                      "RateId": 1003,
                      "Rate": 10.0,
                      "Label": "B"
               },
               {
                      "RateId": 1004,
                      "Rate": 20.0,
                      "Label": "C"
               }],
               "OrderId": 1,
        },
        {
               "CategoryId": 1003,
               "Name": "STT",
               "Type": 1,
               "TaxRates": [{
                      "RateId": 1005,
                      "Rate": 25.0,
                      "Label": "D"
               }],
               "OrderId": 2,
        },
        {
               "CategoryId": 1004,
               "Name": "ECAL",
               "Type": 2,
               "TaxRates": [{
                      "RateId": 1006,
                      "Rate": 10.0,
                      "Label": "E"
               }],
               "OrderId": 3,
        }]
}
```

Error Messages Format

This section describes the structure and format of error messages that SDC returns to POS.

Data Fields

Message	Human-readable error information. If unsure which error message to return to a POS, use “The request is invalid” phrase
ModelState	Dynamic object containing key-value pairs of FieldName-ErrorCode .
Object	Name of the object (if applicable)
FieldName	Path to the field error codes are associated with. If some of the fields in the path is an array, order number shall be included in square brackets.
ErrorCode	Error code associated with a particular field, from the section **Error! Reference source not found.**

Model

```
ModelStateDictionary {
        Message (string),
        ModelState (Array(ModelError))
        }


ModelError {
                FieldName (Array[ErrorCode (string)])
}
```

Implementation example in C# programming language:

```
public class ModelStateDictionary
{
    public string Message { get; set; }
    public Dictionary<string, string[]> ModelState { get; set; }
}
```

Example

```
{
  "Message": "The request is invalid.",
  "ModelState": {
    "invoice.IT": [
      "1234"
    ],
    "invoice.Items[0].Labels[0]": [
      "1234"
    ],
    "invoice.Items[0].GTIN": [
      "1234",
      "5678"
    ]
  }
}
```

POS to E-SDC Communication over HTTP Protocol

E-SDC device shall be equipped with an Ethernet port or a Wireless controller in accordance with IEEE 802.3, with speed no less than 100Mb/s, in order to access a local area network.

The physical connection to a network can be established with a standard LAN cable, Cat.5 or similar with better features. The ends of the cables shall be equipped with RJ-45 plug male connectors since an E-SDC is equipped with a female RJ-45 connector.

E-SDC shall have a globally unique MAC-48 address in accordance with IEEE 802, which is stored on a specialized MAC Address chip, or an address obtained by the authorized vendor stored in the non-volatile memory during the manufacturing.

IP Address and other network settings on an E-SDC shall be configurable. The technical implementation of these features is in the scope of the E-SDC manufacturer.

When an HTTP connection is used between a POS and an E-SDC, data is exchanged in JSON text-based format. POS device shall be able to send JSON formatted data to the specified E-SDC IP address using HTTP protocol and to receive response data from the E-SDC using the same protocol.

Get Status Command

This command is used to get status information from E-SDC.

HTTP POST request is sent to: http://<E-SDC_ip_address>:<port>/api/Status/GetStatus

Example: http://192.168.88.112:8888/api/Status/GetStatus

Verify PIN Command

HTTP POST request data is sent to: http://<ESDC_ip_address>:<port>/api/Status/VerifyPin

Example: http://192.168.88.112:8888/api/Status/VerifyPin

Attention Command

HTTP POST request data is sent to: http://<ESDC_ip_address>:<port>/api/Status/Attention

Example: http://192.168.88.112:8888/api/Status/Attention

Sign Invoice Command

HTTP POST request data is sent to: http://<ESDC_ip_address>:<port>/api/Sign/SignInvoice

Example: http://192.168.88.112:8888/api/Sign/SignInvoice

Get Last Signed Invoice Command

HTTP POST request data is sent to: http://<ESDC_ip_address>:<port>/api/Sign/GetSignedInvoice

Example: http://192.168.88.112:8888/api/Sign/GetSignedInvoice

Get Tax Authority Params

HTTP GET request is sent to: `http://<ESDC_ip_address>:<port>/api/Status/GetTaxAuthorityParams`

Example: http://192.168.88.112:8888/api/Status/GetTaxAuthorityParams

POS to E-SDC Communication over Serial Port

Some E-SDC developers could choose to support older Accredited POS devices by exposing a serial port data transfer protocol.

In that case, the Accredited POS shall be connected to the E-SDC by using NULL MODEM (crossover) serial cable with Transmit (Tx), Receive (Rx) and common ground (GND) cores. Cables with integrated “Serial to USB” converters can be used, too. Physical parameters of the serial protocol are defined by the following parameters:

Databits	8

Parity	None
Stopbits	1
Baudrate	115200 b/s
Handshake	None

Above mentioned parameters are defined during the manufacturing process, they are hardcoded in hardware, so they can't be changed later. Automatic baud rate detection is not possible.

The order of transmission of bits is LSB (least significant bit) first.

Initialization of the serial communication is always done by a POS, it is never started by an E-SDC. In normal working mode, when the communication is uninterrupted, every request from the POS to the E-SDC is followed by an appropriate response in the opposite direction.

Serial transmission protocol doesn't implement any error detection protocol by default, so SLIP protocol with Fletcher-16 checksum is used.

Serial port protocol defines the following commands that will be executed by POS: **VerifyPIN**, **SignInvoice, Attention**, **GetStatus** and **GetSignedInvoice**. All commands shall be UTF-8 encoded string.

SLIP Protocol

The Serial Line Internet Protocol (SLIP) is an encapsulation of the Internet Protocol designed to work over serial ports and modem connections. It is documented in RFC 1055. On microcontrollers, SLIP is the preferred way of encapsulating IP packets due to its very small overhead.

SLIP defines the following special bytes to be used:

Hex value	Dec Value	Oct Value	Abbreviation	Description
0xC0	192	300	END	Frame End
0xDB	219	333	ESC	Frame Escape
0xDC	220	334	ESC_END	Transposed Frame End
0xDD	221	335	ESC_ESC	Transposed Frame Escape

SLIP modifies a standard TCP/IP datagram by

- appending a special "END" byte to it, which distinguishes datagram boundaries in the byte stream,
- if the END byte occurs in the data to be sent, the two byte sequence ESC, ESC_END is sent instead (0xDB, 0xDC),
- if the ESC byte occurs in the data, the two byte sequence ESC, ESC_ESC is sent (0xDB, 0xDD).
- variants of the protocol may begin, as well as end, packets with END.

Therefore, an ESC byte in a SLIP packet shall always be followed by an ESC_END or an ESC_ESC byte; anything else shall be considered a protocol error. Although the implementation code proposed by RFC 1055 ignores such errors, ESDC and POS shall detect and report following SLIP errors:

- ESC character at the end of the packet.
- ESC character in the middle or at the beginning of the packet but not followed by ESC_END or ESC_ESC characters.

Request

Every request sent from a POS over a serial communication protocol is a SLIP packet consisted of the following segments:

<Command><Payload><Checksum><SLIP End>

- Command identifier, 1 byte (alphanumeric) symbol that uniquely identifies command type.
- Payload is a UTF-8 encoded JSON based command data, as defined in section JSON Based POS to E-SDC Protocol.
- Checksum is Fletcher-16 checksum calculated on <Command> and <Payload> segments, as defined in section Fletcher-16 checksum.

Example

The following is the example request bytes (in hexadecimal format) for the Verify PIN Command.

507B225650494E223A2231323334227DB6C4C0

Response

Every response sent by E-SDC to POS over a serial communication protocol is a SLIP packet consisted of the following segments:

<Payload><Checksum><SLIP End>

- Payload is a UTF-8 encoded JSON based command response as defined in section JSON Based POS to E-SDC Protocol.
- Checksum is Fletcher-16 checksum calculated on <Payload> segment, as defined in section Fletcher-16 checksum.

Example

The following is the example response bytes (in hexadecimal format) for the successful Verify PIN Command response.

7B225650494E5F475343223A2230313030227D67F8C0

Error Response

In case E-SDC fails to process a command, error response sent by E-SDC to POS over a serial communication protocol is a SLIP packet consisted of the following segments:

0xFF<Payload><Checksum><SLIP End>

Payload is a UTF-8 encoded JSON based error message format as defined in section Get Tax Authority Params

This command returns environment-specific information to the caller.

HTTP Method

GET

Request Data

None

Response Data

Field	Description
UID	UID of the digital certificate stored in the Subject field
BackendEndpoint	Returns URL of the Backend API stored in the digital certificate. Check *How to Obtain a URL of the Backend.Api Service in RuntimeHow to Obtain a URL of the Backend.Api Service in Runtime* section for more details
TaxRateGroup	Returns current `TaxRateGroup` to caller

Example

```
{
     "UID": "7AF4D923",
     "BackendEndpoint": " https://vsdc.sandbox.taxcore.online/",
     "CurrentTaxRateGroup": {
        "ValidFrom": "2017-07-02T00:00:00",
        "GroupId": "1",
        "TaxCategories": [{
                "CategoryId": 1002,
                "Name": "VAT",
                "Type": 0,
                "TaxRates": [{
                        "RateId": 1002,
                        "Rate": 6.0,
                        "Label": "A"
                },
                {
                        "RateId": 1003,
                        "Rate": 10.0,
                        "Label": "B"
                },
                {
                        "RateId": 1004,
                        "Rate": 20.0,
                        "Label": "C"
                }],
                "OrderId": 1,
        },
        {
                "CategoryId": 1003,
                "Name": "STT",
                "Type": 1,
                "TaxRates": [{
                        "RateId": 1005,
                        "Rate": 25.0,
                        "Label": "D"
                }],
                "OrderId": 2,
        },
        {
                "CategoryId": 1004,
                "Name": "ECAL",
                "Type": 2,
                "TaxRates": [{
                        "RateId": 1006,
                        "Rate": 10.0,
                        "Label": "E"
                }],
            "OrderId": 3,
        }]
}
```

- Error Messages Format
- .
- Checksum is Fletcher-16 checksum calculated on <Payload> segment, as defined in section Fletcher-16 checksum.

Fletcher-16 checksum

The following code represents optimized C language 8-bit implementation of the checksum calculation (https://en.wikipedia.org/wiki/Fletcher%27s_checksum):

```c
uint16_t fletcher16(uint8_t* dataIn, uint16_t bytes)
{
    uint16_t sum1 = 0xff, sum2 = 0xff;
    uint16_t tlen;
    while (bytes){
        tlen = bytes >= 20 ? 20 : bytes;
        bytes -= tlen;
        do {
            sum2 += sum1 += *dataIn++;
        } while (--tlen);
        sum1 = (sum1 & 0xff) + (sum1 >> 8);
        sum2 = (sum2 & 0xff) + (sum2 >> 8);
    }
    /* Second reduction step to reduce sums to 8 bits */
    sum1 = (sum1 & 0xff) + (sum1 >> 8);
    sum2 = (sum2 & 0xff) + (sum2 >> 8);
    return sum2 << 8 | sum1;
}
```

Timeouts

All requests shall use a timeout period of 10 seconds. If there was no response within the timeout period this is considered as a timeout error.

In case of the timeout error on the Attention request, POS shall repeat this request.

Timeout error on Sign Invoice request shall be handled by sending Get Signature request until a proper response is received:

- If the Hash field from Get Signature response is different from the currently processed invoice, POS shall repeat Sign Invoice request because it means that ESDC did not sign that last invoice.
- If the Hash field from Get Signature response is the same as for the currently processed invoice, POS shall finish processing the current invoice.

It is important for POS to ensure that the hash of the currently processing invoice is stored in non-volatile memory until the invoice is successfully signed. This ensures that the invoice shall be signed even in case of POS power failure.

In case of timeout error on Get Signature request, POS shall repeat this request.

Please note that it is good practice to send the Attention request and wait for a valid response before sending any other Command.

GetStatus Command

GetStatus Command is used by a POS to gather information on the state of the connected E-SDC device.

Command Identifier: S ("0x53" in hexadecimal).

Verify PIN Command

This command is used to provide a PIN code to the Secure element.

Command Identifier: P ("0x50" in hexadecimal).

Sign Invoice Command

Sign Invoice Command performs the tax calculation, creates a verification URL, applies a digital signature and optionally generates a QR code and a textual representation of the invoice.

Command Identifier: I ("0x49" in hexadecimal).

Attention Command

This command is used by POS to verify if E-SDC is available.

Command Identifier: A ("0x41" in hexadecimal).

Get Signed Invoice Command

This command is used by POS to get the last signed invoice.

Command Identifier: G ("0x47" in hexadecimal)

Get Tax Authority Params

This command returns environment-specific information to the invoicing system.

Command Identifier: T ("0x54" in hexadecimal)

POS to E-SDC Communication over TCP

Will be supported in the future revision of the document.

E-SDC to Secure element (APDU commands)

Communication with a Secure element shall be performed through standard APDU commands.

For a detailed description of APDU communication, APDU commands data structure and particular bytes meaning, please refer to ISO/IEC 7816-4 standard.

Commands are grouped into three categories based on the type of usage:

1. Personalization
2. Fiscalization
3. Audit

Notes:

1. P1 and P2 values are not considered in the request processing, except for the Select Applet Command
2. All APDU commands are sent to the Smart Card using T1 communication protocol

3. All values are submitted to the Secure element using Big-endian. Big-endian is an order in which the "big end" (most significant value in the sequence) is stored first (at the lowest storage address)

General Commands

Secure element Applet is installed as a non-default applet on a smart card. Before any APDU command is invoked, the applet shall be selected using the standard Select command.

Select Applet

As previously mentioned, the Smart Card has two applets installed. This command shall select the Secure element applet and route a subsequent APDU commands to it.

IsoCase:	Case4Short
Class:	0x00
Instruction:	0xa4
P1:	0x04
P2:	0x00
Data:	0x10 0xA0 0x00 0x00 0x07 0x48 0x46 0x4A 0x49 0x2D 0x54 0x61 0x78 0x43 0x6F 0x72 0x65
Le:	0x00
Example:	0x00 0xA4 0x04 0x00 0x10 0xA0 0x00 0x00 0x07 0x48 0x46 0x4A 0x49 0x2D 0x54 0x61 0x78 0x43 0x6F 0x72 0x65 0x00

Export Certificate

IsoCase:	Case2Extended
Class:	0x88
Instruction:	0x04
Example:	0x88 0x04 0x04 0x00 0x00 0x00 0x00

Exports taxpayer certificate in a DER format. This certificate contains a location data that shall be present on the textual representation of an invoice.

Get Secure Element Version

IsoCase:	Case2Short
Class:	0x88
Instruction:	0x09
Example:	0x88 0x09 0x04 0x00 0x00

Fiscalization

PIN Verify

PIN verification is a method that “unlocks” a card for invoice signing and other operations protected by PIN code. PIN shall be in a decimal format, example PIN:2017 is represented as 0x02, 0x00, 0x01, 0x07

IsoCase:	Case3Short
Class:	0x88

Instruction: 0x11

Example: 0x88 0x11 0x04 0x00 0x04 0x02 0x00 0x01 0x07 (for Pin 2017)

Sign Invoice

Signs invoice and returns fiscalization data for a submitted invoice.

IsoCase: Case4Extended

Class: 0x88

Instruction: 0x13

Request Data

Start (byte)	Length (bytes)	Field	Description
0	8	Date/time	E-SDC timestamp UTC time in Unix Timestamp. Example: 1495018011910 is 2017-05-17T10:46:51.910Z
8	20	Taxpayer ID	Hex encoded byte array, leading bytes filled with 0x00; MSB are sent first Example: Taxpayer ID = 928615467, Byte array = {0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x39, 0x32, 0x38, 0x36, 0x31, 0x35, 0x34, 0x36, 0x37} (byte 0x37 is sent last to SE)
28	20	Buyer ID	If unknown, leave zeroes, formatting is the same as for Taxpayer ID
48	1	Invoice type	Values 0, 1, 2, 3, as explained in section **Error! Reference source not found.**
49	1	Transaction Type	Sale=0, Refund=1
50	8	Invoice amount	Sale or refund total amount (including taxes) - depends on applied tax types
58	1	Number of tax categories	Defines the number of tax categories which appear on the invoice (value between 0 and 26). The following data structure **Tax categories** shall be repeated exactly this number of times.
	Tax categories		
59	[1]	[Tax category ID]	The first tax category's OrderID, as explained in Tax Rates section (mandatory if **Number of tax categories** > 0)
60	[8]	[Tax category	The first total tax amount for the category specified in

		amount]	preceding field **Tax category ID** (mandatory if **Number of tax categories** > 0)
68	[1]	[Tax category ID]	The next tax category's OrderID (mandatory if **Number of tax categories** > 1)
69	[8]	[Tax category amount]	The next total tax amount for the category specified in preceding field **Tax category ID** (mandatory if **Number of tax categories** > 1)
77	…		

Response Data

Start (byte)	Length (bytes)	Field	Description
0	8	Date/time	Same as data sent from E-SDC to SE
8	20	Taxpayer ID	Same as data sent from E-SDC to SE
28	20	Buyer ID	Same as data sent from E-SDC to SE
48	1	Invoice type	Same as data sent from E-SDC to SE
49	1	Transaction type	Same as data sent from E-SDC to SE
50	8	Invoice amount	Same as data sent from E-SDC to SE
58	8	Sale or refund counter value	Depends on request's *Tax type* field
66	8	Total counter value (sale+refund)	unsigned int 64bit big endian,
74	256|512	Encrypted Internal Data	Encrypted Internal Data length depends on the number of available tax rates programmed during personalization. It may be 256 or 512 bytes long.
330|586	256	Digital signature	
586|842			

Example: 0x88 0x13 0x04 0x00 0x00 0x00 0x44 0x00 0x00 0x01 0x5D 0x79 0x40 0x3B 0x69 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x30 0x32 0x31 0x31 0x33 0x31 0x36 0x38 0x32 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x24 0x9F 0x00 0x01 0x03 0x00 0x00 0x00 0x00 0x00 0x02 0x12 0xA9 0x00 0x00

Amount Status

Returns 16 bytes long data structure (8 bytes for sum SALE and REFUND, and 8 bytes for Limit Amount)

IsoCase: Case2Short

Class: 0x88

Instruction: 0x14

Example: 0x88 0x14 0x04 0x00 0x00

Audit

Export TaxCore Public Key

Returns 259 bytes data structure represents public card key (256 bytes modulus and 3 bytes exponent), This key is used for Audits.

IsoCase: Case2Extended

Class: 0x88

Instruction: 0x07

Example: 0x88 0x07 0x04 0x00 0x00 0x00 0x00

Export Internal Data

Exports encrypted Internal Data structure only (256 or 512 bytes).

Class: 0x88

Instruction: 0x12

Example: 0x88 0x12 0x04 0x00 0x00

Start Audit

Notifies Secure element that audit process has been initialized by E-SDC.

Secure element returns an encrypted message that shall be submitted to TaxCore as Audit Request Payload.

IsoCase: Case2Extended

Class: 0x88

Instruction: 0x21

Example: 0x88 0x21 0x04 0x00 0x00 0x00 0x00

End Audit

Notifies Secure element that audit process has been finalized by TaxCore. If APDU Command status is OK (0x90 0x00) consider audit operation is successfully completed.

IsoCase: Case3Extended

Class: 0x88

Instruction: 0x20

Example: 0x88 0x20 0x04 0x00 0x00 0x01 0x00 0x53 0x8B 0x46 0xC8 0x86 0x48 0x74 0xE4 0x33 0x46 0xA7 0x13 0x81 0x58 0x5E 0xF4 0xD6 0xDC 0xB8 0xB9 0x92 0x42 0x23 0x1B 0xCA 0x60 0xAD 0x41 0x0A 0x70 0x74 0x7B 0xD4 0x8D 0x5F 0xA1 0x21 0x18 0x85 0x07 0x73 0x6B 0x24 0xA3 0x3E 0x4F 0xFE 0x98 0x8C 0x99 0xC2 0x4E 0x77 0x2E 0xF9 0x6F 0xF8 0x72 0x99 0xB8 0x20 0x16 0x2F 0xAD 0xC6 0x97 0xCD 0x42 0xC0 0xA9 0xF1 0x96 0xF8 0x22 0x00 0x7C 0xD4 0xD1 0xE9 0x41 0x19 0x33 0x24 0xF4 0xB0 0x01 0xE1 0x6D 0x40 0xEB 0x9D 0xE1 0xC3 0xBE 0xBE 0x22 0x67 0x4B 0xAC 0xA6 0x23 0x99 0x3F 0xF5 0xA5 0xA2 0x7F 0x67 0x7A 0x01 0x8B 0xC8 0x3E 0x45 0x08 0x7E 0x34 0xCD 0xEA 0x2F 0x0B 0xCF 0x59 0x5F 0xCE 0x9D 0x6B 0xFE 0x36 0x80 0x85 0x86 0x40 0xD3 0xB4 0x3F

```
0xD7 0x06 0x90 0x79 0x35 0xCE 0x07 0x4B 0x9F 0xAA 0xB8 0x70 0x95 0x5F 0xAC 0x15 0x40 0xE2
0x8A 0x0D 0x5C 0x81 0x27 0x72 0x14 0x00 0xBD 0x68 0x52 0x9B 0x23 0xE5 0xD2 0x23 0x63 0x62
0x87 0x32 0x98 0xA2 0x7A 0x2E 0xDD 0x88 0xD5 0x10 0x0E 0x2B 0x5E 0xA0 0x66 0x89 0xEF 0xD3
0x7E 0x61 0xF9 0x6A 0x6A 0x73 0x4E 0xFE 0xCF 0x6F 0xA6 0xFC 0x67 0xFA 0x88 0xC2 0xA4 0xD5
0x13 0x31 0x12 0x5F 0xC1 0xE8 0x28 0x98 0x87 0x2C 0x43 0xF9 0x11 0x1E 0xC9 0x76 0x16 0xD6
0x9D 0x9D 0x68 0x89 0x7D 0x85 0x0D 0x61 0xB4 0x12 0xB3 0xB5 0x95 0x84 0xCD 0xCA 0x44 0x92
0x9E 0x10 0x22 0x4A 0x10 0x8F 0xB1 0xEE 0xC1 0x1D 0xD4 0xAF
```

Secure element specific APDU error codes

This table contains the expected error codes and descriptions that a caller may encounter while working with the Secure element applet

Error code	Description
0x6301	PIN verification required before executing a command
0x6302	PIN verification failed – wrong PIN code
0x6303	Wrong PIN size
0x6304	Maximum number of tax categories exceeded
0x6305	Maximum amount of tax exceeded (Sign Invoice) or Audit has not been started yet (End Audit)
0x6306	Audit has not started yet
0x6310	The number of allowed PIN entries exceeded
0x63FF	8-byte arithmetic operation overflow
0x6700	Data shall be 256 bytes long
0x6A80	Audit Identification is not valid

PKI Applet

PKI (public key infrastructure) Applet is installed along with the Secure element applet on the same Smart Card.

The role of the PKI applet is to support the secure communication and client certificate authentication of the E-SDC with Backend.Api using HTTPS protocol. The certificate used to establish a secure connection is stored on a smart card and it can be accessed from the PKI Applet using PKSC#11 API.

The certificate is loaded in the slot / token structure on the PKI Applet.

After the certificate is extracted from the smart card (in DER format) it can be used as a standard X.509 certificate for TLS/SSL and HTTPS protocols.

Valid PIN is required to read the certificate from PKI Applet using PKCS#11 API. Pin for PKI Applet is the same as the PIN for SE.

Required Drivers

Smart Cards are programmed with PKI firmware according to GIDS (Generic Identity Device Specification) standard. Appropriate drivers shall be installed/programmed on an E-SDC in order to enable PKI Applet usage.

Windows OS Drivers

GIDS driver is an integral part of Windows OS since Windows 7 SP1, enabling the instant use of a smart card. No additional driver installation is required.

Linux OS Drivers

In order to use PKI Applet on Linux based OS, a pkcs11 driver from the OpenSC library is required. OpenSC libraries and tools are freely available on https://github.com/OpenSC.

In the following example, the installation of required drivers, libraries and tools on Debian / Ubuntu flavor of Linux OS with USB based card reader is shown. It is assumed that OpenSSL is used for TLS/SSL communication.

1. Install card reader driver
   i. # apt-get install libudev-dev
   ii. # wget https://alioth.debian.org/frs/download.php/file/4126/pcsc-lite-x.y.z.tar.bz2
   iii. # tar -xf pcsc-lite-x.y.z.tar.bz2
   iv. # cd pcsc-lite-x.y.z
   v. # ./configure
   vi. # make
   vii. # make install
   viii. # aptitude install libusb-1.0-0-dev
   ix. # wget https://alioth.debian.org/frs/download.php/file/4111/ccid-x.y.z.tar.bz2
   x. # tar -xf ccid-x.y.z.tar.bz2
   xi. # cd ccid-x.y.z
   xii. # ./configure
   xiii. # make
   xiv. # make install
   xv. copy 92_pcscd_ccid.rules file from src directory to /etc/udev/rules.d/
   xvi. # aptitude install libltdl-dev
   xvii. # wget http://ftp.de.debian.org/debian/pool/main/o/openct/openct_x.y.z.orig.tar.gz
   xviii. # tar -xf openct_x.y.z.orig.tar.gz
   xix. # cd openct_x.y.z
   xx. # ./configure
   xxi. # make
   xxii. # make all

2. Install OpenSSL development library
   i. # apt-get install libssl-dev

3. Install OpenSC package
   i. # wget http://cznic.dl.sourceforge.net/project/opensc/OpenSC/opensc-x.y.z/opensc-x.y.z.tar.gz
   ii. # tar -xf opensc-x.y.z.tar.gz
   iii. # cd opensc-x.y.z
   iv. # ./configure
   v. # make
   vi. # make install

vii. Run **opensc-tool** command from terminal
viii. If message that **libopensc.so.3** cannot be loaded find it with **find / -name “libopensc.so”**
ix. Copy found library to **/usr/lib**

4. Install libp11 library
   i. # apt-get install libp11-2

5. Install engine_pkcs11 library
   ii. Download source code from https://github.com/OpenSC/engine_pkcs11/releases/
   iii. Build and install library according to instructions found project page

After the above steps are executed, the certificate shall be accessible from the appropriate slot/token using a PKCS11 family of functions from the lipb11 library. ENGINE family of functions can be used to load the pkcs11 engine in the OpenSSL.

Other Platforms and Operating Systems

Please contact OpenSC community (https://github.com/OpenSC) for further information.

E-SDC to Backend.Api

API is designed and based on OpenAPI-Specification V2 (https://github.com/OAI/OpenAPI-Specification). You can use OpenAPI-Specification code generators (e.g. https://swagger.io/swagger-codegen/) to quickly build a proxy library for almost any programming language and platform.

Once valid Test certificate(s) is obtained you can access API description on the following URL: https://vsdc.sandbox.taxcore.online/Swagger

NOTE: Development, testing and technical review are all done in SandBox environment. The next step is the administrative review process which enables getting accreditation for a specific country. Different countries have different system names, and every environment has its own URL.

System by country/state:

4. Fiji - VMS
5. Samoa – TIMS
6. Washington – TaxCore

For this reason, URLs in your documentation should not be hardcoded but configurable.

How to Obtain a URL of the Backend.Api Service in Runtime

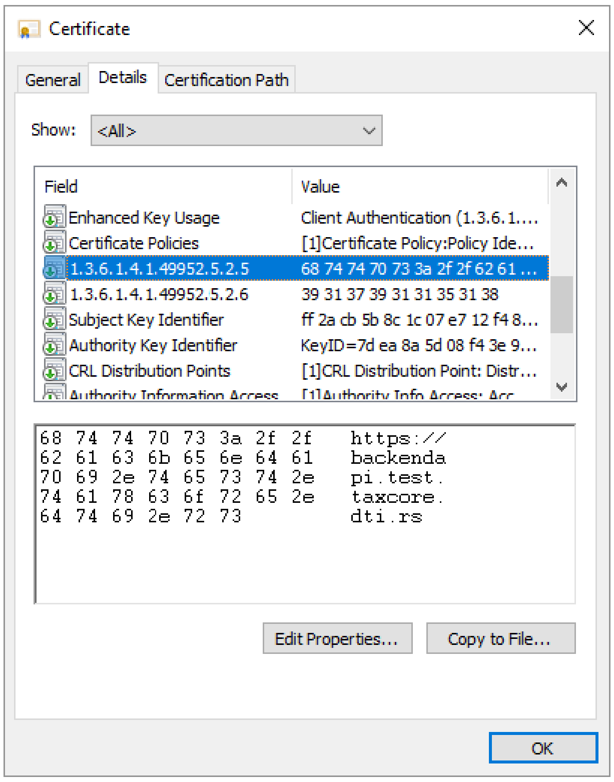
Digital certificate exported using Export Certificate APDU command (in DER format) contains a URL of Backend.Api REST Services.

Backend.Api URL is stored in a Digital certificate as the value of OID. OID is dynamically created during Smart Card personalization and depends on the target environment. Test and Production environments will have different OID so that smart cards issued for one environment cannot be used for any purpose in another environment.

In order to use the same E-SDC with the Test and Production environment, the correct OID shall be constructed using the following procedure.

1. Get Certificate using Export Certificate APDU command
2. Read Value of EnhancedKeyUsage (for example, 1.3.6.1.4.1.49952.**5**.**2**.3.3)
3. Fourth and Third integer to the right identify the environment

4. Construct OID that contains a URL of the Backend.Api by replacing stars with numbers using the following pattern - 1.3.6.1.4.1.49952.*.*.5
5. For this example, resulting OID will be 1.3.6.1.4.1.49952.**5**.**2**.5
6. Read Value of resulting OID containing root URL of Backend.Api REST Service



Field	Value
Enhanced Key Usage	Client Authentication (1.3.6.1....
Certificate Policies	[1]Certificate Policy:Policy Ide...
1.3.6.1.4.1.49952.5.2.5	68 74 74 70 73 3a 2f 2f 62 61 ...
1.3.6.1.4.1.49952.5.2.6	39 31 37 39 31 31 35 31 38
Subject Key Identifier	ff 2a cb 5b 8c 1c 07 e7 12 f4 8...
Authority Key Identifier	KeyID=7d ea 8a 5d 08 f4 3e 9...
CRL Distribution Points	[1]CRL Distribution Point: Distr...
Authority Information Access	[1]Authority Info Access: Acc

```
68 74 74 70 73 3a 2f 2f   https://
62 61 63 6b 65 6e 64 61   backenda
70 69 2e 74 65 73 74 2e   pi.test.
74 61 78 63 6f 72 65 2e   taxcore.
64 74 69 2e 72 73         dti.rs
```

Authenticate

Communication between an E-SDC and Backend.Api is carried out via the HTTPS protocol. The E-SDC is authenticated by Backend.Api using a certificate stored on PKI Applet or an authentication token received from Backend.Api, once a client certificate authentication has been successfully conducted as the first step.

Request Authentication Token

When requesting the authentication token, an E-SDC shall authenticate with a valid Digital Certificate (stored in the PKI applet). If the token is successfully created it shall be returned to the E-SDC as a string. In order to receive an authentication token, an E-SCD shall establish a secure connection to “/api/SDC/RequestAuthenticationToken” operation on Backend.Api.

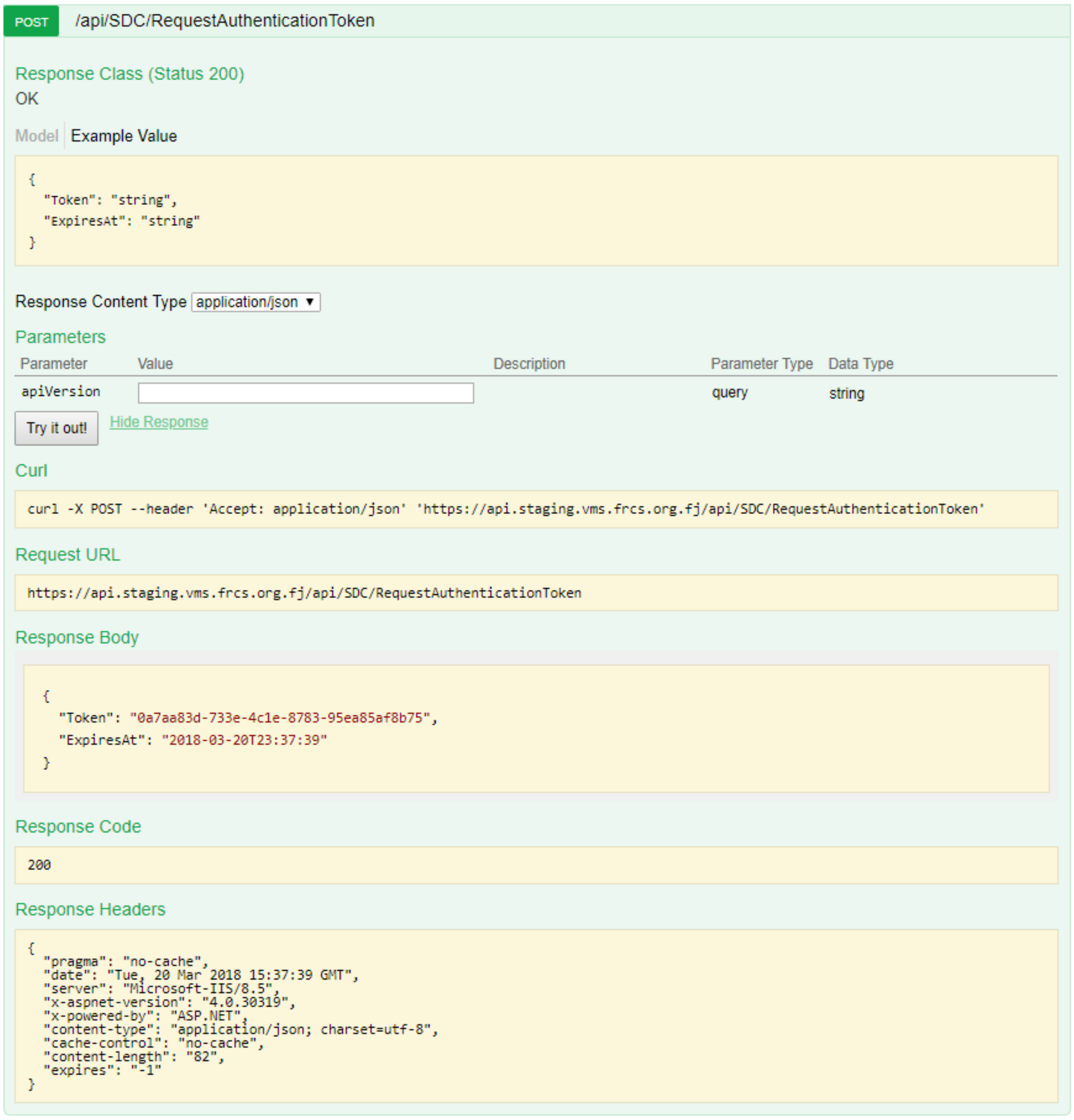
A request is composed as follows:

1. Create HTTPS POST request object
2. Add HTTP headers "Accept: application/json" and "Content-Type: application/json"
3. Read certificate from the PKI Applet
4. Use the certificate from the PKI Applet to establish SSL/TLS connection
5. Send request to “/api/SDC/RequestAuthenticationToken” operation on Backend.Api web service.

Response from Backend.Api will contain a JSON formatted text with the authentication token string object that shall be used for further communication.

The certificate-based authentication is used only to request a token. Request for the authentication token shall be periodically invoked to obtain a new token and to verify the date and time.

The following image is an example of a token request and response from the staging environment.



POST /api/SDC/RequestAuthenticationToken

Response Class (Status 200)
OK

Model | Example Value

```
{
  "Token": "string",
  "ExpiresAt": "string"
}
```

Response Content Type: application/json

Parameters

Parameter	Value	Description	Parameter Type	Data Type
apiVersion			query	string

Try it out! | Hide Response

Curl

```
curl -X POST --header 'Accept: application/json' 'https://api.staging.vms.frcs.org.fj/api/SDC/RequestAuthenticationToken'
```

Request URL

```
https://api.staging.vms.frcs.org.fj/api/SDC/RequestAuthenticationToken
```

Response Body

```
{
  "Token": "0a7aa83d-733e-4c1e-8783-95ea85af8b75",
  "ExpiresAt": "2018-03-20T23:37:39"
}
```

Response Code

```
200
```

Response Headers

```
{
  "pragma": "no-cache",
  "date": "Tue, 20 Mar 2018 15:37:39 GMT",
  "server": "Microsoft-IIS/8.5",
  "x-aspnet-version": "4.0.30319",
  "x-powered-by": "ASP.NET",
  "content-type": "application/json; charset=utf-8",
  "cache-control": "no-cache",
  "content-length": "82",
  "expires": "-1"
}
```

The Token is valid for 8 hours by default.

An E-SDC shall use the current token when calling all other services exposed by Backend.Api.

When a token expires an E-SDC shall request a new token.

If an E-SDC requests a new token while the current token is still valid, TaxCore shall return the existing token.

While creating an HTTP request, the E-SDC shall put the token in the HTTP request header. The header key is *TaxCoreAuthenticationToken*, and value is a valid token string.

Get Initialization Commands

For each new smart card issued by Tax Service, a set of commands is generated, which contain information necessary for invoice signing (Tax Rates, Verification URL, NTP server, etc.). Commands can be downloaded using one of the following channels:

- By invoking Backend.Api operation **Error! Reference source not found.** (typically by E-SDC)

By invoking Backend.Api operation Notify Online Status

If an E-SDC is online, it shall periodically (once every 1 – 5 minutes) invoke “Notify Online Status” operation on Backend.Api.

Compose HTTPS POST request as follows:

1. Add headers "Accept: application/json", "Content-Type: application/json" and header that contains authentication token
2. Add a POST field “true” to the request
3. Submit POST request to https://<backend_api_url>/api/SDC/NotifyOnlineStatus

After the request is sent, Backend.Api shall return a response with a JSON formatted string containing a list of commands, as described in section Commands, that an E-SDC shall execute (new tax rates, verification URL, NTP URL or public key used for encryption). The Command list can be empty.

Notify Command Processed

After an E-SDC process commands received from Backend.Api, it shall report the results of execution to Backend.Api.

The format of request is described in the section Commands Results.

1. Add headers "Accept: application/json", "Content-Type: application/json" and header that contains authentication token
2. Submit POST request to https://<backend_api_url>/api/SDC/NotifyCommandProcessed

- Submit Audit Package (typically by E-SDC)
- By invoking Backend.Api operation Get Initialization Commands (typically by E-SDC)
- By using Taxpayer Admin Portal

Once the commands are processed, E-SDC reports execution status to Backend.Api as explained in section **Error! Reference source not found.**.

E-SDC can explicitly require initialization commands, by invoking Backend.Api operation Get Initialization Commands.

Initialization commands include:

- Configure Time Server URL Command,
- Set Tax Rates Command,
- Update Verification URL Command.

To get Initialization commands, compose the HTTPS POST request as follows:

1. Add headers "Accept: application/json", "Content-Type: application/json" and header that contains an authentication token
2. Submit POST request to https://<backend_api_url>/Api/SDC/GetInitializationCommands

The response contains a list of commands that shall be executed by E-SDC, as described in section Commands.

Notify Online Status

If an E-SDC is online, it shall periodically (once every 1 – 5 minutes) invoke "Notify Online Status" operation on Backend.Api.

Compose HTTPS POST request as follows:

4. Add headers "Accept: application/json", "Content-Type: application/json" and header that contains authentication token
5. Add a POST field "true" to the request
6. Submit POST request to https://<backend_api_url>/api/SDC/NotifyOnlineStatus

After the request is sent, Backend.Api shall return a response with a JSON formatted string containing a list of commands, as described in section Commands, that an E-SDC shall execute (new tax rates, verification URL, NTP URL or public key used for encryption). The Command list can be empty.

Notify Command Processed

After an E-SDC process commands received from Backend.Api, it shall report the results of execution to Backend.Api.

The format of request is described in the section Commands Results.

3. Add headers "Accept: application/json", "Content-Type: application/json" and header that contains authentication token
4. Submit POST request to https://<backend_api_url>/api/SDC/NotifyCommandProcessed

Submit Audit Package

After the invoice audit package is created (explained in the section Creating an Audit Package), it shall be transferred to Backend.Api the next time Internet connection is available.

Compose HTTPS POST request as follows:

1. Add headers "Accept: application/json", "Content-Type: application/json" and header that contains an authentication token
2. Add an Audit Package as a JSON message to the body of the HTTP POST request
3. Submit POST request to https://<backend_api_url>/Api/SDC/SubmitAuditData

After the request is sent, Backend.Api shall response with a JSON formatted text containing a status of operation and a list of commands an E-SDC shall execute.

Model

```
AuditDataStatus {
      Status (integer, optional) = ['0', '1', '2', '3', '4', '5', '6']integerEnum:0,
1, 2, 3, 4, 5, 6,
      Commands (Array[Command], optional),
      OperationSuccess (boolean, optional)
}Command {
      CommandId (string, optional),
      Type (integer, optional) = ['0', '1', '2', '3', '4', '5']integerEnum:0, 1, 2, 3,
4, 5,
      Payload (string, optional),
      UID (string, optional),
      Recipient (string, optional)
}
```

Data Fields

Field	Description
Status	Audit Package unpacked and verified by Backend API. Status may help E-SDC developers rectify problems with audit packages If all verifications are successfully Status should have value 4 - Invoice is verified

Status	Description
0	Invoice is not yet verified
1	Signature is valid
2	Signature is invalid
3	Internal data is invalid
4	Invoice is verified
5	Verification data is not complete
6	Signed with a revoked certificate

Commands	Contains a list of commands that should be executed by E-SDC, as described in the Commands section.
OperationSuccess	If the result field `OperationSuccess` is `true` that audit package file can be deleted from the E-SDC.

Submit Audit Request Payload (ARP)

E-SDC invokes BeginAudit command and receives 256bytes of data that represents Audit Request Payload (ARP). ARP has to be converted to the string using Base64 encoding and submitted to endpoint https://<backend_api_url>/api/SDC/StartProofOfAudit as body of the HTTP request.

Compose HTTPS POST request as follows:

1. Add headers "Accept: application/json", "Content-Type: application/json" and header that contains authentication token
2. Add a Json message to the body of the HTTP POST request
3. Submit POST Request to https://<backend_api_url>/Api/SDC/StartProofOfAudit

Data Format

```
{
  "AuditRequestPayload": "string"
}
```

File-Based Communication

SD Cards or Flash memory drives format

Each E-SDC shall work with the following file system formats of SD Cards and USB Flash drives

- FAT
- FAT32
- NTFS

Tax Inspector Configures a new E-SDC using an SD Card

JSON file (*.commands) with commands shall be stored in a subfolder named after UID of the card inserted in the E-SDC. e.g D:\\YJ37C9Z9\YJ37C9Z9.commands

JSON File Format

```
{
  "Commands": [
    {
      "CommandId": "GUID",
      "Type": 0,
      "Payload": "Command Specific Json as string",
      "UID": "string"
    }
  ]
}
```

E-SDC Executes Commands Received via SD Card/USB drive

An E-SDC shall process commands automatically upon insertion of SD Card or USB Flash drive. Command execution takes precedence over a Local audit. Command types and structure are explained in the section Commands.

JSON file with commands shall be stored in the subfolder named after UID value.

E-SDC shall execute only those commands with the same UID as UID assigned to the digital certificate of the Secure Element (stored in the SerialNumber field of the certificate subject).

E-SDC Stores a command execution result to the SD Card/USB drive

After commands have been executed, E-SDC shall store JSON file (<UID>.results) with the result to the UID folder on the SD Card/USB drive, e.g. G:\BJ3PN1S9\ where G is the root of the SD card/USB drive and <UID> is UID of the smart card in use. The existing file on the SD Card/USB drive shall be overwritten.

The format of the data is explained in section Commands

E-SDC Stores Audit Files on SD Card/USB drive

An E-SDC shall perform an audit automatically once an SD Card or USB drive is inserted. If any commands are received on the same medium, they shall be executed before the proceeding with the Local audit.

All files shall be stored in the subfolder titled Audit of the UID folder.

Example: `G:\BJ3PN1S9\Audit\` where G is the root of the SD card/USB drive.

If the folder does not exist, an E-SDC shall create a new one.

An Audit consists of two file types:

1. One ARP.bin file containing the result of the invocation of Begin Audit APDU command (256Bytes)
2. One or more audit package files named using the following convention: {UID}-{Ordinal_Number}.json