KeyTalk - Protocols

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Creation date	14-March-2017
Last updated	29-May-2018
Document version	2.2.0.1
Document status	Qualified
Product	KeyTalk certificate and key management & enrolment virtual appliance
Data classification	Public

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1. INTRODUCTION

1.1 Purpose

The purpose of this document is to describe the protocols used by the KeyTalk system. This document is the leading source for these protocols.

1.2 Scope

This document is intended for KeyTalk and its hired 3rd parties for continuous development of the KeyTalk product and related services.

More importantly this document is intended for release to the public so they may use it for their own KeyTalk related development purposes.

1.3 Definitions and abbreviations

1.3.1 Definitions

1.3.2 Abbreviations

RDD	: **R**ESEPT **D**ispatcher **D**aemon
RCDP	: **R**ESEPT **C**lient <-> RESEPT **D**ispatcher Daemon **P**rotocol
ABNF	: Augmented Backus–Naur Form
RESEPT	: The historical name of the KeyTalk software

2. RCDP V2

This section describes RCDP protocol version 2. The motivation to develop a new protocol over the existing legacy RCDPv1 was as follows:

- Offload handcrafted security to the standard SSL/TLS stack implemented by HTTPS protocol
- Use RESTful way of communication based on simple HTTP GET requests and JSON responses
- Simplify the protocol to make it easier to develop KeyTalk clients and related services

2.1 RCDPv2 versions

RCDP version	Supported KeyTalk server	Changes wrt the previous RCDP version
`2.0.0`	`4.6.0` and up	
`2.1.0`	`5.3.0` and up	Allow caller to request a certificate download URL in the phase 3 `cert` request instead of a certificate body.
`2.2.0`	`5.3.1` and up	- Allow submitting CSR for signing - Include TPM Virtual Smart Card requirement flag as a part of auth-requirements response

2.2 KeyTalk config file

In order to make use of the KeyTalk API, several details are required from the KeyTalk Real Client Communication Data file (RCCD).
This configuration file is used to feed a KeyTalk app with minimal required information to setup a proper secure connection to any KeyTalk instance.

The RCCD file is effectively a zip container and can thus easily be extracted.
As such a developer incorporating the KeyTalk API in their app, can choose to statically make use of individual files in an RCCD file, or choose to import the entire RCCD into their app or simply make use of some of the components within this RCCD file.

The content folder within the RCCD contains several files, the most important ones being:

- **RCA.der Root CA** typically only included when KeyTak's internal private CA is generated under an already existing CA.
- **PCA.der Primary CA** with a KeyTalk self-signed private CA its usually the top of the KeyTalk internal private CA, but when RCA is included its generated under the RCA.
- **UCA.der User CA** signed under the PCA. It is the trust under which the end-point client and/or server certificates are signed and issued only in case of using the internal KeyTalk CAfor issuance.
  When issuing end-point client and/or server certificates under for example a connected Microsoft CA or Trusted Certificate Service Provider, ensure that their intermediate certificates are included in your app or present on the target OS as well as these are by default not part of the current KeyTalk RCCD
- **SCA.der Server CA** signed under the PCA, it is the trust under which the KeyTalk virtual appliance certificates are generated and used.
- **user.ini** Generic configuration settings which includes the KeyTalk server URL/IP as well as the KeyTalk tenant name/SERVICE used to communicate with.
- **user.yaml** Generic configuration settings which includes the KeyTalk server URL/IP as well as the KeyTalk tenant name/SERVICE used to communicate with.
  Similar to user.ini just another format

2.3 RCDPv2 overview

Communication in RCDPv2 is encapsulated in RESTful calls over HTTPS using standard port 443. Optional out-of-band certificate downloads are made possible over HTTP using port 8000.

Below is a set of client HTTP headers that the client needs to send to the server.

HTTP Header	Required	Description
GET	YES	`/rcdp/2.X.Y/<action>?<request-params>`
Host	YES	Should contain the FQDN or IP (v4 or v6) of the KeyTalk virtual appliance.
Cookie	YES except for hello	Session identifier received from KeyTalk server.

`action` is a request action
`request-params` is URL-encoded string of request parameters. Complex request parameters (arrays, dictionaries) should be JSON-encoded. All JSON objects should escape forward slashes `'/'` as `'\/'`.

A typical set of client HTTP headers:

```
GET
/rcdp/2.2.0/authentication?service=DEMO_SERVICE&PASSWD=change%21&HWSIG=12345
6&USERID=DemoUser &ips=%5B%2281.175.103.107%22%5D&caller-hw-
description=Windows+7%2C+BIOS+s%2Fn+1234567890 HTTP/1.1
Host: keytalkdemo.keytalk.com
Cookie: keytalkcookie=a622bb821bec1f5315668c8f9a8e780f
```

A typical set of HTTP response headers:

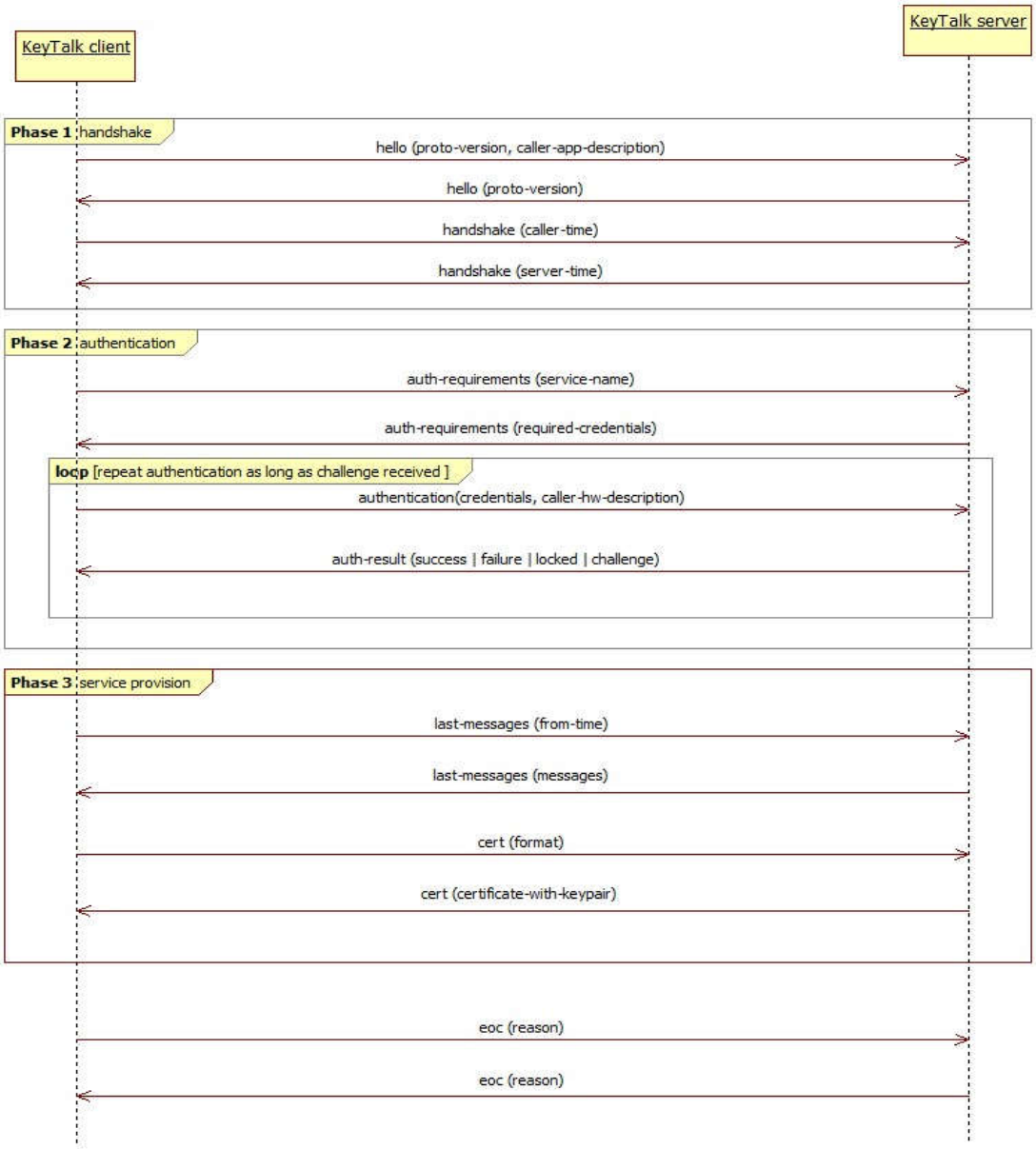
```
HTTP/1.1 200 OK
Content-type: application/json
Cache-Control: no-cache
Set-Cookie: keytalkcookie=a622bb821bec1f5315668c8f9a8e780f

{'status': 'auth-result', 'auth-status': 'OK'}
```

2.4 RCDPv2 communication phases

The complete RCDPv2 communication circle consists of 3 phases:

Phase1: handshake
Phase 2: authentication
Phase 3: service provision



Further we describe message semantics on each phase in detail.

2.5 Messages sent in all phases

2.5.1 End Of communication

Request

`GET /rcdp/<version>/eoc`

Example:

```
/rcdp/2.2.0/eoc
/rcdp/2.2.0/eoc?reason=bye%2C+server
```

Query parameters

parameter	type	required	description
`reason`	*string*	no	optional reason for ending communication

Response

`HTTP 200 – application/json`

```
{
  'status': 'eoc',
  [optional] 'reason': optional reason for ending communication
}
```

End of communication can be sent at any time, initiated by any communication side.

2.5.2 Error

Errors are typically sent by the server to notify the caller on error processing its request. The client can also send errors to the server when it can't handle the server's response.

Request

`GET /rcdp/<version>/error`

Example:

```
/rcdp/2.2.0/error?code=1066&description=invalid+response
```

Query parameters

parameter	type	required	description
`code`	*number*	yes	numeric error code
`reason`	*string*	no	optional error description. Might be required for certain error codes. See the error code table below.

Response

HTTP 200 – application/json

```
{
  'status': 'error',
  'code': numeric error code,
  [optional] 'description': error description. Might be required for certain error codes. See the error code table below.
}
```

Error codes

code	description	direction	remarks
1001 (ErrResolvedIpInvalid)	optional	server -> client	Sent by the server when none of IPs resolved by the client and by the server match.
1002 (ErrDigestInvalid)	optional	server -> client	Sent by the server when the client's calculated executable digest does not much the digest stored on the server.
1003 (ErrTimeOutOfSync)	difference in seconds between caller UTC and the server UTC	server -> client	Sent by the server when the client time is out of sync with the server's time.
1004 (ErrMaxLicensedUsersReached)	optional	server -> client	Sent by the server when no certificate can be supplied because the max number of licensed users has been reached
1005 (ErrPasswordExpired)	optional	server -> client	Sent by the server when the password of the user trying to authenticate is expired and the caller is not supposed to change it.

2.6 Phase 1 (handshake)

2.6.1 Hello

Agree on RCDP protocol version and establish session ID.

Request

`GET /rcdp/<version>/hello`

Example:

```
/rcdp/2.2.0/hello
/rcdp/2.1.0/hello?caller-app-description=Demo+KeyTalk+client
```

Query parameters

parameter	type	required	description
`caller-app-description`	*string*	no	optional description of the caller application

RCDP protocol version proposed by a caller is sent as a part HTTP GET path.

Response

`HTTP 200 – application/json`

```
{
  "status": "hello",
  "version": proposed protocol version
}
```

Session ID is returned in HTTP cookie `keytalkcookie` in `Set-Cookie` header.

2.6.2 Handshake

Confirm version handshake and exchange time information.

Request

`GET /rcdp/<version>/handshake`

Example:

`/rcdp/2.2.0/handshake?caller-utc=2016-04-22T10%3A44%3A35.746255Z`

Query parameters

parameter	type	required	description
`caller-utc`	*UTC string in ISO 8601 format including date and time*	yes	caller UTC

If the caller supports protocol version proposed by the server on the previous step, it proceeds with this version in HTTP GET path. Otherwise the caller ends communication.

Response

`HTTP 200 – application/json`

```
{
  "status": "handshake",
  "server-utc":  server UTC in ISO 8601 format including date and time
}
```

5

2.7 Phase 2 (authentication)

2.7.1 Request authentication requirements

Request authentication requirements from the server.

Request

`GET /rcdp/<version>/auth-requirements`

Example:

`/rcdp/2.2.0/auth-requirements?service=DEMO_SERVICE`

Query parameters

parameter	type	required	description
`service`	*string*	yes	KeyTalk service name

Response

`HTTP 200 – application/json`

```
{
  "status": "auth-requirements",
  "credential-types": credential types,
  [optional] "hwsig_formula": HWSIG formula,
  [optional] "password-prompt": password-prompt,
  [optional] "service-uris": service URIs,
  [optional] "resolve-service-uris": if service URIs need to be resolved,
  [optional] "calc-service-uris-digest": if service URIs digest needs to be calculated,
  [as of v2.2.0][optional] "use-tpm-vsc-authentication": if TPM Virtual Smart Card authentication should be used,
}
```

credential-types
: JSON array of credential types required to authenticate against the given service. Supported credential types are: `"USERID"`, `"HWSIG"`, `"PASSWD"`, `"PIN"` and `"RESPONSE"`. Example: `["USERID", "HWSIG", "PASSWD"]`

hwsig_formula
: formula to calculate caller's hardware signature. Example: `"1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16"`. Sent when `credential-types` parameter contains `HWSIG`.

password-prompt
: prompt to display to a user when a password is requested interactively e.g. `"password"` or `"tokencode"`. Sent when `credential-types` parameter contains `PASSWD`.

service-uris

JSON array of RFC 3986-compliant URIs of the given service
Example:
`["https://demo1.keytalk.com", "https://demo2.keytalk.com"]`
or
`["file://%ProgramFiles%\vpn\vpn.exe"]`

resolve-service-uris

Boolean flag (`"true"` or `"false"`) requesting a caller to resolve IP addresses of each supplied `service-uris` identifying web resources. Defaults to `"false"`.

calc-service-uris-digest

Boolean flag (`"true"` or `"false"`) requesting a caller to calculate sha-256 hexadecimal digests of each supplied `service-uris` identifying file resources. Defaults to `"false"`.

use-tpm-vcs-authentication

Boolean flag (`"true"` or `"false"`) requesting a caller to make use of PM Virtual Smart Card to generate a certificate signing request (CSR). The CSR will be then sent KeyTalk server to create a certificate. Defaults to `"false"`.

Example:

```
{
  "status": "auth-requirements",
  "credential-types": ["HWSIG", "PASSWD", "USERID"],
  "hwsig_formula": "1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16",
  "password-prompt": "Password",
  "service-uri": ["https://demo.keytalk.com"],
  "resolve-service-uri" : "true"
}
```

2.7.2 Authentication

Authenticate the caller against the selected service using the supplied set of credentials. Multiple authentication rounds might be needed e.g. for RADIUS SecurID or RADIUS EAP AKA/SIM authentication.

Request

`GET /rcdp/<version>/authentication`

Example:

```
/rcdp/2.2.0/authentication?service=DEMO_SERVICE&caller-hw-
description=Windows+7%2C+BIOS+s%2Fn+1234567890&USERID=DemoUser&HWSIG=123456&P
ASSWD=change%21&resolved=%5B%7B%22ips%22%3A+%5B%2281.175.103.107%22%5D%2C+%22
uri%22%3A+%22https%3A%2F%2Fdemo.keytalk.com%2F%22%7D%5D
```

Query parameters

parameter	type	required	description
`service`	*string*	yes	KeyTalk service name
`caller-hw-description`	*string*	yes	Caller HW description which should be unique for the given device. For uniqueness e.g. BIOS serial number or iOS device UDID can be used. Examples: - `Windows 10, BIOS s/n 1234567890` - `iPAD: Jan's iPAD 234567890abcdef1234567890abcdef`
`USERID`	*string*	if requested	ID of the user. Required if `USERID` was previously set by the server in `auth-requirements` response.
`HWSIG`	*string*	if requested	Hardware Signature of the caller's device calculated with the formula specified in the previous `auth-requirements` server response. Required if `HWSIG` was previously set by the server in `auth-requirements` response..
`PASSWD`	*string*	if requested	User password. Required if `PASSWD` was previously set by the server in `auth-requirements` response.
`PIN`	*string*	if requested	User pincode. Required if `PIN` was previously set by the server in `auth-requirements` response.
`resolved`	*JSON array*	if requested	JSON array of objects containing service URIs accompained with RFC 3986-compliant IPv4 or IPv6 address resolved from the URI hostname. Required if `resolve-service-uris` was previously set in `auth-requirements` response. Example: `[ { "uri":"https://demo1.keytalk.com", "ips":["81.175.10.107","81.175.103.109"] }, { "uri":"https://demo2.keytalk.com", "ips":["81.175.10.108","[2001:db8:a0b:12f0::1]"] } ]`
`digests`	*JSON array*	if requested	JSON array of objects containing service URIs accompained with SHA-256 hexadecimal digest of the underlying file. Required if `calc-service-uris-digest` was previously set in `auth-requirements` response. Example: `[ { "uri":"file://%Program Files%\vpn\vpn.exe", "digest":"01c7198fb614bf8746b46062aa551dff4506dd553ad96817622c76dafe8dc354" }, { "uri":"file://%Program Files%\vpn\vpn2.exe", "digest":"01c7198fb614bf8746b46062aa551dff4506dd553ad96817622c76dafe8dc355" } ]`

Response

`HTTP 200 – application/json`

```
{
  "status": "auth-result",
  "auth-status": authentication-status,
  [optional] "delay": authentication delay for failed authentication,
  [optional] "password-validity": password validity on success,
  [optional] "challenges": requested challenges,
  [optional] "response-names": response names for the given challenges
}
```

auth-status
: authentication status. Can be one of:
"OK" - authentication successful
"DELAY" - authentication was not successful and `delay` parameter is set
"LOCKED" - cannot login because the user is locked on the server
"EXPIRED" – authentication not successful because the user password is expired
"CHALLENGE"– challenge is supplied by the server and `challenges` parameter is set

delay
: when `DELAY` is received in `auth-status`, indicates the time in seconds the caller is suspended from repeating its authentication attempt. Can be 0 which means a caller can try re-authenticating immediately.

password-validity
: when authentication succeeds ("OK" received), indicates the number of seconds until the password expires or -1 if the password never expires. Password validity is supplied only when provided by an authentication backend.

challenges
: when `CHALLENGE` is received, contains JSON array of challenges. Challenge names are meant to be displayed to a user during interactive challenge prompt. Challenge values is the value of the challenge to use for response calculation.
Example:

```
[
    {
        "name": "enter first pincode",
        "value": "981fa356"
    },
    {
        "name": "enter second pincode",
        value": "981fa357"
    }
]
```

response-names
: when `CHALLENGE` is received, contains JSON array of response names. When multiple responses are required by the server, response name allow identifying each response sent by the caller, thus serving as response keys. Response names can be omitted when only one response is expected by the server.
Example: `["response 1", "response 2", "response 3"]`

Example:

Successful authentication:

```
{
  "status": "auth-result",
  "auth-status": "OK"
}
```

Unsuccessful authentication, the caller is suspended for 10 seconds

```
{
  "status": "auth-result",
  "auth-status": "DELAY",
  "delay": 10,
}
```

Extra challenge is requested (RADIUS SecurID authentication)

```
{
  "status": "auth-result",
  "auth-status": "CHALLENGE",
  "challenges": [{"name":"Password challenge", "value":"Enter your new PIN
of 4 to 8 digits, or <Ctrl-D> to cancel the New PIN procedure:"}],
}
```

Extra challenge is requested (RADIUS EAP-AKA UMTS challenge-response authentication)

```
{
  "status": "auth-result",
  "auth-status": "CHALLENGE",
  "challenges": [{"name":"UMTS AUTN",
"value":"01010101010101010101010101010101"},
                 {"name":"UMTS RANDOM",
"value":"101112131415161718191a1b1c1d1e1f"}],
  "response-names": ["RES", "IK", "CK"]
}
```

When a caller receives `CHALLENGE` in `auth-status` from the server, it should proceed as follows:

- provided the set of required credentials does not include `RESPONSE`, the caller should re-submit all the credentials required by the server, filling `PASSWD` credential with the response to the received challenge. This is called multi-phase password authentication. Example: RADIUS SecurID authentication.
- provided the set of required credentials includes `RESPONSE`, the caller should respond with `RESPONSE` credential only as described below in 2.6.2.1. This is called Challenge-Response authentication. Example: RADIUS EAP AKA/SIM authentication.

2.7.2.1 Challenge-response authentication

Request

`GET /rcdp/<version>/authentication`

Example:

```
/rcdp/2.2.0/authentication?responses=%7B%22CK%22%3A+%22123%22%2C+%22RES%22%3A
+%22456%22%2C+%22IK%22%3A+%22789%22%7D
```

Query parameters

parameter	type	required	description

`responses`	*JSON object*	yes	JSON array of responses. Response names should be the same as returned by the server on the previous `authentication` request.
			Example:
			`[`
			`{"name":"RES", "value":"123"},`
			`{"name":"IK", "value":"456"},`
			`{"name":"CK", "value":"789"}`
			`]`

Response

Response

`HTTP 200 – application/json`

```
{
  "status": "auth-result",
  "auth-status": authentication-status,
  [optional] "delay": authentication delay for failed authentication,
  [optional] "password-validity": password validity on success,
  [optional] "challenges": requested challenges,
  [optional] "response-names": response names for the given challenges
}
```

auth-status
: authentication status. Can be one of:
"OK" - authentication successful
"DELAY" - authentication was not successful and `delay` parameter is set
"LOCKED" - cannot login because the user is locked on the server
"EXPIRED" – authentication not successful because the user password is expired
"CHALLENGE"– challenge is supplied by the server and `challenges` parameter is set

delay
: when `DELAY` is received in `auth-status`, indicates the time in seconds the caller is suspended from repeating its authentication attempt. Can be 0 which means a caller can try re-authenticating immediately.

password-validity
: when authentication succeeds ("OK" received), indicates the number of seconds until the password expires or -1 if the password never expires. Password validity is supplied only when provided by an authentication backend.

challenges

when `CHALLENGE` is received, contains JSON array of challenges. Challenge names are meant to be displayed to a user during interactive challenge prompt. Challenge values is the value of the challenge to use for response calculation.

Example:

```
[
   {
       "name": "enter first pincode",
       "value": "981fa356"
   },
   {
       "name": "enter second pincode",
       value": "981fa357"
   }
]
```

response-names

when `CHALLENGE` is received, contains JSON array of response names. When multiple responses are required by the server, response name allow identifying each response sent by the caller, thus serving as response keys. Response names can be omitted when only one response is expected by the server.

Example: `["response 1", "response 2", "response 3"]`

Example:

Successful authentication:

```
{
  "status": "auth-result",
  "auth-status": "OK"
}
```

Unsuccessful authentication, the caller is suspended for 10 seconds

```
{
  "status": "auth-result",
  "auth-status": "DELAY",
  "delay": 10,
}
```

Extra challenge is requested (RADIUS SecurID authentication)

```
{
  "status": "auth-result",
  "auth-status": "CHALLENGE",
  "challenges": [{"name": "Password challenge", "value":"Enter your new PIN
of 4 to 8 digits, or <Ctrl-D> to cancel the New PIN procedure:"}],
}
```

2.7.3 Change password

Change user password. Password change facility has to be supported by the server backend such as Active Directory. A caller should normally change his password after `EXPIRED` authentication result is received from the server. A caller may also choose to change his password on successful authentication when *`password-validity`* parameter gives a hint that the password is about to expire.

Request

`GET /rcdp/<version>/change-password`

Example:

`/rcdp/2.2.0/change-password?old-password=changeme&new-password=changed`

Query parameters

parameter	type	required	description
`old-password`	*string*	yes	Current (old) user password.
`new-password`	*string*	yes	New user password.

Response

See 2.6.2 with authentication status limited to "`OK`", "`DELAY`" or "`LOCKED`"
"`OK`" means the password has been successfully changed and the user has to re-authenticate with his new password.
"`DELAY`" means the password change did not succeed (e.g. incorrect old password or too short new password) and the caller may try again after the given amount of seconds.

2.8 Phase 3 (service provision)

2.8.1 Check for the last messages

Check for the last server messages. Server messages are meant for KeyTalk users e.g. to indicate planned server maintenance.

Request

`GET /rcdp/<version>/last-messages`

Example:

```
/rcdp/2.2.0/last-messages
/rcdp/2.2.0/last-messages?from-utc=2018-04-26T06%3A49%3A55.614010Z
```

Query parameters

parameter	type	required	description
`from-utc`	*UTC string in ISO 8601 including date and time*	no	UTC to request the messages from. Defaults to requesting all server messages.

Response

`HTTP 200 – application/json`

```
{
  "status": "last-messages",
  "messages": [
                  {
                     "text": message text string,
                     "utc": message UTC in ISO 8601 including date and time
                  },
                 ....
              ]
}
```

Example:

```
{
  "status": "last-messages",
  {"messages": [{"text": "This is user message number 1",
                 "utc": "2017-04-06T04:15:15+0000"},
                {"text": "This is user message number 2",
                 "utc": "2018-03-04T02:10:10+0000"},
                {"text": "This is user message number 3",
                 "utc": "2018-05-02T00:05:05+0000"}]
}
```

2.8.2 Generate certificate on the server

Retrieve a server-generated certificate in the desired format along with a private key.

Request

`GET /rcdp/<version>/cert`

Example:

```
/rcdp/2.2.0/cert?format=P12
/rcdp/2.2.0/cert?format=PEM&include-chain=True
/rcdp/2.2.0/cert?format=P12&out-of-band=True
```

Query parameters

parameter	type	required	default value	description
`format`	*"P12 or "PEM"*	yes	n/a	"`PEM`" to request PEM-encoded X.509 certificate and private key "`P12`" to request PKCS#12-encoded X.509 certificate and private key
`include-chain`	*boolean*	no	false	Request the entire certificate chain including suburdinate and root CAs.
`out-of-band`	*boolean*	no	false	***[as of v2.1.0]*** When set, the server will send back URL to download the certificate instead of the certificate itself.

Response

`HTTP 200 - application/json`

```
{
  "status": "cert",

  "cert": certificate in the desired format returned when out-of-band is not set.
          PEM-encoded certificate has its private key encrypted with the first 30 characters of the
session ID sent by the server in keytalkcookie.
          When the certificate is delivered in PKCS#12 package, the package gets encrypted with
with the first 30 characters of the session ID sent by the server in keytalkcookie and subsequently
base64 encoded to be transported with JSON,

 "cert-url-templ": certificate download URL template returned when out-of-band is set.
        The template conatins $(KEYTALK_SVR_HOST) placeholder that needs to be instantiated with
a hostname or IP address of the KeyTalk server used by the caller to make up a valid URL. The
download URL is valid for a limited amount of time (normally 5 minutes) and gets invalidated after
the first use.
        PEM-encoded certificate has its private key encrypted with the first 30 characters of the
session ID sent by the server in keytalkcookie.
        When the certificate is delivered in PKCS#12 package , the package gets encrypted with with
the first 30 characters of the session ID sent by the server in keytalkcookie,

  "execute-sync": boolean flag indicating whether the caller should invoke the service URIs
synchronously (true) or asynchronously (false). Defaults to false.
}
```

Example regular usage (certificate is returned in the response body):


```
{
  “status”: “cert”,
  “cert”: "-----BEGIN CERTIFICATE-----
\nMIIFGTCCAwGgAwIBAgIIWurOaAAAABYwDQYJKoZIhvcNAQELBQAwgYgxHzAdBgkq\nhkiG9w0B
CQEWEGluZm9Aa2V5dGFsay5jb20xCzAJBgNVBAYTAk5MMRwwGgYDVQQK\nDBNLZXlUYWxrIElUIF
NlY3VyaXR5MRgwFgYDVQQLDA9GYWN0b3J5IERlZmF1bHQx\nIDAeBgNVBAMMF0tleVRhbGsgRGVt
byBTaWduaW5nIENBMB4XDTE4MDUwMzA3NTUw\nNFoXDTE4MDUwMzA5NTUwNFowgZAxETAPBgNVBA
MMCERlbW9Vc2VyMQswCQYDVQQG\nEwJOTDEWMBQGA1UECAwNTm9vcmQtQmFyYmFudDESMBAGA1UE
BwwJRWluZGhvdmVu\nMRQwEgYDVQQKDAtTaW91eCBHcm91cDEMMAoGA1UECwwDU0VTMR4wHAYJKo
ZIhvcN\nAQkBFg90ZXN0dWlAc2lvdXguZXUwggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEK\nAo
IBAQDJGKTHSL16vsgxIjXvDOTKLk2q518JaIF9Q9ews88NmpVV9cDbOPRxwsns\nSd1kNAXEYi05
ScmIc5pGpIV8hyyNjtZ17tiolVO0ALkXgk7hG7wO2Rz+bAQzCdvS\noJjtzo6gZPYcQVlfq+ENMt
39ibLqfuAnMLjVpn44fwfqxQFeEsd4doO74E1bUXh7\n7KzaoxsiDAyIITYZe5Azz9Ol47ffg3pR
Dtq\/6IDYmr7xlBMOq+7QObKBU0pgwNkn\n3JTgkBspXGEXok6S1qNBqJ199NJjdYjiWjHa\/9vS
pHSN8RF2s9xrBanLM3S+fnr6\nBx34P6cBoTcc1lZ9Dpr8IYNJWkanAgMBAAGjfTB7MAkGA1UdEw
QCMAAwHQYDVR0l\nBBYwFAYIKwYBBQUHAwIGCCsGAQUFBwMBMAsGA1UdDwQEAwID+DAqBglghkgB
hvhC\nAQIEHRYbQ1VTVF9QQVNTV0RfSU5URVJOQUxfVEVTVFVJMBYGA1UdEQQPMA2CC25z\nLnNp
b3V4LmV1MA0GCSqGSIb3DQEBCwUAA4ICAQCYKF1OTJqL3eg1JgJdbLPzDo74\nfqZbEBpNkeBFe6
nQ6calHJrZNG857WGdfVKfXSOrkwGHmdSNl\/0XM+ySIpcNOWQf\nM9o9rxKQigk4n\/tvjNCiVX
Ra125t5pUR1ZSyu11SWQAJYc2nPjzasl5B8SwJOIet\nJV80z1pgLFh2GU7hGNiWVqJLF\/U0\/t
+xZ1lW1sZ64iih49owTsLt9CL06pD6KPN6\nWvmzLNoK\/ouEeRnYgkyWXvlahGY5N2bPwlq+7+s
3BOYRo3APL4N6iVEOUfYDE78K\n05g5zdhVbn717CMx1sQpXggyF5X\/ztQLkrUB5kLT9D7eCBnL
DVdjELzl12KJar\/b\ny9eumkCg+Y9PCZN2513o1zUlDLGaH9\/9KdCf6yEca3D3NvnbfCmrDvx1
0AN+Ht3L\n4XU2L5Rx2rqwB9tj3rZy8i6BK7\/A+ARfg6Tqki5FQ9k667q2hBRPtr69bLeML5at\
nyn\/beKjnYnzCRcfXDgnJIKZdfKt2PBM7lh508HNn6aaRZUfHBKHxjMxwuXNMdq9m\nHk6+H8rb
RipV\/4xCzEFYvaqlpYO3lOzLIrw8AohRlUzX7UFGm1Dbpn3G2qeikD1Z\nhySYTxjmjXE0DVnPL
X05+MR08Eq3hC6QDYs3gBZgP3nILvfEZliOax4fqbT3ijJ9\noxMI+OJsawZMG0uO0w==\n-----
END CERTIFICATE-----\n-----BEGIN ENCRYPTED PRIVATE KEY-----
\nMIIFDjBABgkqhkiG9w0BBQ0wMzAbBgkqhkiG9w0BBQwwDgQIq9o+wzvbXQQCAggA\nMBQGCCqG
SIb3DQMHBAipsAoCJT4gVgSCBMhTb\/8ws1tw9uhH12t9mozccMJQeSAe\nIDxu86RaxgbaMcHj2
GnfQjFPou1Ik28eU4Pbi6OEpdlGSBAtrRTK9ZsIOCv+26vN\njrh4gFsLqa9LC\/RB6T7gQFK6nS
j+9332d+jCr4tKBIJvSu6hmTGTOraePHb8ic8B\niSHphmz9lN91M311qYKMzhW\/MZg043u2TBJ
zx1LdsFicIH\/KJ8LXkYQNyM0G663y\nqWpngyjWvzIL7oL5rZh5pv7ygFTuUTy\/1akDW3inuC8
fN3\/Zy1374IHeAk4V\/hGQ\nC7FmpF15FTZAYICuKQQsTzUKOd+9Oqlq8YrbcPbHrcMH43UTeaJ
zjklc3R5K\/mQk\n6a2ggjPc2z4LoFOYEtoPUointBLnRetk7QEHWQdWWW5WfFGRrjbK2t0jZLLV
zXuS\nZ0QYBoHeGzFYH0AeYB01DAcT8OC9PAB4r\/vEFdKyXD85OdYdIp4cAbYm5IBB8bYd\nnnf9
JIV8iifIHy38of6FpHI3AwPZqZTTDaR+arLTjpmpN6d9bRfMNyWUWnJsv0WOo\nd1YuWU\/\/OE0
tdvVQKnU1T9FdhbjyW6nQpR8uwhYLi\/BIjpvCUK6ZAe\/+llik0Z2+\nCXnlbU225MOaY2YLS3B
izXUkkMcQAo4JE5tEj9vMsEa4VHvt9zcsfpT4vZIGmG2h\nU9UoY2XGhZ4jIEVtqO2ihz7V1ow+k
O7eD6HlHMhws9CPZkKh03Z94FK1V\/Sf53U6\ndnR1sAmuuI5HJroXYyX6N5cLguSnwyyvOWRPrU
UjqWPZrfvLzndpro6IFPilS7L4\n2fR1DEHwe\/VV0StF31CV6N88KRyGN+gBWrvkGKJ8EozhEz2
qToqLBU0CLQ+FVOlE\nuYS30hejXc8wYKFupwSOlhpJUp2B4zC4EbsmTnn7sS55Yk+9NCetE\/k0
VMf\/PVVN\nWG0kFhq5CCmtkx8fvvq0nnnNuZS4Hy+tBlEeqMvRvQQ62eRCR94msYG2LCVxRUiB\
nNrKQvBM3\/RbxjQFVULr6Wjw9I8dLenjfjou47JLSMShaxlDeAG5iBb0GzLZP6Wlh\nOyXIyusR
ePxv40GPZsCBRqD2c6fdk52U3Bgk7asctp1L9Y1qP71lbJwnuFtygt+7\nZ+7b38PLltxMRYMCoL
D78kugFAP2St0iGGdzdUEWoIP\/IZT2SmMo578CPum3RSHt\nu3lCtHfzzrMIq2o1uTGv+HDswTr
LwZt\/VDcaZZUP9a6Vyfzd83jqRXCkFeBk2udM\nHDo5TC6EvLAv9cXqGRW8VSxkJ1WdyxhIdjNS
CN+CrECX\/PTbmv5MP9gydnqDSJDq\npCHXZr6dca6vAUGYn5ouQuhrTjsSRsk4M5ZhwgYt9xwCc
fNE+juVeweWEJM1GnxP\nmEW3fFSE+NNDfYoPWEA5XEGpR3xF7g9Bj5lT4Yk0XVk\/ED3hTx0VI8
g2IZGrvt40\nyh+\/OxyxB9zUzsleQVDitmzQnqti3nXReHwyenO0p9frC5J\/o4ibYKkPF91H9\
/UK\nh8SCSLpWBil\/8RBQ8kD0Pms5G\/Z2TNS6dnwrXZU+so1pl+Kk+T+TTjKkDp8U1xkv\nWCl
AUsbs8gO0289SjGjhPge0c4UWRiKLElj6jDx0g3yHoJU8bi6pMnJzVeg7IhLF\nxK8=\n-----
END ENCRYPTED PRIVATE KEY-----\n“
}
```


Notice again that JSON-serialization of PEM certificates requires forward slashes '/' to be escaped as '\/'

Example when certificate download URL is returned:

```
{
  "status": "cert",
  "cert-url-templ": "
http://$(KEYTALK_SVR_HOST):8000/cert/?cbf498dc683c4e0499fd7e2d27640917"
}
```

2.8.3 *[as of v2.2.0]* Query CSR requirements

Client might want to generate a key pair itself and submit the CSR to KeyTalk server for signing. Before generating a key pair the client should ask the server for the initial parameters for the CSR such as key size, signing algorithm and certificate subject.

Request

`GET /rcdp/<version>/csr-requirements`

Example:

`/rcdp/2.2.2/csr-requirements`

Response

`HTTP 200 – application/json`

```
{
  "status": "csr-requirements",
  "key-size": key size in bits,
  "signing-algo": algorithm to use for CSR signing,
  "subject": dictionary of  subject fields to use in CSR
}
```

Example:

```
{"status": "csr-requirements",
 "key-size": "2048",
 "signing-algo": "sha256",
 "subject": {"cn": "TestUser",
             "c": "NL",
             "st": "Utrecht"
             "l": "Amsersfort",
             "o": "KeyTalk",
             "ou": "Development",
             "e": "test@keytalk.com",
            }
}
```

2.8.4 *[as of v2.2.0]* Generate certificate from the client CSR

Retrieve a PEM-encoded certificate from the CSR supplied by the client. The CSR should be created from the parameters retrieved from `csr-requirements` call desribed in 2.7.3.

Request

```
POST /rcdp/<version>/cert
Content-type: application/x-www-form-urlencoded
```

Example:

```
$ curl -H "Content-Type: application/x-www-form-urlencoded" -H "Cookie:
keytalkcookie=a77c33e55a1f411396031ce91ee48d9d" -H"Expect: " -d "csr=-----
BEGIN+CERTIFICATE+REQUEST-----
%0AMIIC1jCCAb4CAQAwgZAxCzAJBgNVBAYTAk5MMRIwEAYDVQQHDAlFaW5kaG92ZW4x%0ADDAKBgN
VBAsMA1NFUzEUMBIGA1UECgwLU2lvdXggR3JvdXAxFjAUBgNVBAgMDU5v%0Ab3JkLUJhcmJhbnQxE
TAPBgNVBAMMCERlbW9Vc2VyMR4wHAYJKoZIhvcNAQkBFg90%0AZXN0dWlAc2lvdXguZXUwggEiMA0
GCSqGSIb3DQEBAQUAA4IBDwAwggEKAoIBAQDG%0AfyCCkM7cbVhpBCSx1Nf%2BFDqa9banKf9sPRW
5VwBFYP5siLdsywNkNqrFYcV0w6ss%0Ath21qK9bkjZoyiKpbzvzgQw08NlbBmJfj700Ol8HUn2xL
vp2z6J6q3Z4rAR4d8jx%0ApwcdRlPeJO5b3OtBaURKILaJTjtsUVyCXr%2B6u%2FgiuaD0DGBKsIQ
ccyAWGy%2B1zNer%0AsmUib%2FsnWHEaAPJtvg7T2amaWACKcqIOppR%2BHDJUUNSYYju9xZqCLjx
6Y2%2B2ZXHK%0AMpFcFsP%2F8GCYGZ2%2FAIlWtsVzKSaRWmTVJfBsy50gW3YmwI0QYghl52NIDQu
BJeoT%0AmQFxsKXpqcWjpP3KTOS5AgMBAAGgADANBgkqhkiG9w0BAQsFAAOCAQEAbUVCaYm%2F%0A
w1otZaLgtCP2mIVVH%2FgHvTeVFs1436Lz%2FaKT5q1QRee81C2us1z9G7h3PG%2BM6w1N%0AUJau
wqQ2mR2c1VAidROdT52syNPR4jXeR11%2F7a%2FmsZFqaw3%2FLlwVtBJHEfOA6apU%0AjSVWi6%2
F3kUjD0FhYHAufKm2nJ10qGnwC5xpzuvYOQsUFFobLZoyGq5NNEgnSpK8X%0A9A9j5kKGBOm9eQOr
Wxw%2F0UlwRqLpt6l76Gt5%2BlMp5BtTCPK2uboHvJiPu4aJUuHh%0Afx9ZjKox73V%2BleOEmNSY
fesuQPE5AwiFkE988NFixGXOHw7uQdWc9SFsYFRFZG2p%0AYb%2Bm9iFyUY8AHw%3D%3D%0A-----
END+CERTIFICATE+REQUEST-----%0A" -X POST
https://test.keytalk.com/rcdp/2.2.0/cert
```

Request POST parameters:

parameter	type	required	default value	description
`csr`	*string*	yes	n/a	Base64 encoded PKCS#10 certificate signing request
`include-chain`	*boolean*	no	false	Request the entire certificate chain including suburdinate and root CAs.
`out-of-band`	*boolean*	no	false	When set, the server will send back URL to download the certificate instead of the certificate itself.

Response

`HTTP 200 – application/json`

```
{
  "status": "cert",

  "cert": PEM-encoded certificate returned when out-of-band is not set,

  "cert-url-templ": certificate download URL template returned when out-of-band is set.
        The template conatins $(KEYTALK_SVR_HOST) placeholder that needs to be instantiated with
a hostname or IP address of the KeyTalk server used by the caller to make up a valid URL. The
download URL is valid for a limited amount of time (normally 5 minutes) and gets invalidated after
the first use,

  "execute-sync": boolean flag indicating whether the caller should invoke the service URIs
synchronously (true) or asynchronously (false). Defaults to false.
}
```

Example regular usage (certificate is returned in the response):

```
{
  "status": "cert",
  "cert": "-----BEGIN CERTIFICATE-----
\nMIIFGTCCAwGgAwIBAgIIWurNEwAAABUwDQYJKoZIhvcNAQELBQAwgYgxHzAdBgkq\nhkiG9w0B
CQEWEGluZm9Aa2V5dGFsay5jb20xCzAJBgNVBAYTAk5MMRwwGgYDVQQK\nDBNLZXlUYWxrIElUIF
NlY3VyaXR5MRgwFgYDVQQLDA9GYWN0b3J5IERlZmF1bHQx\nIDAeBgNVBAMMF0tleVRhbGsgRGVt
byBTaWduaW5nIENBMB4XDTE4MDUwMzA3NDky\nM1oXDTE4MDUwMzA5NDkyM1owgZAxCzAJBgNVBA
YTAk5MMRIwEAYDVQQHDAlFaW5k\naG92ZW4xDDAKBgNVBAsMA1NFUzEUMBIGA1UECgwLU2lvdXgg
R3JvdXAxFjAUBgNV\nBAgMDU5vb3JkLUJhcmJhbnQxETAPBgNVBAMMCERlbW9Vc2VyMR4wHAYJKo
ZIhvcN\nAQkBFg90ZXN0dWlAc2lvdXguZXUwggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEK\nAo
IBAQDGfyCCkM7cbVhpBCSx1Nf+FDqa9banKf9sPRW5VwBFYP5siLdsywNkNqrF\nYcV0w6ssth21
qK9bkjZoyiKpbzvzgQw08NlbBmJfj700Ol8HUn2xLvp2z6J6q3Z4\nrAR4d8jxpwcdRlPeJO5b3O
tBaURKILaJTjtsUVyCXr+6u\/giuaD0DGBKsIQccyAW\nGy+1zNersmUib\/snWHEaAPJtvg7T2a
maWACKcqIOppR+HDJUUNSYYju9xZqCLjx6\nY2+2ZXHKMpFcFsP\/8GCYGZ2\/AIlWtsVzKSaRWm
TVJfBsy50gW3YmwI0QYghl52NI\nDQuBJeoTmQFxsKXpqcWjpP3KTOS5AgMBAAGjfTB7MAkGA1Ud
EwQCMAAwHQYDVR0l\nBBYwFAYIKwYBBQUHAwIGCCsGAQUFBwMBMAsGA1UdDwQEAwID+DAqBglghk
gBhvhC\nAQIEHRYbQ1VTVF9QQVNTV0RfSU5URVJOQUxfVEVTVFVJMBYGA1UdEQQPMA2CC25z\nLn
Npb3V4LmV1MA0GCSqGSIb3DQEBCwUAA4ICAQCCca0ClI9Dw+iO7IIqMZ8UKzhq\n8MWcbpthcgFH
PHdxqFYIfTWYOzXCN8FVq96oHH2e09anBYopGyHW+a5oMbY8bKbP\nvGD6\/CslC8nFFqkQfRTH6
nanDSq18S\/4uc3bMaIQvWzv5mEYpiTKtKCSUMfV7FLN\nS64I\/UQNglEhHMul1UyL0NM3xU8QY
mz+k6qnkw2C3M5Y9eprUT9iZxXCm4XGJo7j\nUPBIRBXUCsaPz+UdK0Syq2Hl\/IsREt5iPRJIU\
/B4FjduJlD1R68ZAyNnyOeDQI7f\nEJWUeBYC2QwdlXW3FqKdwki928wksRpY4x3Fyz9\/f32chZ
QOihee378HP9PDiTZQ\nFCIWSsrO+WUUjToehK2ErgqwCrH0Ydw5ZuIV1vVivGzlgmDHmIQY6uPn
Yasa1kQw\nspY2JyvlZA\/9mhCvfupwB6L4QIA8yjwNoM3MAsZgq4fvk1kxm\/k1pRMPB2bSGy4u
\nFLyMoodTAYJfpzH\/gCwWnrYowqw2T67HsPqBBiOnsuaA0h4k\/m88i4ypcv5f48wJ\nzcxaXq
RqWqxzw\/efkYg5m4HdncAPU05NxwJmP17n77l88MZvKc0wVbA+22vCBgCi\nMaOYWhnkTuBN90A
oaYAJwe1bkLlbTFMZJjsNPvvS5sAk1l9NihCrXS8ZWtZRfGYz\ngPkm+UPWboYdQbKCRg==\n---
--END CERTIFICATE-----\n"
}
```

Notice again that JSON-serialization of PEM certificates requires forward slashes '/' to be escaped as '\/'

Example when certificate download URL is returned:

```
{
  "status": "cert",
  "cert-url-templ": "
http://$(KEYTALK_SVR_HOST):8000/cert/?cbf498dc683c4e0499fd7e2d27640917"
}
```

3. CERTIFICATE AUTHORITY RETRIEVAL API (CA API)

Besides strongly authenticated TLS-secured RCDP API, KeyTalk server also supports unauthenticated plain-HTTP REST API to retrieve trusted and intermediate signing certificate authorities. CA API is meant to be called by KeyTalk clients in order to roll out the initial trust CAs on the system before RCDP API comes into play. The same effect can be achieved by deploying RCCD files, though parsing RCCD is far more complex task compared to downloading a single file over HTTP.

The calls go over plain HTTP iso HTTPS because at the stage of calling CA API a KeyTalk client is not yet supposed to possess a trusted KeyTalk communication CA to establish secure TLS connection to the server. Further more the requested certificates contain only public information hence no secrets are revealed over HTTP.

3.1 CA API versions

REST API version	Supported KeyTalk server	Changes wrt the previous RCDP version
`1.0.0`	`5.3.1` and up	n/a

3.2 CA API overview

The communication goes over HTTP and uses port 8000.

3.2.1 Request intemediate signing CA

Retrieve KeyTalk Signing CA or KeyTalk Primary CA or KeyTalk root CA for a user certificate that will be eventually received via RCDP call. Each subsequent CA is a issuer of the previous one.

The received CAs are KeyTalk internal CAs (i.e. not from GlobalSign or Microsoft CA tree) corresponding to “Signing CA” “Primary CA” and “Root CA”, on the KeyTak admin web panel. A typical KeyTalk internal CA tree is 2 level deep with self-signed Primary CA and no Root CA.

Request

```
GET /ca/1.0.0/signing
GET /ca/1.0.0/primary
GET /ca/1.0.0/root
```

Response

`HTTP 200 - application/octet-stream -` PEM-encoded CA certificate is returned in HTTP response body
`HTTP 404 -` CA does not exist (e.g. for Root CA)