Device Web APIs for 3D Printer - Technical Specification

Candidate Version 1.0 – 14 Nov 2017

Open Mobile Alliance

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1. Scope

3D Printer is one of the most potential devices will be popular in the near future. And it has power to change the daily life.

The GotAPI provides a multi-purpose web-based framework to enable interwork applications, external devices and external services including 3D printing service. The GotAPI for 3D printer consists of the GotAPI Server and the 3D Printer Extension Plug-Ins. A smartphone application communicates with the specific Extension Plug-In to control and use 3D printing service. In the flow of the 3D printing, the application could simply use 3D printer not only proximately but also remotely via Web technology by GotAPI Server and Contents Server of 3D Printing service.

In the GotAPI framework, the 3D Printer Extension Plug-In interacts with a 3D printer as an external device and Contents Server as an external service, and exposes interfaces to the GotAPI Server as well. Due to the framework, a smartphone application could interact with various kinds of 3D printers using consistent APIs as defined in this specification.

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2. References

2.1 Normative References

[DWAPI-3DP] (DRAFT)
Device WebAPI-3DP
OMA-ER-Device_WebAPIs_3DP-V1_0-20161101-D URL:http://member.openmobilealliance.org/

[DWAPI-PCH] (DRAFT)
Device WebAPI-PCH
OMA-ER-Device_WebAPIs-V1_0-20160419-C URL:http://member.openmobilealliance.org/

[EventSource] "Server-Sent Events", Worldwide Web Consortium (W3C), URL: http://dev.w3.org/html5/eventsource/ (latest working draft)

[GotAPI 1.1] (DRAFT)
Generic Open Terminal API Framework (GotAPI), Candidate Version 1.1 – 15 Dec 2015
URL:http://member.openmobilealliance.org/

[HTTP/1.1] "Hypertext Transfer Protocol -- HTTP/1.1", Internet Engineering Task Force (IETF), URL:http://tools.ietf.org/search/rfc2616

[HTTP/2.0] "Hypertext Transfer Protocol version 2.0", Internet Engineering Task Force (IETF), URL:http://tools.ietf.org/search/draft-ietf-httpbis-http2-09 (latest working draft)

[JSON-RPC] "JSON-RPC 2.0 Specification", JSON-RPC Working Group, URL:http://www.jsonrpc.org/specification

[RFC2119] "Key words for use in RFCs to Indicate Requirement Levels", S. Bradner, March 1997, URL:http://www.ietf.org/rfc/rfc2119.txt

[SCRRULES] "SCR Rules and Procedures", Open Mobile Alliance™, OMA-ORG-SCR_Rules_and_Procedures, URL:http://www.openmobilealliance.org/

[WebSocket] "The WebSocket API, Worldwide Web Consortium (W3C), URL:http://dev.w3.org/html5/websockets/ (latest working draft)

2.2 Informative References

[OMADICT] "Dictionary for OMA Specifications", Version 2.9, Open Mobile Alliance™, OMA-ORG-Dictionary-V2.9, URL:http://www.openmobilealliance.org/

[OMNA] "OMA Naming Authority". Open Mobile Alliance™. URL:http://www.openmobilealliance.org/tech/omna.aspx

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3. Terminology and Conventions

3.1 Conventions

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in [RFC2119].

All sections and appendixes, except “Scope” and “Introduction”, are normative, unless they are explicitly indicated to be informative.

Agent	A node that collects and transmits 3D printer data to an associated manager.
API Patterns	Design guidelines and requirements for definition of APIs
Browser Context	Web applications executing under a Web browser as Web runtime environment.
Datagram	An API providing access to UDP protocol based networking.
Device	A physical device implementing either an Agent or manager role.
ECMAScript	Use definition from [OMADICT].
Hybrid Native/Web App	An application designed to execute under the native OS / middleware environment of a device, and that use native APIs for the execution of web content in addition to native code.
JavaScript	Use definition from [OMADICT].
Manager	A node receiving data from one or more agent systems. Examples of managers include a cellular phone, 3D printing appliance, set top box, or computer system.
Native App	An application designed to execute under the native OS / middleware environment of a device.
Socket	An API providing access to TCP protocol based networking.
Uniform Resource Identifier	Use definition from [OMADICT].
User Agent	Use definition from [OMADICT].
Web	The World Wide Web, a content and application framework based upon hypertext and related technologies, e.g. XML, JavaScript/ECMAScript, CSS, etc.
Web Application	An application designed using Web technologies (e.g. HTML, CSS, and Javascript).
Web IDL	An IDL language for Web application APIs
Web Runtime Application	A client-side Web application that is executed in Web runtime environments.
Web Runtime Environment	Client software that supports the execution of Web applications (e.g. browsers or widget engines).
WebSocket	An API providing networking services per the WebSocket standard [WebSocket].
Widget Context	Web applications installed and executing under a W3C Widget [W3C-Widgets] engine as Web runtime environment.
Widget Engine	Software which supports the execution of Web applications running outside a browser context, e.g. with the same functional capabilities as browsers but without the user interface functions provided by a browser, including window frames, menus, toolbars and scroll bars.

3.2 Abbreviations

3DP	3 Dimensional Printer

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API	Application Programming Interface
EventSource	The EventSource API (Server-Sent Events)
HTTP	HyperText Transfer Protocol
IDL	Interface Definition Language
JSON	JavaScript Object Notation
MIME	Multipurpose Internet Mail Extensions
OMA	Open Mobile Alliance
REST	REpresentational State Transfer
RPC	Remote Procedure Call
SCR	Static Conformance Requirements
TS	Technical Specification
UA	User Agent
UE	User Equipment
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
W3C	World Wide Web Consortium
WRAPI	The OMA Web Runtime API enabler
XML	eXtensible Markup Language
XSD	XML Schema Definition

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4. Introduction

While there are various types of 3D printers to be connected with smartphones coming out, there are fundamental issue to be solved for certain markets:

- Since there are no open standardized APIs and frameworks that application developers can use for the same type of 3D printers, developers are required to customize their applications for each and every different 3D printer.

To solve this problem, OMA has standardized GotAPI (Generic Open Terminal API Framework) [GotAPI 1.1]. GotAPI provides the framework to enable applications (native, hybrid and web applications) to work with external devices and internal enablers through GotAPI Servers and Extension Plug-Ins based on web technologies.

Additionally, OMA has standardized DWAPI (Device Web API) which definces 3D Printer Plug-in. The 3D printer Plug-Ins implements web-based APIs to expose services (or data) from those connected. The applications securely access the web-based APIs under the framework that GotAPI provides.

4.1 Version 1.0

3D Printer Device WebAPIs version 1.0 includes the functionality:

- Device Web API specifications for DWAPI-3DP, with device classes of 3D printer specialization based on the GotAPI 1.1 framework
- Device Web APIs for Service Discovery, One-shot measuring, asynchronous measuring, service connecting, authentication, 3D printing command and 3D printer status.
- Requirements and architecture documents [DWAPI-3DP]

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5. Technical Specifications

This specification must adhere to the GotAPI 1.1 specification. This document specifies certain aspect of GotAPI 1.1 as the basis and introduces new elements that are necessary for 3D Printing Devices.

In order to increase readability, the specification described below uses the same tables as defined in GotAPI 1.1, describing the necessary features including those of the general procedures of any GotAPI 1.1 uses as well as those specific to the 3D Printer APIs. Those specifications that are specific to the 3D Printer APIs are colored in green in the following specifications in the following tables, in order to increase readability, to make identify distinction easily. Those rows that are not colored in green are merely copies from GotAPI 1.1 specification [GotAPI 1.1]

5.1 Service Discovery API

Service Discovery API enables applications to discover available services as define in the Section 7.2.1[DWAPI-3DP]. Service Discovery API specification adheres to that of GotAPI 1.1.

Here is the Service Discovery based on what is defined in GotAPI 1.1. After the application obtains authorization for access to GotAPI-based APIs using the GotAPI-2 Interface, the application sends the Service Discovery request to the GotAPI Server. Then the GotAPI Server sends the Service Discovery request to all of the installed Extension Plug-Ins. The message flow of the Service Discovery is shown in Fig. 1.

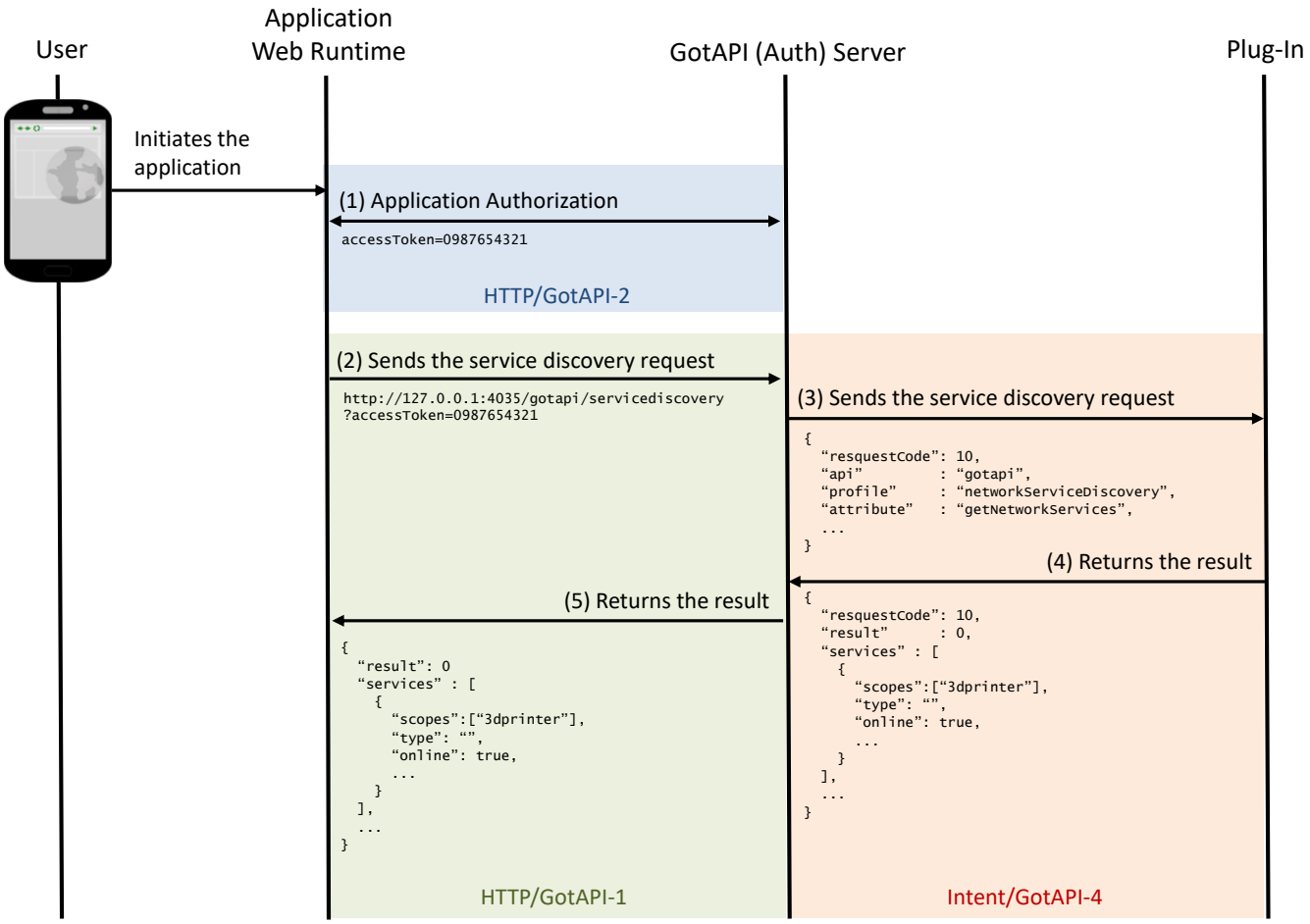

Figure 1: Message flow of the Service Discovery

The specific data in the message flows labelled (4) in the figure above are defined as follows. The other message flows SHALL be consistent to what are defined in the GotAPI 1.1 specification:

When the GotAPI Server receives the request of the Service Discovery API from an application, the GotAPI Server sends the Plug-In discovery request to the installed Plug-Ins as defined in the GotAPI specification. When the 3D Printer Plug-In

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receives the Plug-In discovery request from the GotAPI Server, the 3D Printer Plug-In SHALL return the message as follows:

Definition of the data object for the Plug-In discovery response

Name	Sub name	Type	Definition of value	Mandatory/Optional
requestCode		int	The request code coming from the GotAPI Server.	Mandatory
result		int	If success, the value is 0, otherwise an integer other than 0, which indicates an error code. This specification doesn't define error codes.	Mandatory
services		Array		Mandatory
	serviceId	String	The service identifier. The id could be "com.example.plugin".	Mandatory
	name	String	The name of the targeted 3D printer.	Mandatory
	manufacturer	String	The manufacturer of the targeted 3D Printer.	Optional
	version	String	The version of the targeted 3D printer.	Optional
	type	String	This value represents the type of the network used to connect to the 3D printer. The value must be any one of "WiFi", "BLE", "NFC", "Bluetooth", “USB", or “Mobile”.	Optional
	online	Boolean	If the service is available, this value SHALL be true. Otherwise (e.g. the 3D printer Plug-In has not yet detect any 3D printer or the Plug-In is not allowed to access to any devices), this value SHALL be false.	Mandatory
	scopes	Array	This value SHALL be an array including a string "3dprinter" as an array element (["3dprinter", ...]).	Mandatory

Editor's note: The value "Mobile" was added to the list of the allowed values for the "type" property in the data object. The value “Mobile” is wide area mobile network such as “3G” and “LTE”. For the 3D printer profile, remote access ability to the 3D printer is needed because the user of 3D printer could not be in the proximity of the printer due to its long-time of operation. The value "Mobile" is not specified in the GotAPI 1.1 specification.

The 3D Printer Plug-In MAY append additional data in the data object as needed.

This data object is sent to the Plug-Ins in an OS specific mechanism, .e.g., Intents for Android.

Requirements for OS-specific response channel and data container

OS	Description
Android	The GotAPI Server must use Explicit Intents for the response. The data object must be mapped to the Extra directly.

Example of the data object of the Android Explicit Intents

Name		Example of value	Note
Action		"org.deviceconnect.action.RESPONSE"	This value is defined by the GotAPI Server application.
Component		"org.deviceconnect"	This value is the package name of the GotAPI Server application.
Extra			

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	requestCode	1	
	result	0	
	services	*[Array Object]*	This value is an example. Note that this is "not" a JSON string. This value must be an Array object whose content is the same as the following JSON example: [{ "id": "org.example.plugin.12345", "name": "Flash 3D printer", "manufacturer": "ABC 3D Printing Inc.", "version": "3.0", **"type": "Mobile",** **"online": true,** **"scopes": ["3dprinter"]** }, ...]
	config	*"additional parameters"*	*This name-value pair is an additional data which is not defined by this specification.*

5.2 One-shot measuring API

One-shot API enables applications to receive measured data from targeted devices by one HTTP request/response transaction as define in the Section 7.2.2 [DWAPI-3DP]. One-shot measuring API specification adheres to that of GotAPI 1.1.

As defined by GotAPI 1.1, after the application obtains authorization to access GotAPI-based APIs using the GotAPI-2 Interface and completes the Service Discovery, the application can use the service (so called "One-shot measuring API") provided by the Plug-In through the GotAPI Server.

The One-shot measuring API offers a measurement result reported by the targeted device in response to a request. The message flow of this API is as shown blow.

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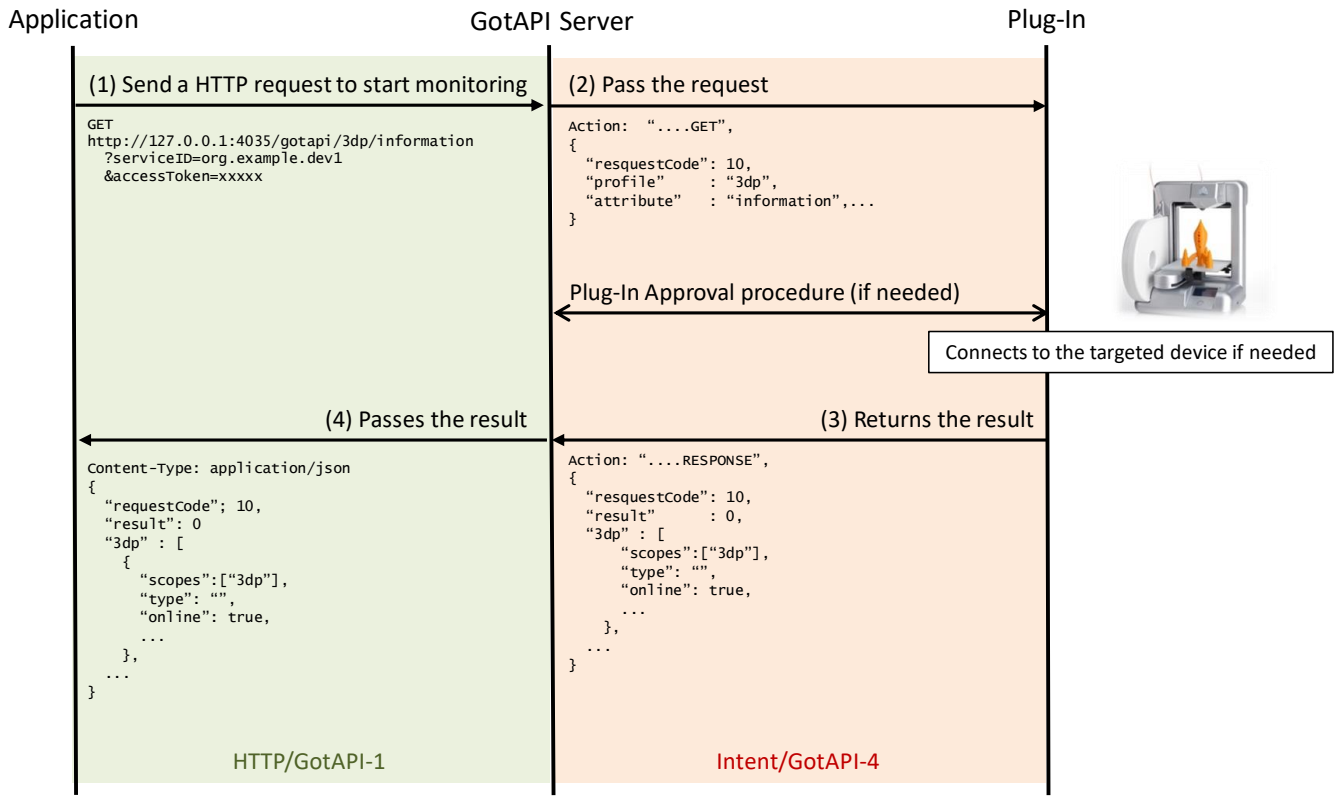

Figure 2: Message flow of the One-shot measuring API

This section defines the data object for all the message flows described in the figure above.

5.2.1 Request for one-shot measuring on the GotAPI-1 Interface

When the application uses the one-shot measuring it sends a request to the GotAPI Server on the GotAPI-1 Interface as follows:

Definition of the HTTP request

	Definitions
Method	HTTP GET
Request URL	http://127.0.0.1:4035/gotapi/3dp/information https://127.0.0.1:4036/gotapi/3dp/information

Definition of the request parameters

Parameter name	Definition of value	Mandatory/Optional
serviceId	The identifier of the targeted service. This value is available from the Service Discovery API on the GotAPI-1 Interface.	Mandatory
accessToken	The access token obtained from the GotAPI Auth Server through the GotAPI-2 Interface.	Mandatory
nonce	A nonce generated by the application, which is described in the section "7.3.3.3 HMAC server authentication using trusted Application ID for the Server spoofing attack" in the GotAPI specification.	Optional

Example of the request URL

```
http://127.0.0.1:4035/gotapi/3dp/information?serviceId=abcdefg123&accessToken=0987654321&nonce=93b3a219347
```

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5.2.2 Request for one-shot measuring on the GotAPI-4 Interface

When an application sends a request to the GotAPI Server on the GotAPI-1 Interface, the GotAPI Server passes the request to the Plug-In on the GotAPI-4 Interface. The request includes the data object as follows:

Definition of the data object for request

Name		Type	Definition of value	Mandatory/Optional
method		String	This value SHALL be "GET".	Mandatory if the OS is not Android. Otherwise, optional. If the OS is Android, the "Action" value SHALL include this information as described below.
receiver		String	The address of the GotAPI Server application used by Plug-Ins. Generally, it is the application ID recognized by the OS, such as a package name.	Mandatory
requestCode		int	A request code identifying the request. This value could be any number but must be an integer greater than 0, and unique for each open request, to ensure responses can be correlated.	Mandatory
serviceId		String	The identifier of the targeted Service. This value is provided by the application over the GotAPI-1 Interface.	Mandatory
api		String	The value must be "gotapi".	Mandatory
profile		String	The value must be "3dp".	Mandatory
attribute		String	The value must be "information"	Mandatory
clientId		String	The identifier of the application, which is generated by the Plug-In when the Plug-In Approval procedure defined in the GotAPI specification.	Mandatory
accessToken		String	The access token for the application, which is generated by the Plug-In when the Plug-In Approval procedure defined in the GotAPI specification.	Mandatory

This data object is sent to the Plug-Ins in an OS specific mechanism, e.g., Intents for Android.

Requirements for OS-specific request channel and data container

OS	Description
Android	The GotAPI Server must use Explicit Intents for the request. The data object must be mapped to the Extra directly.

Example of the data object of the Android Explicit Intents

Name		Example of value	Note
Action		org.deviceconnect.action.**GET**	This value is defined by the GotAPI Server application. But the last part SHALL be "**GET**".
Component		org.example.plugin	This value is the package name of the Plug-In application.
Extra			

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	receiver	org.deviceconnect	
	requestCode	10	
	servcieId	dev1.example.org	
	api	gotapi	
	profile	3dp	
	attribute	information	
	clientId	1234567890	
	accessToken	0987654321	

5.2.3 Response for one-shot measuring on the GotAPI-4 Interface

When the Plug-In receives the request, it SHALL respond to the GotAPI Server as follows:

Definition of the data object for the response

Name			Type	Definition of value	Mandatory/Optional
method			String	This value SHALL be "RESPONSE".	Mandatory if the OS is not Android. Otherwise, optional. If the OS is Android, the "Action" value SHALL include this information as described below.
requestCode			int	The request code coming from the GotAPI Server.	Mandatory
result			int	If success, the value is 0, otherwise an integer greater than 0, which indicates an error code. This specification doesn't define error codes.	Mandatory
3dp					Mandatory
	device		Object		Mandatory
		productName	String	The product name of the targeted device. If the Plug-In cannot obtain this information from the targeted device, it SHALL create a name for the device using an arbitrary algorithm. The algorithm is up to the Plug-In implementation, and this specification does not define any algorithms.	Mandatory
		manufacturerName	String	The manufacturer name of the targeted device. If the Plug-In cannot obtain this information from the targeted device,	Mandatory

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				this value SHALL be an empty string.	
		modelNumber	String	The model number of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		firmwareRevision	String	The firmware revision of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		serialNumber	String	The serial number of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		softwareRevision	String	The software revision of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		hardwareRevision	String	The hardware revision of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		partNumber	String	The part number of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		protocolRevision	String	The protocol revision of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		systemId	String	The system id of the targeted device. This value SHALL be a 16-character HEX string without a '0x' prefix (e.g. "ABCDEF0123456789"). If the Plug-In cannot obtain this information from the targeted device, this value SHALL be "0000000000000000" (a string of 16 '0' characters).	Mandatory
	printAttribute		object		Mandatory
		printType	string	The type of printing technology. This value SHALL be a Max 10-character alphabet string. The value should be one of the following: - “FFF”: Fused Filament Fabrication - “FDM”: Fused Deposition Modeling - “DLP”: Digital Light Processing	Mandatory

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				- “PBP”: Powder Bed & inkjet head 3D Printing - “PolyJet”: Photopolymer Jetting Technology - “LOM”: Laminated Object Manufacturing - “SLA”: Stereolithography Apparatus - “SLS”: Selective Laser Sintering	
		printSizeX	float	This value represents the maximum size of printing object in the direction of X-axis The unit is mm. (1/10cm)	Mandatory
		printSizeY	float	This value represents the maximum size of printing object in the direction of Y-axis The unit is mm. (1/10cm)	Mandatory
		printSizeZ	float	This value represents the maximum size of printing object in the direction of Z-axis The unit is mm. (1/10cm)	Mandatory
		network	float	This value indicates the connectivity of the 3D printer If the value is “0”, the printer does not have networking facility to Wide Area Network such as internet and GSM. If the value is bigger than “0”, the printer has network connectivity.	Mandatory
		memorySize	float	This value represents the memory size of the printer The unit is MB(Mega Bytes)	
	Status		object		Mandatory
		operatingStatus	string	This value represents the current operation status of the targeted device. This value SHALL be a 3-character string The value should be one of the following: - “RDY”: Ready to use - “RUN”: Under printing operation - “MAN”: Maintenance needed - “CLR”: Printing completed but the result is not removed yet - “ERR”: an error is occured	Mandatory
		nozzleTemp	float	This value represents the temperature of the nozzle. This value SHALL be a float number in a range from 0.0 to 1000.0 The unit is Celsius(C)	Mandatory

The Plug-In MAY append additional data in the data object as needed.

This data object is sent to the GotAPI Server in an OS specific mechanism, e.g., Intents for Android.

Requirements for OS-specific response channel and data container

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OS	Description
Android	The GotAPI Server must use Explicit Intents for the request. The data object must be mapped to the Extra directly.

Example of the data object of the Android Intents

Name				Example of value	Note
Action				org.deviceconnect.action.**RESPONSE**	This value is defined by the GotAPI Server application. But the last part SHALL be "**RESPONSE**".
Component				org.deviceconnect	This value is the package name of the GotAPI Server application.
Extra					
	requestCode			10	
	result			0	
	3dp				
		device			
			productName	ABC 3D Printer	
			manufacturerName	ABC Inc.	
			modelNumber	3DP-001	
			firmwareRevision	rev.1.001.003	
			serialNumber	01234-5678-9ABCD-EF01	
			softwareRevision	rev.2.000.000	
			hardwareRevision	rev.1.0	
			partNumber	002	
			protocolRevision	rev.3.1	
			systemId	ABCDEF0123456789	
		printAttribute			
			printType	FDM	
			printSizeX	500.0	
			printSizeY	500.0	
			printSizeZ	500.0	
			network	1.0	
			memorySize	4096.0	
		Status			
			operatingStatus	RDY	

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			nozzleTemp	25.0	

5.2.4 Response for one-shot measuring on the GotAPI-1 Interface

When GotAPI Server receives the response from the Plug-In, the GotAPI Server passes it to the application as follows:

Definition of the HTTP response

	Definitions
MIME-Type	application/json
HTTP status	200 OK

Definition of the data object for the response

Name			Type	Definition of value	Mandatory/Optional
product			String	The name of the GotAPI Server (e.g. "ABConnect")	Mandatory
version			String	The version of the GotAPI Server (e.g. "1.0").	Mandatory
result			Number	If success, the value is 0, otherwise an integer greater than 0, which indicates an error code. This specification doesn't define error codes.	Mandatory
3dp			Object		Mandatory
	device		Object		Mandatory
		productName	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		manufacturerName	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		modelNumber	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		firmwareRevision	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		serialNumber	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		softwareRevision	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		hardwareRevision	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		partNumber	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		protocolRevision	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		systemId	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
	printAttribute		object		Mandatory
		printType	string	This value SHALL be the same as what the	Mandatory

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				GotAPI Server received from the Plug-In.	
		printSizeX	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		printSizeY	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		printSizeZ	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		network	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		memorySize	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	
	Status		object		Mandatory
		operatingStatus	string	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		nozzleTemp	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
hmac			String	An HMAC generated for the counter measure against the GotAPI Server spoofing attack. If the application includes a key for HMAC calculation in the API request, the GotAPI Server adds this value in the API response. Evaluating whether the HMAC is identical to the result of calculation of HMAC from the key, the application can ensure that the response is genuine.	Mandatory if the application provide a key to the GotAPI Server

The GotAPI Server SHALL serialize the data structure above as a JSON formatted stream (i.e. JSON string).

Example of the response

```
{
  "product"              : "ABC3DP",
  "version"              : "1.0",
  "requestCode"          : 10,
  "result"               : 0,
  "3dp"                : {
    "device": {
      "productName"      : "ABC 3D Printer",
      "manufacturerName" : "ABC Inc.",
      "modelNumber"      : "3DP-001",
      "firmwareRevision" : "rev.1.001.003",
      "serialNumber"     : "01234-5678-9ABCD-EF01",
      "softwareRevision" : "rev.2.000.000",
      "hardwareRevision" : "rev.1.0",
      "partNumber"       : "002",
      "protocolRevision" : "rev.3.1",
      "systemId"         : "ABCDEF0123456789"
    },
    "printAttribute": {
      "printType"        : “FDM”,
      "printSizeX"       : 500.0,
```

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```
      "printSizeY"       : 500.0,
      "printSizeZ"       : 500.0,
      "network"          : 1.0,
      "memorySize"       : 4096.0
    }
    "status": {
      "operatingStatus"  : “RDY”,
      "nozzleTemp"       : 25.0
    },
  }
  "hmac"                 : "0123456789"
}
```

5.3 Asynchronous messaging API

Asynchronous messaging API enables applications to receive measured data from the targeted device asynchronously using WebSocket as define in the Section 7.2.3 [DWAPI-3DP]. Asynchronous messaging API specification adheres to that of GotAPI 1.1.

As defined by GotAPI 1.1, after the application obtains authorization to access GotAPI-based APIs using the GotAPI-2 Interface and completes the Service Discovery, the application can use the service (so called "Asynchronous messaging API") provided by the Plug-In through the GotAPI Server.

The asynchronous messaging API offers a series of measurement values reported by the targeted device to an application in real time as the measurement values become available. The timing when and the reasons why such measurement values become available is determined by the Plug-Ins and connected devices, and is out of the scope of this specification.

This API uses WebSocket protocol to handle asynchronous event messages. The message flow of this API is shown blow:

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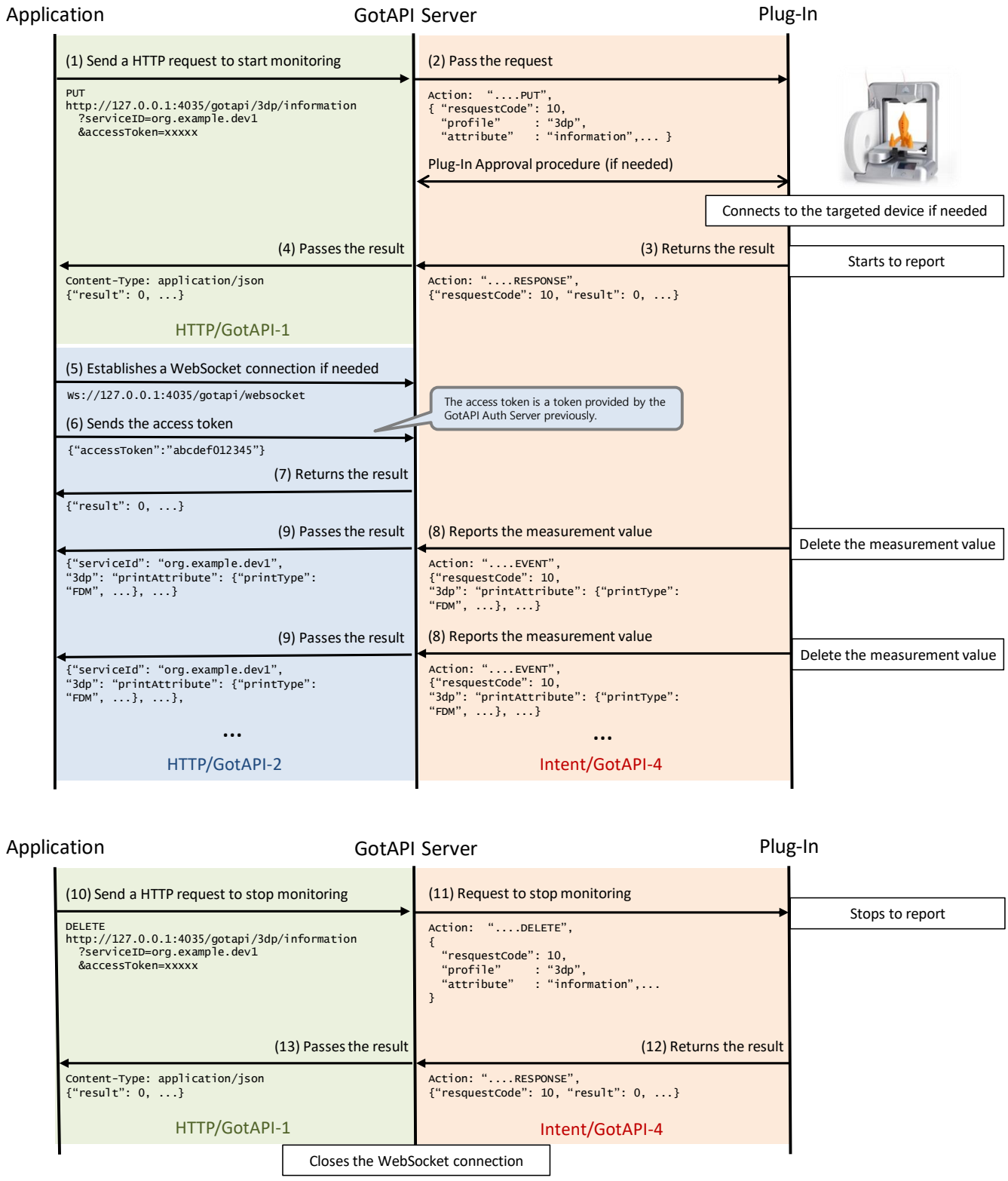

Figure 3: Message Flow of the Asynchronous messaging API

This section defines the data object for the message flows labelled from (1) to (4) and from (8) to (13) described in the figure above.

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5.3.1 Request for asynchronous messaging on the GotAPI-1 Interface

When the application uses the API in order to receive asynchronous messages, it sends a request to the GotAPI Server on the GotAPI-1 Interface as follows:

Definition of the HTTP request

	Definitions
Method	HTTP PUT
Request URL	http://127.0.0.1:4035/gotapi/3dp/information https://127.0.0.1:4036/gotapi/3dp/information

Definition of the request parameters

Parameter name	Definition of value	Mandatory/Optional
serviceId	The identifier of the targeted service. This value is available from the Service Discovery API on the GotAPI-1 Interface.	Mandatory
accessToken	The access token obtained from the GotAPI Auth Server through the GotAPI-2 Interface.	Mandatory
nonce	A nonce generated by the application, which is described in the section "7.3.3.3 HMAC server authentication using trusted Application ID for the Server spoofing attack" in the GotAPI specification.	Optional

Example of the request URL

```
http://127.0.0.1:4035/gotapi/3dp/information?serviceId=abcdefg123&accessToken=0987654321&nonce=93b3a219347
```

5.3.2 Request for asynchronous messaging on the GotAPI-4 Interface

When an application sends a request to the GotAPI Server on the GotAPI-1 Interface, the GotAPI Server passes the request to the Plug-In on the GotAPI-4 Interface. The request includes the data object as follows:

Definition of the data object for request

Name		Type	Definition of value	Mandatory/Optional
method		String	This value SHALL be "PUT".	Mandatory if the OS is not Android. Otherwise, optional. If the OS is Android, the "Action" value SHALL include this information as described below.
receiver		String	The address of the GotAPI Server application used by Plug-Ins. Generally, it is the application ID recognized by the OS, such as a package name.	Mandatory
requestCode		int	A request code identifying the request. This value could be any number but must MUST be an integer greater than 0, and unique for each open request, to ensure responses can be correlated.	Mandatory
serviceId		String	The identifier of the targeted Service. This value is provided by the application over the GotAPI-1 Interface.	Mandatory
api		String	The value must be "gotapi".	Mandatory
profile		String	The value must be "3dp".	Mandatory

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attribute		String	The value must be "information"	Mandatory
clientId		String	The identifier of the application, which is generated by the Plug-In when the Plug-In Approval procedure defined in the GotAPI specification.	Mandatory
accessToken		String	The access token for the application, which is generated by the Plug-In when the Plug-In Approval procedure defined in the GotAPI specification.	Mandatory

This data object is sent to the Plug-Ins in an OS specific mechanism, e.g., Intents for Android.

Requirements for OS-specific request channel and data container

OS	Description
Android	The GotAPI Server must use Explicit Intents for the request. The data object must be mapped to the Extra directly.

Example of the data object of the Android Explicit Intents

Name		Example of value	Note
Action		org.deviceconnect.action.PUT	This value is defined by the GotAPI Server application. But the last part SHALL be "**PUT**".
Component		org.example.plugin	This value is the package name of the Plug-In application.
Extra			
	receiver	org.deviceconnect	
	requestCode	10	
	servcieId	dev1.example.org	
	api	gotapi	
	profile	3dp	
	attribute	information	
	clientId	1234567890	
	accessToken	0987654321	

5.3.3 Response for asynchronous messaging on the GotAPI-4 Interface

When the Plug-In receives the request, it SHALL respond to the GotAPI Server as follows:

Definition of the data object for the response

Name			Type	Definition of value	Mandatory/Optional
method			String	This value SHALL be "RESPONSE".	Mandatory if the OS is not Android. Otherwise, optional. If the OS is Android, the "Action" value SHALL include this information

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					as described below.
requestCode			Number	The request code coming from the GotAPI Server.	Mandatory
result			Number	If success, the value is 0, otherwise an integer greater than 0, which indicates an error code. This specification doesn't define error codes.	Mandatory
3dp					Mandatory
	device		Object		Mandatory
		productName	String	The product name of the targeted device. If the Plug-In cannot obtain this information from the targeted device, it SHALL create a name for the device using an arbitrary algorithm. The algorithm is up to the Plug-In implementation, and this specification does not define any algorithms.	Mandatory
		manufacturerName	String	The manufacturer name of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		modelNumber	String	The model number of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		firmwareRevision	String	The firmware revision of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		serialNumber	String	The serial number of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		softwareRevision	String	The software revision of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		hardwareRevision	String	The hardware revision of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		partNumber	String	The part number of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory

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		protocolRevision	String	The protocol revision of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		systemId	String	The system id of the targeted device. This value SHALL be a 16-character HEX string without a '0x' prefix (e.g. "ABCDEF0123456789"). If the Plug-In cannot obtain this information from the targeted device, this value SHALL be "0000000000000000" (a string of 16 '0' characters).	Mandatory
	printAttribute		object		Mandatory
		printType	string	The type of printing technology. This value SHALL be a Max 10-character alphabet string. The value should be one of the following: - “FFF”: Fused Filament Fabrication - “FDM”: Fused Deposition Modeling - “DLP”: Digital Light Processing - “PBP”: Powder Bed & inkjet head 3D Printing - “PolyJet”: Photopolymer Jetting Technology - “LOM”: Laminated Object Manufacturing - “SLA”: Stereolithography Apparatus - “SLS”: Selective Laser Sintering	Mandatory
		printSizeX	float	This value represents the maximum size of printing object in the direction of X-axis The unit is mm. (1/10cm)	Mandatory
		printSizeY	float	This value represents the maximum size of printing object in the direction of Y-axis The unit is mm. (1/10cm)	Mandatory
		printSizeZ	float	This value represents the maximum size of printing object in the direction of Z-axis The unit is mm. (1/10cm)	Mandatory
		network	float	This value indicates the connectivity of the 3D printer If the value is “0”, the printer does not have networking facility to Wide Area Network such as internet and GSM. If the value is bigger than “0”, the printer has network connectivity.	Mandatory
		memorySize	float	This value represents the memory size of the printer The unit is MB(Mega Bytes)	Mandatory
	status		object		Mandatory
		operatingStatus	string	This value represents the current operation status of the targeted device.	Mandatory

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				This value SHALL be a 3-character string The value should be one of the following: - “RDY”: Ready to use - “RUN”: Under printing operation - “MAN”: Maintenance needed - “CLR”: Printing completed but the result is not removed yet	
		nozzleTemp	float	This value represents the temperature of the nozzle. This value SHALL be a float number in a range from 0.0 to 1000.0 The unit is Celsius(C)	Mandatory
	printQueue		array		
		order	int	The order of printing file. It could be 0 to max integer value. 0 means the file is under printing. 1 or bigger value means 1 or bigger number of files are waiting on the printing queue before the file.	Mandatory
		uri	String	The URI of the printing file. The URI could be "file://www.3dpexcont.com/ex.stl".	Mandatory
		msg	String	The message is indicating the status of the printing file. It should be “Good Start”, “Waiting”, “Completed”.	Mandatory

The Plug-In MAY append additional data in the data object as needed.

This data object is sent to the GotAPI Server in an OS specific mechanism, e.g., Intents for Android.

Requirements for OS-specific response channel and data container

OS	Description
Android	The GotAPI Server must use Explicit Intents for the request. The data object must be mapped to the Extra directly.

Example of the data object of the Android Intents

Name				Example of value	Note
Action				org.deviceconnect.action.**RESPONSE**	This value is defined by the GotAPI Server application. But the last part SHALL be "**RESPONSE**".
Component				org.deviceconnect	This value is the package name of the GotAPI Server application.
Extra					
	requestCode			10	

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	result			0	
	3dp				
		device			
			productName	ABC 3D Printer	
			manufacturerName	ABC Inc.	
			modelNumber	3DP-001	
			firmwareRevision	rev.1.001.003	
			serialNumber	01234-5678-9ABCD-EF01	
			softwareRevision	rev.2.000.000	
			hardwareRevision	rev.1.0	
			partNumber	002	
			protocolRevision	rev.3.1	
			systemId	ABCDEF0123456789	
		printAttribute			
			printType	FDM	
			printSizeX	500.0	
			printSizeY	500.0	
			printSizeZ	500.0	
			network	1.0	
			memorySize	4096.0	

5.3.4 Response for asynchronous messaging on the GotAPI-1 Interface

When GotAPI Server receives the response from the Plug-In, the GotAPI Server passes it to the application as follows:

Definition of the HTTP response

	Definitions
MIME-Type	application/json
HTTP status	200 OK

Definition of the data object for the response

Name			Type	Definition of value	Mandatory/Optional
product			String	The name of the GotAPI Server (e.g. "ABConnect")	Mandatory
version			String	The version of the GotAPI Server (e.g. "1.0").	Mandatory
result			Number	If success, the value is 0, otherwise an integer greater than 0, which indicates an error code. This specification doesn't define error codes.	Mandatory

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3dp			Object		Mandatory
	device		Object		Mandatory
		productName	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		manufacturerName	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		modelNumber	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		firmwareRevision	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		serialNumber	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		softwareRevision	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		hardwareRevision	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		partNumber	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		protocolRevision	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		systemId	String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
	printAttribute		object		Mandatory
		printType	string	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		printSizeX	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		printSizeY	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		printSizeZ	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		network	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		memorySize	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	
hmac			String	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory if the application provide a key to the GotAPI Server

The GotAPI Server SHALL serialize the data structure above as a JSON formatted stream (i.e. JSON string).

Example of the response

```
{
  "product"     : "ABCConnect",
  "version"     : "1.0",
  "requestCode" : 10,
  "result"      : 0,
```

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```
  "3dp" : {
    "device": {
      "productName"      : "ABC 3D Printer",
      "manufacturerName" : "ABC Inc.",
      "modelNumber"      : "3DP-001",
      "firmwareRevision" : "rev.1.001.003",
      "serialNumber"     : "01234-5678-9ABCD-EF01",
      "softwareRevision" : "rev.2.000.000",
      "hardwareRevision" : "rev.1.0",
      "partNumber"       : "002",
      "protocolRevision" : "rev.3.1",
      "systemId"         : "ABCDEF0123456789",
    },
    "printAttribute": {
      "printType"        : “FDM”,
      "printSizeX"       : 500.0,
      "printSizeY"       : 500.0,
      "printSizeZ"       : 500.0,
      "network"          : 1.0,
      "memorySize"       : 4096.0
    }
  },
  "hmac"        : "0123456789"
}
```

5.3.5 Asynchronous message from the Plug-In to the GotAPI Server on the GotAPI-4 Interafce

The Plug-In sends an asynchronous message as follows:

Definition of the data object for request

Name			Type	Definition of value	Mandatory/Optional
method			String	This value SHALL be "EVENT".	Mandatory if the OS is not Android. Otherwise, optional. If the OS is Android, the "Action" value SHALL include this information as described below.
requestCode			int	The request code coming from the GotAPI Server.	Mandatory
result			Number	If success, the value is 0, otherwise an integer greater than 0, which indicates an error code. This specification doesn't define error codes.	Mandatory
3dp			Object		Mandatory
	device		Object		Mandatory

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	Status		object		Mandatory
		operatingStatus	string	This value represents the current operation status of the targeted device. This value SHALL be a 3-character string The value should be one of the following: - “RDY”: Ready to use - “RUN”: Under printing operation - “MAN”: Maintenance needed - “CLR”: Printing completed but the result is not removed yet	Mandatory
		nozzleTemp	float	This value represents the temperature of the nozzle. This value SHALL be a float number in a range from 0.0 to 1000.0 The unit is Celsius(C)	Mandatory

The Plug-In MAY append additional data in the data object as needed.

This data object is sent to the Plug-Ins in an OS specific mechanism, e.g., Intents for Android.

Requirements for OS-specific request channel and data container

OS	Description
Android	The GotAPI Server must use Explicit Intents for the request. The data object must be mapped to the Extra directly.

Example of the data object of the Android Explicit Intents

Name	Extra key name		Example of value	Note
Action			org.deviceconnect.action.**EVENT**	This value is defined by the GotAPI Server application. But the last part SHALL be "**EVENT**".
Component			org.example.plugin	This value is the package name of the Plug-In application.
Extra				
	requestCode		10	
	result		0	
	3dp			
		device		
		status		
			operatingStatus	RDY
			nozzleTemp	25.0

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5.3.6 Asynchronous message from the GotAPI Server to the application on the GotAPI-5 Interface

When the GotAPI Server receives an asynchronous message from the Plug-In, the GotAPI Server passes it to the application on the GotAPI-5 Interface. The format of the data is a JSON string as follows:

Definition of the data object

Name	Sub name		Type	Definition of value	Mandatory/Optional
serviceId			String	The identifier of the targeted Service. This value is provided by the application when the application send the originated API request on the GotAPI-1 Interface.	Mandatory
3dp			Object		Mandatory
	device		Object		Mandatory
	Status		object		Mandatory
		operatingStatus	string	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		nozzleTemp	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
hmac			String	An HMAC generated for the counter measure against the GotAPI Server spoofing attack. If the application includes a key for HMAC calculation in the API request, the GotAPI Server adds this value in the API response. Evaluating whether the HMAC is identical to the result of calculation of HMAC from the key, the application can ensure that the response is genuine.	Mandatory if the application provide a key to the GotAPI Server

Example of the JSON string

```
{
  "serviceId" : 0,
  "3dp"     : {
    "device": {

    },
    "status": {
      "operatingStatus"  : “RDY”,
      "nozzleTemp"       : 25.0,
    }
  },
  "hmac"                 : "0123456789"
}
```

5.3.7 Stop request from the application to the GotAPI Server on the GotAPI-1 Interface

When the application wants to stop receiving asynchronous messages, it sends a request to the GotAPI Server on the GotAPI-1 Interface as follows:

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Definition of the HTTP request

	Definitions
Method	HTTP DELETE
Request URL	http://127.0.0.1:4035/gotapi/3dp/information https://127.0.0.1:4036/gotapi/3dp/information

Definition of the request parameters

Parameter name	Definition of value	Mandatory/Optional
serviceId	The identifier of the targeted service. This value is available from the Service Discovery API on the GotAPI-1 Interface.	Mandatory
accessToken	The access token obtained from the GotAPI Auth Server through the GotAPI-2 Interface.	Mandatory
nonce	A nonce generated by the application, which is described in the section "7.3.3.3 HMAC server authentication using trusted Application ID for the Server spoofing attack" in the GotAPI specification.	Optional

Example of the request URL

```
http://127.0.0.1:4035/gotapi/3dp/information?serviceId=abcdefg123&accessToken=0987654321&nonce=93b3a219347
```

5.3.8 Stop request from the GotAPI Server to the Plug-In on the GotAPI-4 Interface

When the GotAPI Server receives a stop request from the application on the GotAPI-1 Interface, the GotAPI Server sends a stop request to the Plug-in on the GotAPI-4 Interface. The request includes the data object as follows:

Definition of the data object for request

Name		Type	Definition of value	Mandatory/Optional
method		String	This value SHALL be "DELETE".	Mandatory if the OS is not Android. Otherwise, optional. If the OS is Android, the "Action" value SHALL include this information as described below.
receiver		String	The address of the GotAPI Server application used by Plug-Ins. Generally, it is the application ID recognized by the OS, such as a package name.	Mandatory
requestCode		int	A request code identifying the request. This value could be any number but MUST be an integer greater than 0, and unique for each open request, to ensure responses can be correlated.	Mandatory
serviceId		String	The identifier of the targeted Service. This value is provided by the application over the GotAPI-1 Interface.	Mandatory
api		String	The value must be "gotapi".	Mandatory
profile		String	The value must be "3dp".	Mandatory
attribute		String	The value must be "information"	Mandatory
clientId		String	The identifier of the application, which is generated by the Plug-In when the Plug-In Approval procedure	Mandatory

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			defined in the GotAPI specification.	
accessToken		String	The access token for the application, which is generated by the Plug-In when the Plug-In Approval procedure defined in the GotAPI specification.	Mandatory

This data object is sent to the Plug-Ins in an OS specific mechanism, e.g., Intents for Android.

Requirements for OS-specific request channel and data container

OS	Description
Android	The GotAPI Server must use Explicit Intents for the request. The data object must be mapped to the Extra directly.

Example of the data object of the Android Explicit Intents

Name		Example of value	Note
Action		org.deviceconnect.action.**DELETE**	This value is defined by the GotAPI Server application. But the last part SHALL be "**DELETE**".
Component		org.example.plugin	This value is the package name of the Plug-In application.
Extra			
	receiver	org.deviceconnect	
	requestCode	10	
	servcieId	dev1.example.org	
	api	gotapi	
	profile	3dp	
	attribute	information	
	clientId	1234567890	
	accessToken	0987654321	

5.3.9 Stop response from the Plug-In to the GotAPI Server on the GotAPI-4 Interface

When the Plug-In receives the stop request, it SHALL respond as follows:

Definition of the data object for the response

Name		Type	Definition of value	Mandatory/Optional
method		String	This value SHALL be "RESPONSE".	Mandatory if the OS is not Android. Otherwise, optional. If the OS is Android, the "Action" value SHALL include this information as described below.
requestCode		Number	The request code coming from the GotAPI Server.	Mandatory
result		Number	If success, the value is 0, otherwise an integer greater than 0, which indicates an error code. This specification doesn't define	Mandatory

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			error codes.	

The Plug-In MAY append additional data in the data object as needed.

This data object is sent to the GotAPI Server in an OS specific mechanism, e.g., Intents for Android.

Requirements for OS-specific response channel and data container

OS	Description
Android	The GotAPI Server must use Explicit Intents for the request. The data object must be mapped to the Extra directly.

Example of the data object of the Android Intents

Name	Sub name	Example of value	Note
Action		org.deviceconnect.action.**RESPONSE**	This value is defined by the GotAPI Server application. But the last part SHALL be "**RESPONSE**".
Component		org.deviceconnect	This value is the package name of the GotAPI Server application.
Extra			
	requestCode	10	
	result	0	

5.3.10 Stop response from the GotAPI Server to the application on the GotAPI-1 Interface

When the GotAPI Server receives the stop response, the GotAPI Server passes the response to the application follows:

Definition of the HTTP response

	Definitions
MIME-Type	application/json
HTTP status	200 OK

Definition of the data object for the response

Name		Type	Definition of value	Mandatory/Optional
product		String	The name of the GotAPI Server (e.g. "ABConnect")	Mandatory
version		String	The version of the GotAPI Server (e.g. "1.0").	Mandatory
result		Number	If success, the value is 0, otherwise an integer greater than 0, which indicates an error code. This specification doesn't define error codes.	Mandatory
hmac		String	An HMAC generated for the counter measure against the GotAPI Server spoofing attack. If the application includes a key for HMAC calculation in the API request, the GotAPI Server adds this value in the API response. Evaluating whether the HMAC is identical to the result of calculation of HMAC from the key, the application can ensure that the response is genuine.	Mandatory if the application provide a key to the GotAPI Server

The GotAPI Server SHALL serialize the data structure above as a JSON formatted stream (i.e. JSON string), then send it to the originating application on the GotAPI-5 (WebSocket connection).

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Example of the response

```
{
  "product": "ABCConnect",
  "version": "1.0",
  "result" : 0,
  "hmac"   : "0123456789"
}
```

5.4 Service Connecting API

Service Connecting API enables applications to discover available contents services. Service Connecting API specification adheres to that of GotAPI 1.1.

Here is the Service Connecting based on what is defined in GotAPI 1.1. After the application obtains authorization for access to GotAPI-based APIs using the GotAPI-2 Interface, and completes the Service Discovery request, the application sends the Service Connecting request to the GotAPI Server. Then the GotAPI Server sends the Service Connecting request to the installed 3D Printer Extension Plug-In. The message flow of the Service Connecting is shown in Fig. 4.

In the Fig.4, the Service Connecting flow has two additional out-of-scope processes such as pre-handling and requesting 3D model file list:

- No need to define all the format to handle between the 3DP application and the Contents Server in DWAPI-3DP. The Contents Server could provide various contents description and option

The Service Connecting API offers a list of contents server reported by the Plug-In of the 3D printer as a targeted device in response to a request. The message flow of this API is as shown below.

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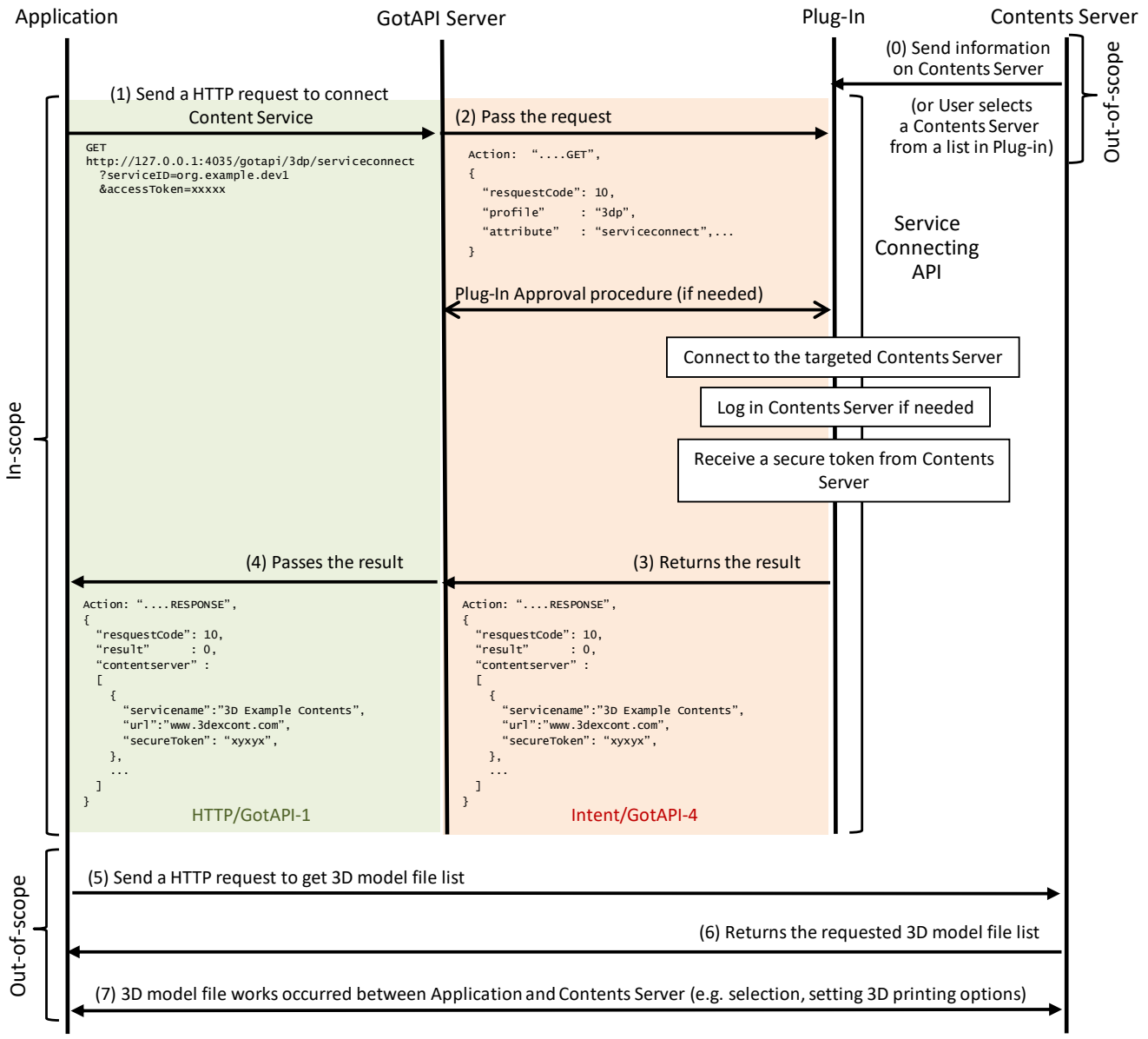

Figure 4: Message flow of the Service Connecting API

This section defines the data object for all the message flows described in the figure above.

5.4.1 Request for Service Connecting on the GotAPI-1 Interface

When the application uses the service connecting it sends a request to the GotAPI Server on the GotAPI-1 Interface as follows:

Definition of the HTTP request

	Definitions
Method	HTTP GET
Request URL	http://127.0.0.1:4035/gotapi/3dp/serviceconnect https://127.0.0.1:4036/gotapi/3dp/serviceconnect

Definition of the request parameters

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Parameter name	Definition of value	Mandatory/Optional
serviceId	The identifier of the targeted service. This value is available from the Service Discovery API on the GotAPI-1 Interface.	Mandatory
accessToken	The access token obtained from the GotAPI Auth Server through the GotAPI-2 Interface.	Mandatory
nonce	A nonce generated by the application, which is described in the section "7.3.3.3 HMAC server authentication using trusted Application ID for the Server spoofing attack" in the GotAPI specification.	Optional

Example of the request URL

```
http://127.0.0.1:4035/gotapi/3dp/serviceconnect?serviceId=abcdefg123&accessToken=0987654321&nonce=93b3a219347
```

5.4.2 Request for Service Connecting on the GotAPI-4 Interface

When an application sends a request to the GotAPI Server on the GotAPI-1 Interface, the GotAPI Server passes the request to the Plug-In on the GotAPI-4 Interface. The request includes the data object as follows:

Definition of the data object for request

Name		Type	Definition of value	Mandatory/Optional
method		String	This value SHALL be "GET".	Mandatory if the OS is not Android. Otherwise, optional. If the OS is Android, the "Action" value SHALL include this information as described below.
receiver		String	The address of the GotAPI Server application used by Plug-Ins. Generally, it is the application ID recognized by the OS, such as a package name.	Mandatory
requestCode		int	A request code identifying the request. This value could be any number but must MUST be an integer greater than 0, and unique for each open request, to ensure responses can be correlated.	Mandatory
serviceId		String	The identifier of the targeted Service. This value is provided by the application over the GotAPI-1 Interface.	Mandatory
api		String	The value must be "gotapi".	Mandatory
profile		String	The value must be "3dp".	Mandatory
attribute		String	The value must be "serviceconnect"	Mandatory
clientId		String	The identifier of the application, which is generated by the Plug-In when the Plug-In Approval procedure defined in the GotAPI specification.	Mandatory
accessToken		String	The access token for the application, which is generated by the Plug-In when the Plug-In Approval procedure defined in the GotAPI specification.	Mandatory

This data object is sent to the Plug-Ins in an OS specific mechanism, e.g., Intents for Android.

Requirements for OS-specific request channel and data container

OS	Description

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Android	The GotAPI Server must use Explicit Intents for the request. The data object must be mapped to the Extra directly.

Example of the data object of the Android Explicit Intents

Name		Example of value	Note
Action		org.deviceconnect.action.**GET**	This value is defined by the GotAPI Server application. But the last part SHALL be "**GET**".
Component		org.example.plugin	This value is the package name of the Plug-In application.
Extra			
	receiver	org.deviceconnect	
	requestCode	10	
	servcieId	dev1.example.org	
	api	gotapi	
	profile	3dp	
	attribute	serviceconnect	
	clientId	1234567890	
	accessToken	0987654321	

5.4.3 Response for Service Connecting on the GotAPI-4 Interface

When the Plug-In receives the request, it SHALL respond to the GotAPI Server as follows:

Definition of the data object for the response

Name		Type	Definition of value	Mandatory/Optional
method		String	This value SHALL be "RESPONSE".	Mandatory if the OS is not Android. Otherwise, optional. If the OS is Android, the "Action" value SHALL include this information as described below.
requestCode		int	The request code coming from the GotAPI Server.	Mandatory
result		int	If success, the value is 0, otherwise an integer greater than 0, which indicates an error code. This specification doesn't define error codes.	Mandatory
contentserver		Array		Mandatory
	servicename	String	The name of the contents service. It could be “3D Example Contents”.	Mandatory
	url	String	The URL of the contents server. The URL could be "www.3dpexcont.com".	Mandatory

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	secureToken	String	The secure token obtained from the Contents Server to use accessing the server securely by the application and the 3D Printer.	Mandatory

The Plug-In MAY append additional data in the data object as needed.

This data object is sent to the GotAPI Server in an OS specific mechanism, e.g., Intents for Android.

Requirements for OS-specific response channel and data container

OS	Description
Android	The GotAPI Server must use Explicit Intents for the request. The data object must be mapped to the Extra directly.

Example of the data object of the Android Intents

Name			Example of value	Note
Action			org.deviceconnect.action.**RESPONSE**	This value is defined by the GotAPI Server application. But the last part SHALL be "**RESPONSE**".
Component			org.deviceconnect	This value is the package name of the GotAPI Server application.
Extra				
	requestCode		10	
	result		0	
	contentServer		[Array Object]	This value is an example. Note that this is "not" a JSON string. This value must be an Array object whose content is the same as the following JSON example: [{ "servicename": "3D Example Contents", "url": "www.3dexcont.com", "secureToken": "1234567890" }, ...]
	config		"additional parameters"	This name-value pair is an additional data which is not defined by this specification

5.4.4 Response for Service Connecting on the GotAPI-1 Interface

When GotAPI Server receives the response from the Plug-In, the GotAPI Server passes it to the application as follows:

Definition of the HTTP response

	Definitions
MIME-Type	application/json
HTTP status	200 OK

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Definition of the data object for the response

Name		Type	Definition of value	Mandatory/Optional
product		String	The name of the GotAPI Server (e.g. "ABConnect")	Mandatory
version		String	The version of the GotAPI Server (e.g. "1.0").	Mandatory
result		Number	If success, the value is 0, otherwise an integer greater than 0, which indicates an error code. This specification doesn't define error codes.	Mandatory
contentserver		Array		Mandatory
	servicename	String	The name of the contents service. It could be “3D Example Contents”.	Mandatory
	url	String	The URL of the contents server. The URL could be "www.3dpexcont.com".	Mandatory
	secureToken	String	The secure token obtained from the Contents Server to use accessing the server securely by the application and the 3D Printer.	Mandatory
hmac		String	An HMAC generated for the counter measure against the GotAPI Server spoofing attack. If the application includes a key for HMAC calculation in the API request, the GotAPI Server adds this value in the API response. Evaluating whether the HMAC is identical to the result of calculation of HMAC from the key, the application can ensure that the response is genuine.	Mandatory if the application provide a key to the GotAPI Server

The GotAPI Server SHALL serialize the data structure above as a JSON formatted stream (i.e. JSON string).

Example of the response

```
{
  "product"              : "GOT3DP",
  "version"              : "1.0",
  "requestCode"          : 10,
  "result"               : 0,
  "contentserver"        :
  [
    {
      "servicename"      : "3D Example Contents",
      "url"              : "www.3dexcont.com",
      "secureToken"      : "1234567890",

    },
    ...
  ]
  "hmac"                 : "0123456789"
```

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```
}
```

5.5 Printing Command API

Printing Command API enables applications to start and stop the printing of 3D printer. Printing Command API specification adheres to that of GotAPI 1.1.

Here is the Printing Command based on what is defined in GotAPI 1.1. After the application obtains authorization for access to GotAPI-based APIs using the GotAPI-2 Interface, and completes the Service Connecting request, the application sends the Printing Command request to the GotAPI Server to start printing. Then the GotAPI Server sends the Printing Command request to the installed 3D Printer Extension Plug-In. The message flow of the Printing Command is shown in Fig. 5.

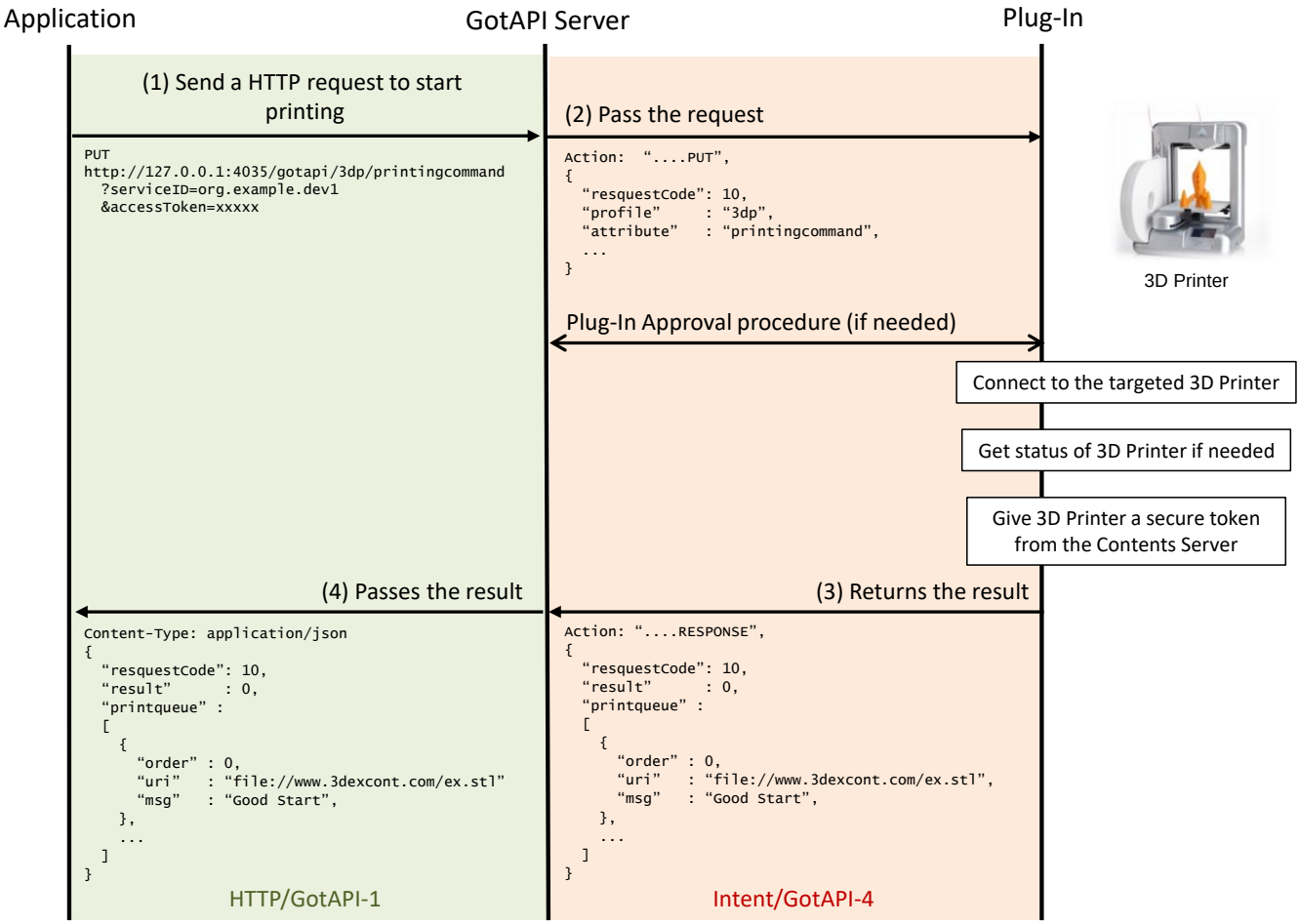

Figure 5: Message flow of the Printing Command API to start

Here is the Printing Command to stop printing based on GotAPI 1.1. During a 3D printing, there is possibility of failure of printing due to many reasons, e.g. run out of filament. After the application receives the error message, the application sends the Printing Command request to the GotAPI Server to stop printing. Then the GotAPI Server sends the Printing Command request to the installed 3D Printer Extension Plug-In. The message flow of the Printing Command is shown in Fig. 6.

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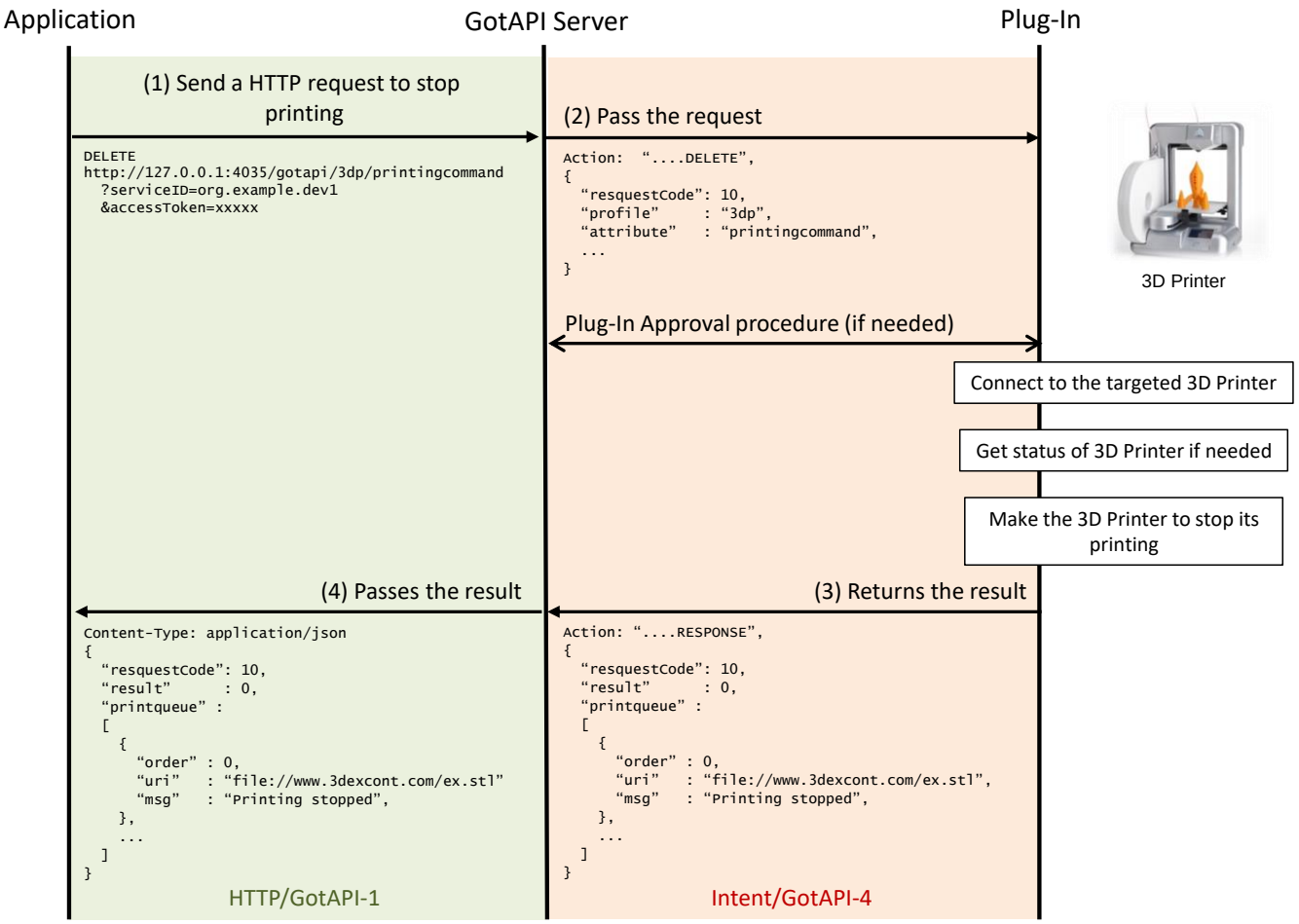

Figure 6: Message flow of the Printing Command API to stop

This section defines the data object for all the message flows described in the figure above.

5.5.1 Request for Printing Command to start on the GotAPI-1 Interface

When the application uses the Printing Command it sends a request to the GotAPI Server on the GotAPI-1 Interface as follows:

Definition of the HTTP request

	Definitions
Method	HTTP PUT
Request URL	http://127.0.0.1:4035/gotapi/3dp/printingcommand https://127.0.0.1:4036/gotapi/3dp/printingcommand

Definition of the request parameters

Parameter name	Definition of value	Mandatory/Optional
serviceId	The identifier of the targeted service. This value is available from the Service Discovery API on the GotAPI-1 Interface.	Mandatory
accessToken	The access token obtained from the GotAPI Auth Server through the GotAPI-2 Interface.	Mandatory
nonce	A nonce generated by the application, which is described in the section	Optional

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	"7.3.3.3 HMAC server authentication using trusted Application ID for the Server spoofing attack" in the GotAPI specification.	

Example of the request URL

```
http://127.0.0.1:4035/gotapi/3dp/printingcommand?serviceId=abcdefg123&accessToken=0987654321&nonce=93b3a219347
```

5.5.2 Request for Printing Command to start on the GotAPI-4 Interface

When an application sends a request to the GotAPI Server on the GotAPI-1 Interface, the GotAPI Server passes the request to the Plug-In on the GotAPI-4 Interface. The request includes the data object as follows:

Definition of the data object for request

Name		Type	Definition of value	Mandatory/Optional
method		String	This value SHALL be "PUT".	Mandatory if the OS is not Android. Otherwise, optional. If the OS is Android, the "Action" value SHALL include this information as described below.
receiver		String	The address of the GotAPI Server application used by Plug-Ins. Generally, it is the application ID recognized by the OS, such as a package name.	Mandatory
requestCode		int	A request code identifying the request. This value could be any number but must be an integer greater than 0, and unique for each open request, to ensure responses can be correlated.	Mandatory
serviceId		String	The identifier of the targeted Service. This value is provided by the application over the GotAPI-1 Interface.	Mandatory
api		String	The value must be "gotapi".	Mandatory
profile		String	The value must be "3dp".	Mandatory
attribute		String	The value must be "printingcommand"	Mandatory
clientId		String	The identifier of the application, which is generated by the Plug-In when the Plug-In Approval procedure defined in the GotAPI specification.	Mandatory
accessToken		String	The access token for the application, which is generated by the Plug-In when the Plug-In Approval procedure defined in the GotAPI specification.	Mandatory

This data object is sent to the Plug-Ins in an OS specific mechanism, e.g., Intents for Android.

Requirements for OS-specific request channel and data container

OS	Description
Android	The GotAPI Server must use Explicit Intents for the request. The data object must be mapped to the Extra directly.

Example of the data object of the Android Explicit Intents

Name		Example of value	Note
Action		org.deviceconnect.action.**PUT**	This value is defined by the GotAPI Server application. But the last part

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			SHALL be "**PUT**".
Component		org.example.plugin	This value is the package name of the Plug-In application.
Extra			
	receiver	org.deviceconnect	
	requestCode	10	
	servcieId	dev1.example.org	
	api	gotapi	
	profile	3dp	
	attribute	printingcommand	
	clientId	1234567890	
	accessToken	0987654321	

5.5.3 Response for Printing Command to start on the GotAPI-4 Interface

When the Plug-In receives the request, it SHALL respond to the GotAPI Server as follows:

Definition of the data object for the response

Name		Type	Definition of value	Mandatory/Optional
method		String	This value SHALL be "RESPONSE".	Mandatory if the OS is not Android. Otherwise, optional. If the OS is Android, the "Action" value SHALL include this information as described below.
requestCode		int	The request code coming from the GotAPI Server.	Mandatory
result		int	If success, the value is 0, otherwise an integer greater than 0, which indicates an error code. This specification doesn't define error codes.	Mandatory
printQueue		Array		Mandatory
	order	int	The order of printing file. It could be 0 to max integer value. 0 means the file is under printing. 1 or bigger value means 1 or bigger number of files are waiting on the printing queue before the file.	Mandatory
	uri	String	The URI of the printing file. The URI could be "file://www.3dpexcont.com/ex.stl".	Mandatory
	msg	String	The message is indicating the status of the printing file. It could be “Good Start” or “Waiting”, etc.	Mandatory

The Plug-In MAY append additional data in the data object as needed.

This data object is sent to the GotAPI Server in an OS specific mechanism, e.g., Intents for Android.

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Requirements for OS-specific response channel and data container

OS	Description
Android	The GotAPI Server must use Explicit Intents for the request. The data object must be mapped to the Extra directly.

Example of the data object of the Android Intents

Name			Example of value	Note
Action			org.deviceconnect.action.**RESPONSE**	This value is defined by the GotAPI Server application. But the last part SHALL be "**RESPONSE**".
Component			org.deviceconnect	This value is the package name of the GotAPI Server application.
Extra				
	requestCode		10	
	result		0	
	queue		[Array Object]	This value is an example. Note that this is "not" a JSON string. This value must be an Array object whose content is the same as the following JSON example: [{ "order" : 0, "uri" : "file//www.3dexcont.com/ex.stl", "msg" : "Good Start" }, ...]
	config		"additional parameters"	This name-value pair is an additional data which is not defined by this specification

5.5.4 Response for Printing Command to start on the GotAPI-1 Interface

When GotAPI Server receives the response from the Plug-In, the GotAPI Server passes it to the application as follows:

Definition of the HTTP response

	Definitions
MIME-Type	application/json
HTTP status	200 OK

Definition of the data object for the response

Name		Type	Definition of value	Mandatory/Optional
product		String	The name of the GotAPI Server (e.g. "ABConnect")	Mandatory

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version		String	The version of the GotAPI Server (e.g. "1.0").	Mandatory
result		Number	If success, the value is 0, otherwise an integer greater than 0, which indicates an error code. This specification doesn't define error codes.	Mandatory
printqueue		Array		Mandatory
	order	int	The order of printing file. It could be 0 to max integer value. 0 means the file is under printing. 1 or bigger value means 1 or bigger number of files are waiting on the printing queue before the file.	Mandatory
	uri	String	The URI of the printing file. The URI could be "file://www.3dpexcont.com/ex.stl".	Mandatory
	msg	String	The message is indicating the status of the printing file. It could be “Good Start” or “Waiting”, etc.	Mandatory
hmac		String	An HMAC generated for the counter measure against the GotAPI Server spoofing attack. If the application includes a key for HMAC calculation in the API request, the GotAPI Server adds this value in the API response. Evaluating whether the HMAC is identical to the result of calculation of HMAC from the key, the application can ensure that the response is genuine.	Mandatory if the application provide a key to the GotAPI Server

The GotAPI Server SHALL serialize the data structure above as a JSON formatted stream (i.e. JSON string).

Example of the response

```
{
  "product"              : "GOT3DP",
  "version"              : "1.0",
  "requestCode"          : 10,
  "result"               : 0,
  "printqueue"        :
  [
    {
      "order"            : 0,
      "uri"              : "file://www.3dexcont.com/ex.stl",
      "msg"              : "Good Start",

    },
    ...
  ]
  "hmac"                 : "0123456789"
}
```

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5.5.5 Request for Printing Command to stop on the GotAPI-1 Interface

When the application uses the Printing Command it sends a request to the GotAPI Server on the GotAPI-1 Interface as follows:

Definition of the HTTP request

	Definitions
Method	HTTP DELETE
Request URL	http://127.0.0.1:4035/gotapi/3dp/printingcommand https://127.0.0.1:4036/gotapi/3dp/printingcommand

Definition of the request parameters

Parameter name	Definition of value	Mandatory/Optional
serviceId	The identifier of the targeted service. This value is available from the Service Discovery API on the GotAPI-1 Interface.	Mandatory
accessToken	The access token obtained from the GotAPI Auth Server through the GotAPI-2 Interface.	Mandatory
nonce	A nonce generated by the application, which is described in the section "7.3.3.3 HMAC server authentication using trusted Application ID for the Server spoofing attack" in the GotAPI specification.	Optional

Example of the request URL

```
http://127.0.0.1:4035/gotapi/3dp/printingcommand?serviceId=abcdefg123&accessToken=0987654321&nonce=93b3a219347
```

5.5.6 Request for Printing Command to stop on the GotAPI-4 Interface

When an application sends a request to the GotAPI Server on the GotAPI-1 Interface, the GotAPI Server passes the request to the Plug-In on the GotAPI-4 Interface. The request includes the data object as follows:

Definition of the data object for request

Name		Type	Definition of value	Mandatory/Optional
method		String	This value SHALL be "DELETE".	Mandatory if the OS is not Android. Otherwise, optional. If the OS is Android, the "Action" value SHALL include this information as described below.
receiver		String	The address of the GotAPI Server application used by Plug-Ins. Generally, it is the application ID recognized by the OS, such as a package name.	Mandatory
requestCode		int	A request code identifying the request. This value could be any number but must be an integer greater than 0, and unique for each open request, to ensure responses can be correlated.	Mandatory
serviceId		String	The identifier of the targeted Service. This value is provided by the application over the GotAPI-1 Interface.	Mandatory
api		String	The value must be "gotapi".	Mandatory
profile		String	The value must be "3dp".	Mandatory

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attribute		String	The value must be "printingcommand"	Mandatory
clientId		String	The identifier of the application, which is generated by the Plug-In when the Plug-In Approval procedure defined in the GotAPI specification.	Mandatory
accessToken		String	The access token for the application, which is generated by the Plug-In when the Plug-In Approval procedure defined in the GotAPI specification.	Mandatory

This data object is sent to the Plug-Ins in an OS specific mechanism, e.g., Intents for Android.

Requirements for OS-specific request channel and data container

OS	Description
Android	The GotAPI Server must use Explicit Intents for the request. The data object must be mapped to the Extra directly.

Example of the data object of the Android Explicit Intents

Name		Example of value	Note
Action		org.deviceconnect.action.**DELETE**	This value is defined by the GotAPI Server application. But the last part SHALL be "**DELETE**".
Component		org.example.plugin	This value is the package name of the Plug-In application.
Extra			
	receiver	org.deviceconnect	
	requestCode	10	
	servcieId	dev1.example.org	
	api	gotapi	
	profile	3dp	
	attribute	printingcommand	
	clientId	1234567890	
	accessToken	0987654321	

5.5.7 Response for Printing Command to stop on the GotAPI-4 Interface

When the Plug-In receives the request, it SHALL respond to the GotAPI Server as follows:

Definition of the data object for the response

Name		Type	Definition of value	Mandatory/Optional
method		String	This value SHALL be "RESPONSE".	Mandatory if the OS is not Android. Otherwise, optional. If the OS is Android, the "Action" value SHALL include this information as described below.
requestCode		int	The request code coming from the GotAPI Server.	Mandatory
result		int	If success, the value is 0, otherwise	Mandatory

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			an integer greater than 0, which indicates an error code. This specification doesn't define error codes.	
printqueue		Array		Mandatory
	order	int	The order of printing file. It could be 0 to max integer value. 0 means the file is under printing. 1 or bigger value means 1 or bigger number of files are waiting on the printing queue before the file.	Mandatory
	uri	String	The URI of the printing file. The URI could be "file://www.3dpexcont.com/ex.stl".	Mandatory
	msg	String	The message is indicating the status of the printing file. It could be “Printing stopped”, etc.	Mandatory

The Plug-In MAY append additional data in the data object as needed.

This data object is sent to the GotAPI Server in an OS specific mechanism, e.g., Intents for Android.

Requirements for OS-specific response channel and data container

OS	Description
Android	The GotAPI Server must use Explicit Intents for the request. The data object must be mapped to the Extra directly.

Example of the data object of the Android Intents

Name			Example of value	Note
Action			org.deviceconnect.action.**RESPONSE**	This value is defined by the GotAPI Server application. But the last part SHALL be "**RESPONSE**".
Component			org.deviceconnect	This value is the package name of the GotAPI Server application.
Extra				
	requestCode		10	
	result		0	
	queue		[Array Object]	This value is an example. Note that this is "not" a JSON string. This value must be an Array object whose content is the same as the following JSON example: [{ "order" : 0, "uri" : "file//www.3dexcont.com/ex.stl", "msg" : "Printing stopped" },

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				...]
	config		"additional parameters"	This name-value pair is an additional data which is not defined by this specification

5.5.8 Response for Printing Command to stop on the GotAPI-1 Interface

When GotAPI Server receives the response from the Plug-In, the GotAPI Server passes it to the application as follows:

Definition of the HTTP response

	Definitions
MIME-Type	application/json
HTTP status	200 OK

Definition of the data object for the response

Name		Type	Definition of value	Mandatory/Optional
product		String	The name of the GotAPI Server (e.g. "ABConnect")	Mandatory
version		String	The version of the GotAPI Server (e.g. "1.0").	Mandatory
result		Number	If success, the value is 0, otherwise an integer greater than 0, which indicates an error code. This specification doesn't define error codes.	Mandatory
printqueue		Array		Mandatory
	order	int	The order of printing file. It could be 0 to max integer value. 0 means the file is under printing. 1 or bigger value means 1 or bigger number of files are waiting on the printing queue before the file.	Mandatory
	uri	String	The URI of the printing file. The URI could be "file://www.3dpexcont.com/ex.stl".	Mandatory
	msg	String	The message is indicating the status of the printing file. It could be “Printing stopped”.	Mandatory
hmac		String	An HMAC generated for the counter measure against the GotAPI Server spoofing attack. If the application includes a key for HMAC calculation in the API request, the GotAPI Server adds this value in the API response. Evaluating whether the HMAC is identical to the result of calculation of HMAC from the key, the application can ensure that the response is genuine.	Mandatory if the application provide a key to the GotAPI Server

The GotAPI Server SHALL serialize the data structure above as a JSON formatted stream (i.e. JSON string).

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Example of the response

```
{
  "product"              : "GOT3DP",
  "version"              : "1.0",
  "requestCode"          : 10,
  "result"               : 0,
  "printqueue"        :
  [
    {
      "order"            : 0,
      "uri"              : "file://www.3dexcont.com/ex.stl",
      "msg"              : "Printing stopped",

    },
    ...
  ]
  "hmac"                 : "0123456789"
}
```

5.6 Printer Authentication API

Printer Authentication API enables the 3D Printer to connect contents servers. Printer Authentication API specification itself is out of scope of this specification. Therefore, the definition of the interface in this section is as an example to make easy understanding for the printing message flow.

Conceptually, there are 3 more interfaces between the 3D Printer Plug-In, the 3D Printer and the Contents Server.

3DP-1 is an interface between the Plug-In and the printer. It handles the security token from the Contents Server.

3DP-2 is an interface between the Plug-In and the Contents Server, which is related to issue a Security Token.

3DP-3 is an interface between the printer and the Contents Server. Through the interface, the 3D Printer gets the authentication to access the Contents Server.

The message flow of the Printer Authentication is shown in Fig. 7.

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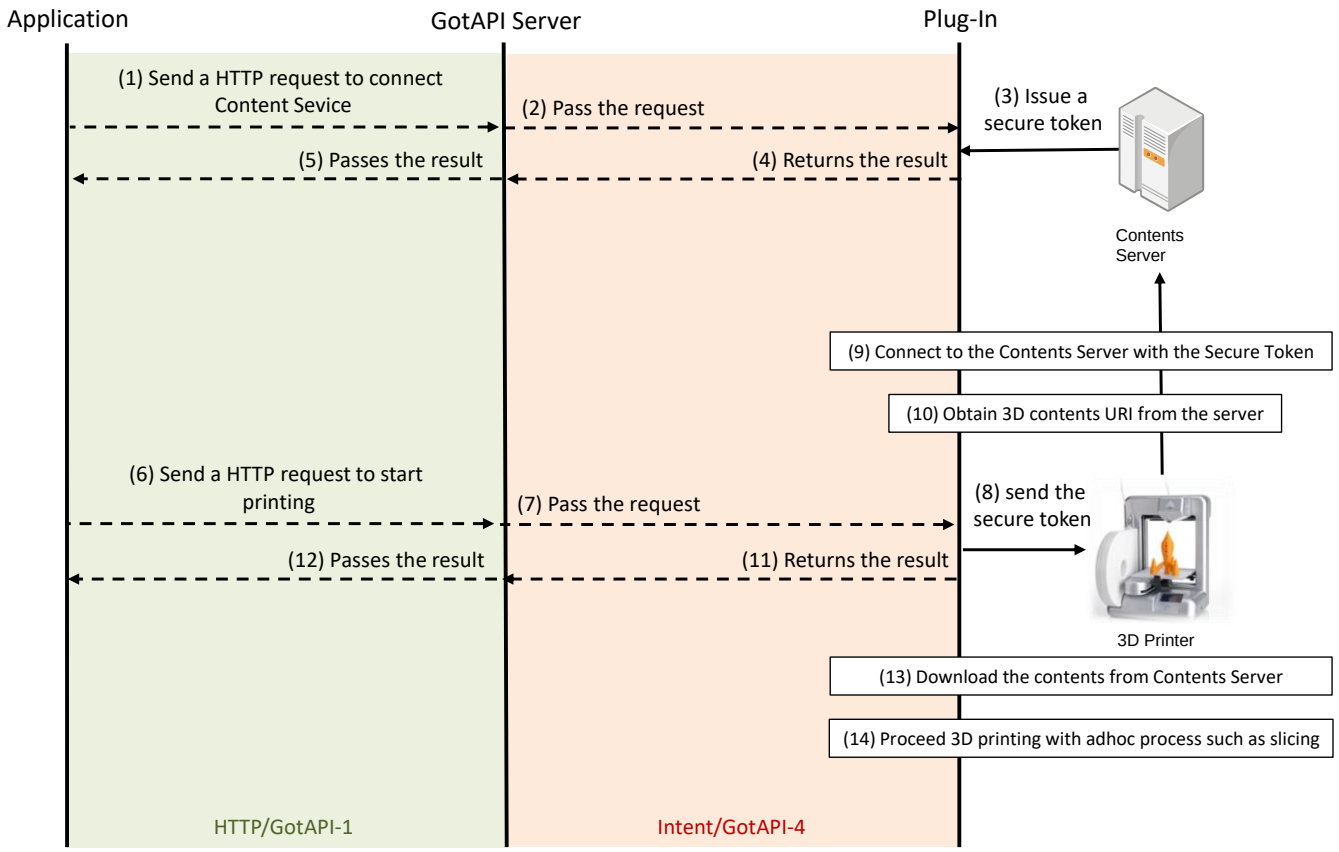

Figure 7: Message flow of the Printer Authentication API

The 3DP-1 interface could be defined as follows:

Definition of the request parameters of sending secure token (3DP-1)

Parameter name	Definition of value	Mandatory/Optional
serviceId	The identifier of the targeted service. This value is available from the Service Discovery API on the GotAPI-1 Interface.	Mandatory
secureToken	The secure token obtained from the Contents Server through the 3DP-2 Interface.	Mandatory
nonce	A nonce generated by the application, which is described in the section "7.3.3.3 HMAC server authentication using trusted Application ID for the Server spoofing attack" in the GotAPI specification.	Optional

Definition of the response parameters of sending secure token (3DP-1)

Parameter name	Definition of value	Mandatory/Optional
serviceId	The identifier of the targeted service. This value is available from the Service Discovery API on the GotAPI-1 Interface.	Mandatory
uri	The URI of the printing file. The URI could be "file://www.3dpexcont.com/ex.stl".	Mandatory
nonce	A nonce generated by the application, which is described in the section "7.3.3.3 HMAC server authentication using trusted Application ID for the Server spoofing attack" in the GotAPI specification.	Optional

The 3DP-2 interface could have following parameters:

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Definition of the request parameters of issuing secure token (3DP-2)

Parameter name	Definition of value	Mandatory/Optional
serviceId	The identifier of the targeted service. This value is available from the Service Discovery API on the GotAPI-1 Interface.	Mandatory
nonce	A nonce generated by the application, which is described in the section "7.3.3.3 HMAC server authentication using trusted Application ID for the Server spoofing attack" in the GotAPI specification.	Optional

Definition of the response parameters of issuing secure token (3DP-2)

Parameter name	Definition of value	Mandatory/Optional
serviceId	The identifier of the targeted service. This value is available from the Service Discovery API on the GotAPI-1 Interface.	Mandatory
secureToken	The secure token obtained from the Contents Server through the 3DP-2 Interface.	Mandatory
nonce	A nonce generated by the application, which is described in the section "7.3.3.3 HMAC server authentication using trusted Application ID for the Server spoofing attack" in the GotAPI specification.	Optional

The 3DP-3 interface could include following parameters:

Definition of the request parameters of sending secure token (3DP-3)

Parameter name	Definition of value	Mandatory/Optional
serviceId	The identifier of the targeted service. This value is available from the Service Discovery API on the GotAPI-1 Interface.	Mandatory
secureToken	The secure token obtained from the Contents Server through the 3DP-2 Interface.	Mandatory
nonce	A nonce generated by the application, which is described in the section "7.3.3.3 HMAC server authentication using trusted Application ID for the Server spoofing attack" in the GotAPI specification.	Optional

Definition of the response parameters of sending secure token (3DP-3)

Parameter name	Definition of value	Mandatory/Optional
serviceId	The identifier of the targeted service. This value is available from the Service Discovery API on the GotAPI-1 Interface.	Mandatory
order	The order of printing file. It could be 0 to max integer value. 0 means the file is under printing. 1 or bigger value means 1 or bigger number of files are waiting on the printing queue before the file.	Mandatory
uri	The URI of the printing file. The URI could be "file://www.3dpexcont.com/ex.stl".	Mandatory
scale	It is a scale parameter of Float type of 3D printing. It is modified by user through the Contents Server page.	Mandatory
supporter	It is a supporter parameter of Boolean type of 3D printing. It is modified by user through the Contents Server page.	Mandatory
platformAdhesion	It is a platform adhesion parameter of Boolean type of 3D printing. It is modified by user through the Contents Server page.	Mandatory
infill	It is a infill parameter of Float type of 3D printing. It is modified by user through the Contents Server page. [0(empty), … , 1(solid)]	Mandatory

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nonce	A nonce generated by the application, which is described in the section "7.3.3.3 HMAC server authentication using trusted Application ID for the Server spoofing attack" in the GotAPI specification.	Optional

5.7 Printer Status API

Printer Status API enables applications to receive the current status data including the printing queue from a targeted device by one HTTP request/response transaction as define in the Section 7.2.x [DWAPI-3DP]. Printer Status API specification adheres to that of GotAPI 1.1.

As defined by GotAPI 1.1, after the application obtains authorization to access GotAPI-based APIs using the GotAPI-2 Interface and completes the Service Discovery, the application can use the service (so called "Printer Status API") provided by the Plug-In through the GotAPI Server.

The Printer Status API offers a current status data result reported by the targeted device in response to a request. The message flow of this API is as shown blow.

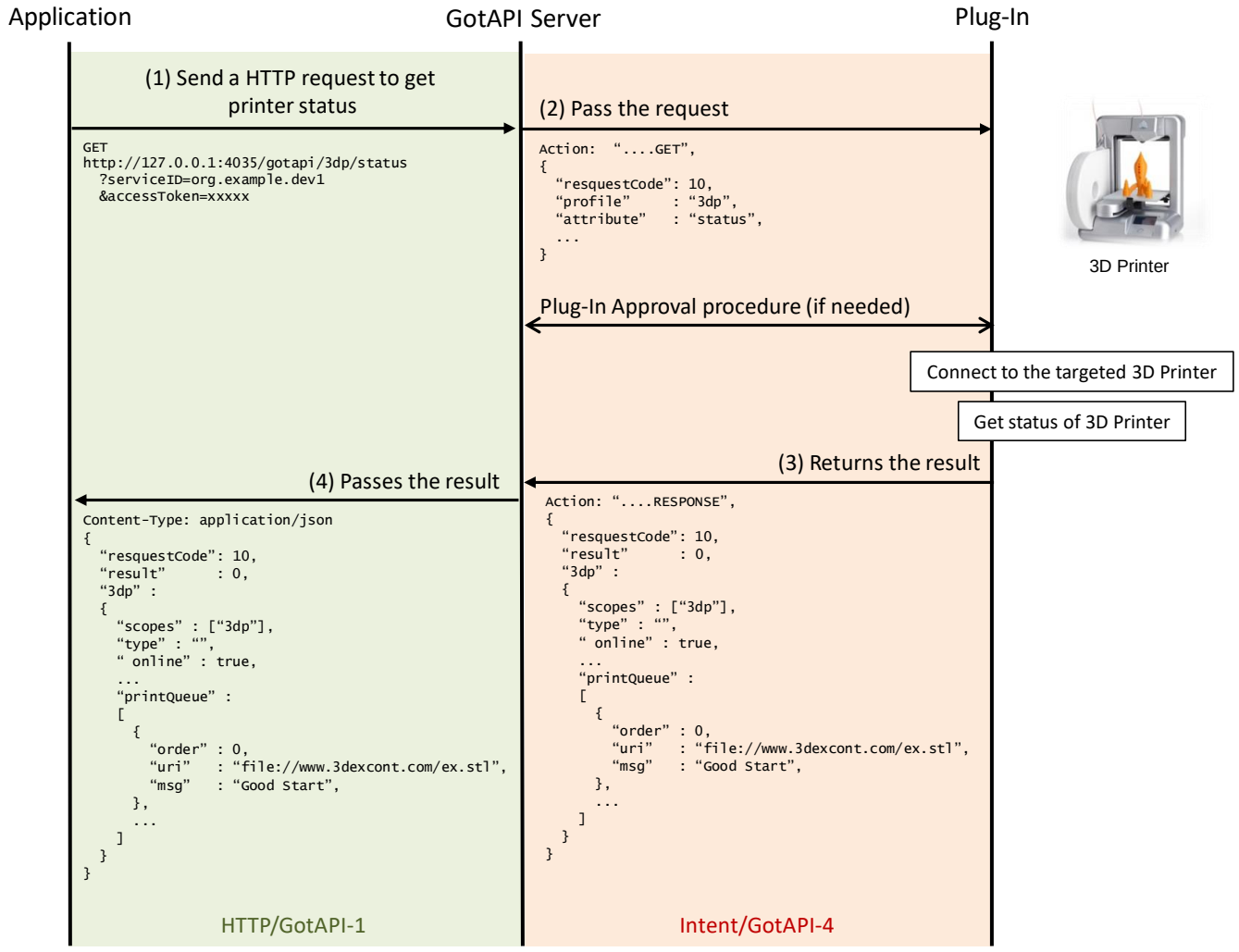

Figure 8: Message flow of the Printer Status API

This section defines the data object for all the message flows described in the figure above.

5.7.1 Request for printer status on the GotAPI-1 Interface

When the application gets the printer status it sends a request to the GotAPI Server on the GotAPI-1 Interface as follows:

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Definition of the HTTP request

	Definitions
Method	HTTP GET
Request URL	http://127.0.0.1:4035/gotapi/3dp/status https://127.0.0.1:4036/gotapi/3dp/status

Definition of the request parameters

Parameter name	Definition of value	Mandatory/Optional
serviceId	The identifier of the targeted service. This value is available from the Service Discovery API on the GotAPI-1 Interface.	Mandatory
accessToken	The access token obtained from the GotAPI Auth Server through the GotAPI-2 Interface.	Mandatory
nonce	A nonce generated by the application, which is described in the section "7.3.3.3 HMAC server authentication using trusted Application ID for the Server spoofing attack" in the GotAPI specification.	Optional

Example of the request URL

```
http://127.0.0.1:4035/gotapi/3dp/status?serviceId=abcdefg123&accessToken=0987654321&nonce=93b3a219347
```

5.7.2 Request for printer status on the GotAPI-4 Interface

When an application sends a request to the GotAPI Server on the GotAPI-1 Interface, the GotAPI Server passes the request to the Plug-In on the GotAPI-4 Interface. The request includes the data object as follows:

Definition of the data object for request

Name		Type	Definition of value	Mandatory/Optional
method		string	This value SHALL be "GET".	Mandatory if the OS is not Android. Otherwise, optional. If the OS is Android, the "Action" value SHALL include this information as described below.
receiver		string	The address of the GotAPI Server application used by Plug-Ins. Generally, it is the application ID recognized by the OS, such as a package name.	Mandatory
requestCode		int	A request code identifying the request. This value could be any number but must MUST be an integer greater than 0, and unique for each open request, to ensure responses can be correlated.	Mandatory
serviceId		string	The identifier of the targeted Service. This value is provided by the application over the GotAPI-1 Interface.	Mandatory
api		string	The value must be "gotapi".	Mandatory
profile		string	The value must be "3dp".	Mandatory
attribute		string	The value must be "status"	Mandatory
clientId		string	The identifier of the application, which is generated by the Plug-In when the Plug-In Approval procedure defined in the GotAPI specification.	Mandatory

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accessToken		string	The access token for the application, which is generated by the Plug-In when the Plug-In Approval procedure defined in the GotAPI specification.	Mandatory

This data object is sent to the Plug-Ins in an OS specific mechanism, e.g., Intents for Android.

Requirements for OS-specific request channel and data container

OS	Description
Android	The GotAPI Server must use Explicit Intents for the request. The data object must be mapped to the Extra directly.

Example of the data object of the Android Explicit Intents

Name		Example of value	Note
Action		org.deviceconnect.action.**GET**	This value is defined by the GotAPI Server application. But the last part SHALL be "**GET**".
Component		org.example.plugin	This value is the package name of the Plug-In application.
Extra			
	receiver	org.deviceconnect	
	requestCode	10	
	servcieId	dev1.example.org	
	api	gotapi	
	profile	3dp	
	attribute	status	
	clientId	1234567890	
	accessToken	0987654321	

5.7.3 Response for printer status on the GotAPI-4 Interface

When the Plug-In receives the request, it SHALL respond to the GotAPI Server as follows:

Definition of the data object for the response

Name			Type	Definition of value	Mandatory/Optional
method			string	This value SHALL be "RESPONSE".	Mandatory if the OS is not Android. Otherwise, optional. If the OS is Android, the "Action" value SHALL include this information as described below.
requestCode			int	The request code coming from the GotAPI Server.	Mandatory

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result			int	If success, the value is 0, otherwise an integer greater than 0, which indicates an error code. This specification doesn't define error codes.	Mandatory
3dp					Mandatory
	device		object		Mandatory
		productName	string	The product name of the targeted device. If the Plug-In cannot obtain this information from the targeted device, it SHALL create a name for the device using an arbitrary algorithm. The algorithm is up to the Plug-In implementation, and this specification does not define any algorithms.	Mandatory
		manufacturerName	string	The manufacturer name of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		modelNumber	string	The model number of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		firmwareRevision	string	The firmware revision of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		serialNumber	string	The serial number of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		softwareRevision	string	The software revision of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		hardwareRevision	string	The hardware revision of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		partNumber	string	The part number of the targeted device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	Mandatory
		protocolRevision	string	The protocol revision of the targeted	Mandatory

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				device. If the Plug-In cannot obtain this information from the targeted device, this value SHALL be an empty string.	
		systemId	string	The system id of the targeted device. This value SHALL be a 16-character HEX string without a '0x' prefix (e.g. "ABCDEF0123456789"). If the Plug-In cannot obtain this information from the targeted device, this value SHALL be "0000000000000000" (a string of 16 '0' characters).	Mandatory
	printAttribute		object		Mandatory
		printType	string	The type of printing technology. This value SHALL be a Max 10-character alphabet string. The value should be one of the following: - “FFF”: Fused Filament Fabrication - “FDM”: Fused Deposition Modeling - “DLP”: Digital Light Processing - “PBP”: Powder Bed & inkjet head 3D Printing - “PolyJet”: Photopolymer Jetting Technology - “LOM”: Laminated Object Manufacturing - “SLA”: Stereolithography Apparatus - “SLS”: Selective Laser Sintering	Mandatory
		printSizeX	float	This value represents the maximum size of printing object in the direction of X-axis The unit is mm. (1/10cm)	Mandatory
		printSizeY	float	This value represents the maximum size of printing object in the direction of Y-axis The unit is mm. (1/10cm)	Mandatory
		printSizeZ	float	This value represents the maximum size of printing object in the direction of Z-axis The unit is mm. (1/10cm)	Mandatory
		network	float	This value indicates the connectivity of the 3D printer If the value is “0”, the printer does not have networking facility to Wide Area Network such as internet and GSM. If the value is bigger than “0”, the printer has network connectivity.	Mandatory
		memorySize	float	This value represents the memory size of the printer The unit is MB(Mega Bytes)	
	status		object		Mandatory
		operatingStatus	string	This value represents the current	Mandatory

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				operation status of the targeted device. This value SHALL be a 3-character string The value should be one of the following: - “RDY”: Ready to use - “RUN”: Under printing operation - “MAN”: Maintenance needed - “CLR”: Printing completed but the result is not removed yet	
		nozzleTemp	float	This value represents the temperature of the nozzle. This value SHALL be a float number in a range from 0.0 to 1000.0 The unit is Celsius(C)	Mandatory
	printQueue		array		
		order	int	The order of printing file. It could be 0 to max integer value. 0 means the file is under printing. 1 or bigger value means 1 or bigger number of files are waiting on the printing queue before the file.	Mandatory
		uri	String	The URI of the printing file. The URI could be "file://www.3dpexcont.com/ex.stl".	Mandatory
		msg	String	The message is indicating the status of the printing file. It should be “Good Start”, “Waiting”, “Completed”.	Mandatory

The Plug-In MAY append additional data in the data object as needed.

This data object is sent to the GotAPI Server in an OS specific mechanism, e.g., Intents for Android.

Requirements for OS-specific response channel and data container

OS	Description
Android	The GotAPI Server must use Explicit Intents for the request. The data object must be mapped to the Extra directly.

Example of the data object of the Android Intents

Name				Example of value	Note
Action				org.deviceconnect.action.**RESPONSE**	This value is defined by the GotAPI Server application. But the last part SHALL be "**RESPONSE**".
Component				org.deviceconnect	This value is the package name of the GotAPI Server application.
Extra					
	requestCode			10	

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	result			0	
	3dp				
		device			
			productName	ABC 3D Printer	
			manufacturerName	ABC Inc.	
			modelNumber	3DP-001	
			firmwareRevision	rev.1.001.003	
			serialNumber	01234-5678-9ABCD-EF01	
			softwareRevision	rev.2.000.000	
			hardwareRevision	rev.1.0	
			partNumber	002	
			protocolRevision	rev.3.1	
			systemId	ABCDEF0123456789	
		printAttribute			
			printType	FDM	
			printSizeX	500.0	
			printSizeY	500.0	
			printSizeZ	500.0	
			network	1.0	
			memorySize	4096.0	
		status			
			operatingStatus	RDY	
			nozzleTemp	25.0	
		printQueue			
			order	1	
			uri	file//www.3dexcont.com/ex.stl	
			msg	Good Start	

5.7.4 Response for printer status on the GotAPI-1 Interface

When GotAPI Server receives the response from the Plug-In, the GotAPI Server passes it to the application as follows:

Definition of the HTTP response

	Definitions
MIME-Type	application/json
HTTP status	200 OK

Definition of the data object for the response

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Name			Type	Definition of value	Mandatory/Optional
product			string	The name of the GotAPI Server (e.g. "ABConnect")	Mandatory
version			string	The version of the GotAPI Server (e.g. "1.0").	Mandatory
result			number	If success, the value is 0, otherwise an integer greater than 0, which indicates an error code. This specification doesn't define error codes.	Mandatory
3dp			object		Mandatory
	device		object		Mandatory
		productName	string	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		manufacturerName	string	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		modelNumber	string	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		firmwareRevision	string	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		serialNumber	string	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		softwareRevision	string	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		hardwareRevision	string	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		partNumber	string	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		protocolRevision	string	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		systemId	string	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
	printAttribute		object		Mandatory
		printType	string	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		printSizeX	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		printSizeY	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		printSizeZ	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		network	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		memorySize	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	

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	status		object		Mandatory
		operatingStatus	string	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		nozzleTemp	float	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
	printQueue		object		
		order	int	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		uri	string	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
		msg	string	This value SHALL be the same as what the GotAPI Server received from the Plug-In.	Mandatory
hmac			String	An HMAC generated for the counter measure against the GotAPI Server spoofing attack. If the application includes a key for HMAC calculation in the API request, the GotAPI Server adds this value in the API response. Evaluating whether the HMAC is identical to the result of calculation of HMAC from the key, the application can ensure that the response is genuine.	Mandatory if the application provide a key to the GotAPI Server

The GotAPI Server SHALL serialize the data structure above as a JSON formatted stream (i.e. JSON string).

Example of the response

```
{
  "product"              : "ABC3DP",
  "version"              : "1.0",
  "requestCode"          : 10,
  "result"               : 0,
  "3dp"                : {
    "device": {
      "productName"      : "ABC 3D Printer",
      "manufacturerName" : "ABC Inc.",
      "modelNumber"      : "3DP-001",
      "firmwareRevision" : "rev.1.001.003",
      "serialNumber"     : "01234-5678-9ABCD-EF01",
      "softwareRevision" : "rev.2.000.000",
      "hardwareRevision" : "rev.1.0",
      "partNumber"       : "002",
      "protocolRevision" : "rev.3.1",
      "systemId"         : "ABCDEF0123456789"
    },
    "printAttribute": {
      "printType"        : "FDM",
      "printSizeX"       : 500.0,
      "printSizeY"       : 500.0,
      "printSizeZ"       : 500.0,
      "network"          : 1.0,
      "memorySize"       : 4096.0
    }
```

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```
    "status": {
      "operatingStatus"  : "RDY",
      "nozzleTemp"       : 25.0
    },
    "printQueue": [
      {
        "order"          : 0,
        "uri"            : "file://www.3dpexcont.com/ex1.stl",
        "msg"            : "Good Start"
      },
     {
        "order"          : 1,
        "uri"            : "file://www.3dpexcont.com/ex2.stl",
        "msg"            : "Waiting"
      },
    ],
  }
  "hmac"                 : "0123456789"
}
```

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Appendix A. Change History (Informative)

A.1 Approved Version History

Reference	Date	Description
n/a	n/a	No prior version

A.2 Draft/Candidate Version 1.0 History

Document Identifier	Date	Sections	Description
Draft Versions OMA-TS-3D_Printer_APIs-V1_0	25 Apr 2016	5.1, 5.2, 5.3	Incorporated CRs: OMA-CD-DWAPI-2015-0034-CR_3D_Printer_API_Service_Discovery OMA-CD-DWAPI-2016-0002-CR_3DP_one_shot_measuring_API OMA-CD-DWAPI-2016-0003-CR_3DP_asynchronous_messaging_API
	01 Nov 2016	1, 5.4, 5.5, 5.6	Incorporated CRs: OMA-CD-DWAPI-2016-0001R01-CR_3DP_Scope OMA-CD-DWAPI-2016-0021R02-CR_3DP_authentication_API OMA-CD-DWAPI-2016-0022R01-CR_3DP_printing_command_API OMA-CD-DWAPI-2016-0023-CR_3DP_service_connecting_API OMA-CD-DWAPI-2016-0024-CR_3DP_stop_printing_API Editorial changes
	18 Nov 2016	All	Editorial changes
	19 Nov 2016	4	Incorporated CR: OMA-CD-DWAPI-2016-0030-CR_TS_introduction
	03 Jul 2017	5.4, 5.7	Incorporated CR: OMA-CD-DWAPI-2017-0007-CR_3DP_model_file_flow OMA-CD-DWAPI-2017-0009-CR_3D_printer_status_API
	17 Aug 2017	All	Incorporated commends from: OMA-CD-DWAPI-2017-0010-INP_Consistency_Review_for_3DP_ERP_and_TS Editorial changes
	17 Sep 2017	All	Incorporated commends from: OMA-CD-DWAPI-2017-0015-INP_Consistency_Review_for_3DP_ERP_and_TS_No_2 Editorial changes
Candidate Version OMA-TS-3D_Printer_APIs-V1_0	14 Nov 2017	n/a	Status changed to Candidate by TP TP Ref # OMA-TP-2017-0046R01-INP_DWAPI_3DP_1.0_for_Candidate_Approval

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