SCM1612
Wi-Fi 6 和 BLE 5 低功耗 SoC

HTTP 客户端 开发指南

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1 概述

本文档旨在指导如何在 SCM1612 平台上实现运行 HTTP 客户端的应用程序。

SCM1612 SDK 使用了来自 ESP-IDF 的 esp_http_client 模块：

- **API 路径:** lib/net/esp_http_client
- **Demo 路径:** api/examples/protocols/http_client

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2 Demo 配置与构建

要运行 HTTP 客户端 Demo，请按照以下步骤进行操作：

2.1 设置构建配置

1. 选择 HTTP 客户端 Demo 作为主应用程序：
   $ make scm1612s_defconfig
   $ make menuconfig

2. 在 menuconfig 界面中，导航到以下选项：
   - `Applications -> Protocols Demo`
   - Select `Protocols Demo -> HTTP Client Demo`
   - `Libraries/middleware -> net -> ESP HTTP Client`
   - Select `Enable HTTP Basic Authentication`
   - Select `Enable HTTP Digest Authentication`
3. 退出并保存配置

2.2 设置测试 HTTP 服务器

1. 在 menuconfig 界面中导航至 Applications -> Example Configuration。
2. 根据需要修改测试 HTTP 服务器的设置。

```
(httpbin.org) Example HTTP Endpoint
[ ] Enable logging response buffer from HTTP event handler
```

2.3 设置 Wi-Fi 参数

1. 打开 menuconfig 界面：
   $ make menuconfig
2. 导航至 Applications -> Common -> include WI-FI Configuration。
3. 在 DEMO WI-FI Configuration 中输入 Wi-Fi 参数。如果需要，可以使用帮助菜单查看各项的详细说明。
4. 退出并保存配置。

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2.4 构建 wise-mcuboot.bin

1. 构建项目：
   $ make
2. 请参考《SCM1612_SDK 入门指南.pdf》，将生成的镜像下载至 SCM1612 EVK，并运行它。

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3 使用 HTTP 客户端

HTTP 客户端 API 提供了多种类型的 HTTP 请求功能，并支持身份认证、数据流传输和 HTTPS 连接。

```
$ httpc
Usage: httpc rest <type : url or hostname>
  or:  httpc auth
  or:  httpc digest_auth <type : md5 or sha256>
  or:  httpc stream_read
  or:  httpc native_req
  or:  httpc secure <type : url or hostname or invalid>
$
```

3.1 基本 HTTP 请求

esp_http_client API 支持执行 GET、POST、PUT、PATCH 和 DELETE 请求。一旦建立连接后，可以在关闭连接前发起多次请求。本节重点介绍使用 URL 或主机名测试 REST API 的常见用例。

- 使用 URL 进行测试

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```
$ httpc rest url
$ I (3635574) HTTP_CLIENT: HTTP client Start
I (3636162) HTTP_CLIENT: HTTP GET Status = 200, content_length = 0x121
0x00225490: .... ....  .... ....  .... ....  7b0a 2020    ............{
0x002254a0: 2261 7267  7322 3a20  7b0a 2020  2020 2273    "args": {     "s
0x002254b0: 636d 223a  2022 220a  2020 7d2c  200a 2020    cm": ""    },
0x002254c0: 2268 6561  6465 7273  223a 207b  0a20 2020    "headers": {
0x002254d0: 2022 436f  6e74 656e  742d 4c65  6e67 7468     "Content-Length
0x002254e0: 223a 2022  3022 2c20  0a20 2020  2022 486f    ": "0",      "Ho
0x002254f0: 7374 223a  2022 6874  7470 6269  6e2e 6f72    st": "httpbin.or
0x00225500: 6722 2c20  0a20 2020  2022 5573  6572 2d41    g",      "User-A
0x00225510: 6765 6e74  223a 2022  5343 4d20  4854 5450    gent": "SCM HTTP
0x00225520: 2043 6c69  656e 742f  312e 3022  2c20 0a20     Client/1.0",
0x00225530: 2020 2022  582d 416d  7a6e 2d54  7261 6365       "X-Amzn-Trace
0x00225540: 2d49 6422  3a20 2252  6f6f 743d  312d 3636    -Id": "Root=1-66
0x00225550: 6630 6239  6233 2d33  6665 6466  3134 6331    f0b9b3-3fedf14c1
0x00225560: 3938 6537  6534 6437  6564 3231  6135 3322    98e7e4d7ed21a53"
0x00225570: 0a20 207d  2c20 0a20  2022 6f72  6967 696e       },    "origin
0x00225580: 223a 2022  3131 352e  3932 2e31  3138 2e35    ": "115.92.118.5
0x00225590: 3322 2c20  0a20 2022  7572 6c22  3a20 2268    3",    "url": "h
0x002255a0: 7474 703a  2f2f 6874  7470 6269  6e2e 6f72    ttp://httpbin.or
0x002255b0: 672f 6765  743f 7363  6d22 0a7d  0a.. ....    g/get?scm" } ...
I (3636725) HTTP_CLIENT: HTTP POST Status = 200, content_length = 0x1a5
I (3637176) HTTP_CLIENT: HTTP PUT Status = 200, content_length = 0x1a4
I (3637384) HTTP_CLIENT: HTTP PATCH Status = 200, content_length = 0x14d
I (3637592) HTTP_CLIENT: HTTP DELETE Status = 200, content_length = 0x14e
I (3637800) HTTP_CLIENT: HTTP HEAD Status = 200, content_length = 0x10c
I (3637802) HTTP_CLIENT: HTTP client done
```

- 使用主机名进行测试

```
$ httpc rest hostname
$ I (3650035) HTTP_CLIENT: HTTP client Start
I (3650441) HTTP_CLIENT: HTTP GET Status = 200, content_length = 0x10c
I (3650887) HTTP_CLIENT: HTTP POST Status = 200, content_length = 0x1ba
I (3651374) HTTP_CLIENT: HTTP PUT Status = 200, content_length = 0x1b9
I (3651575) HTTP_CLIENT: HTTP PATCH Status = 200, content_length = 0x14d
I (3651777) HTTP_CLIENT: HTTP DELETE Status = 200, content_length = 0x14e
I (3651976) HTTP_CLIENT: HTTP HEAD Status = 200, content_length = 10c
I (3651977) HTTP_CLIENT: HTTP client done
```

3.2 HTTP 身份认证

HTTP 客户端支持 Basic 和 Digest 两种身份认证方式。Digest 身份认证支持 MD5 和 SHA-256 算法。

- Basic 认证

```
$ httpc auth
$ I (4540966) HTTP_CLIENT: HTTP client Start
I (4541480) HTTP_CLIENT: HTTP Basic Auth Status = 200, content_length = 0x2f
I (4541482) HTTP_CLIENT: HTTP client done
```

- MD5 认证

```
$ httpc digest_auth md5
$ I (4644049) HTTP_CLIENT: HTTP client Start
I (4644784) HTTP_CLIENT: HTTP MD5 Digest Auth Status = 200, content_length = 0x2f
I (4644786) HTTP_CLIENT: HTTP client done
```

- SHA256 认证

```
$ httpc digest_auth sha256
$ I (4677430) HTTP_CLIENT: HTTP client Start
I (4678150) HTTP_CLIENT: HTTP SHA256 Digest Auth Status = 200, content_length = 0x2f
I (4678152) HTTP_CLIENT: HTTP client done
```

3.3 HTTP 数据流传输

- 对于需要主动控制数据交换的应用场景（如实时数据流传输），可以使用 HTTP 流模式。应用的执行流程与常规请求有所不同。

```
$ httpc stream_read
$ I (5632910) HTTP_CLIENT: HTTP client Start
I (5633320) HTTP_CLIENT: HTTP Stream reader Status = 200, content_length = 0x10e
0x0022eca0: 7b0a 2020  2261 7267  7322 3a20  7b7d 2c20    {   "args": {},
0x0022ecb0: 0a20 2022  6865 6164  6572 7322  3a20 7b0a       "headers": {
0x0022ecc0: 2020 2020  2243 6f6e  7465 6e74  2d4c 656e        "Content-Len
0x0022ecd0: 6774 6822  3a20 2230  222c 200a  2020 2020    gth": "0",
0x0022ece0: 2248 6f73  7422 3a20  2268 7474  7062 696e    "Host": "httpbin
0x0022ecf0: 2e6f 7267  222c 200a  2020 2020  2255 7365    .org",      "Use
0x0022ed00: 722d 4167  656e 7422  3a20 2245  5350 3332    r-Agent": "ESP32
0x0022ed10: 2048 5454  5020 436c  6965 6e74  2f31 2e30     HTTP Client/1.0
0x0022ed20: 222c 200a  2020 2020  2258 2d41  6d7a 6e2d    ",      "X-Amzn-
0x0022ed30: 5472 6163  652d 4964  223a 2022  526f 6f74    Trace-Id": "Root
0x0022ed40: 3d31 2d36  3666 3063  3138 302d  3133 6262    =1-66f0c180-13bb
0x0022ed50: 3165 6633  3138 3231  6238 3137  3434 3231    1ef31821b8174421
0x0022ed60: 3966 3166  220a 2020  7d2c 200a  2020 226f    9f1f"   },    "o
0x0022ed70: 7269 6769  6e22 3a20  2231 3135  2e39 322e    rigin": "115.92.
0x0022ed80: 3131 382e  3533 222c  200a 2020  2275 726c    118.53",    "url
0x0022ed90: 223a 2022  6874 7470  3a2f 2f68  7474 7062    ": "http://httpb
0x0022eda0: 696e 2e6f  7267 2f67  6574 220a  7d0a ....    in.org/get" } ..
I (5633417) HTTP_CLIENT: HTTP client done
```

3.4 HTTP 原生接口

HTTP 客户端提供了底层 API，可实现对 HTTP 连接的精细化控制。

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```
$ httpc native_req
$ I (5883926) HTTP_CLIENT: HTTP client Start
I (5884533) HTTP_CLIENT: HTTP GET Status = 200, content_length = 0x10e
0x00225490: .... .... .... .... .... .... 7b0a 2020    ............{
0x002254a0: 2261 7267 7322 3a20 7b7d 2c20 0a20 2022    "args": {},    "
0x002254b0: 6865 6164 6572 7322 3a20 7b0a 2020 2020    headers": {
0x002254c0: 2243 6f6e 7465 6e74 2d4c 656e 6774 6822    "Content-Length"
0x002254d0: 3a20 2230 222c 200a 2020 2020 2248 6f73    : "0",      "Hos
0x002254e0: 7422 3a20 2268 7474 7062 696e 2e6f 7267    t": "httpbin.org
0x002254f0: 222c 200a 2020 2020 2255 7365 722d 4167    ",      "User-Ag
0x00225500: 656e 7422 3a20 2245 5350 3332 2048 5454    ent": "ESP32 HTT
0x00225510: 5020 436c 6965 6e74 2f31 2e30 222c 200a    P Client/1.0",
0x00225520: 2020 2020 2258 2d41 6d7a 6e2d 5472 6163        "X-Amzn-Trac
0x00225530: 652d 4964 223a 2022 526f 6f74 3d31 2d36    e-Id": "Root=1-6
0x00225540: 3666 3063 3237 622d 3266 3137 6632 3165    6f0c27b-2f17f21e
0x00225550: 3733 3563 3131 6630 3232 3563 3838 3365    735c11f0225c883e
0x00225560: 220a 2020 7d2c 200a 2020 226f 7269 6769    "   },    "origi
0x00225570: 6e22 3a20 2231 3135 2e39 322e 3131 382e    n": "115.92.118.
0x00225580: 3533 222c 200a 2020 2275 726c 223a 2022    53",    "url": "
0x00225590: 6874 7470 3a2f 2f68 7474 7062 696e 2e6f    http://httpbin.o
0x002255a0: 7267 2f67 6574 220a 7d0a .... .... ....    rg/get" } ......
I (5885243) HTTP_CLIENT: HTTP POST Status = 200, content_length = 0x1a7
0x00225490: .... .... .... .... .... .... 7b0a 2020    ............{
0x002254a0: 2261 7267 7322 3a20 7b7d 2c20 0a20 2022    "args": {},    "
0x002254b0: 6461 7461 223a 2022 7b5c 2266 6965 6c64    data": "{\"field
0x002254c0: 315c 223a 5c22 7661 6c75 6531 5c22 7d22    1\":\"value1\"}"
0x002254d0: 2c20 0a20 2022 6669 6c65 7322 3a20 7b7d    ,    "files": {}
0x002254e0: 2c20 0a20 2022 666f 726d 223a 207b 7d2c    ,    "form": {},
0x002254f0: 200a 2020 2268 6561 6465 7273 223a 207b        "headers": {
0x00225500: 0a20 2020 2022 436f 6e74 656e 742d 4c65        "Content-Le
0x00225510: 6e67 7468 223a 2022 3139 222c 200a 2020    ngth": "19",
0x00225520: 2020 2243 6f6e 7465 6e74 2d54 7970 6522      "Content-Type"
0x00225530: 3a20 2261 7070 6c69 6361 7469 6f6e 2f6a    : "application/j
0x00225540: 736f 6e22 2c20 0a20 2020 2022 486f 7374    son",      "Host
0x00225550: 223a 2022 6874 7470 6269 6e2e 6f72 6722    ": "httpbin.org"
0x00225560: 2c20 0a20 2020 2022 5573 6572 2d41 6765    ,      "User-Age
0x00225570: 6e74 223a 2022 4553 5033 3220 4854 5450    nt": "ESP32 HTTP
0x00225580: 2043 6c69 656e 742f 312e 3022 2c20 0a20     Client/1.0",
0x00225590: 2020 2022 582d 416d 7a6e 2d54 7261 6365      "X-Amzn-Trace
0x002255a0: 2d49 6422 3a20 2252 6f6f 743d 312d 3636    -Id": "Root=1-66
0x002255b0: 6630 6332 3763 2d30 3831 6639 3866 6636    f0c27c-081f98ff6
0x002255c0: 6263 3632 3537 3536 3331 3038 6431 3622    bc6257563108d16"
0x002255d0: 0a20 207d 2c20 0a20 2022 6a73 6f6e 223a      },    "json":
0x002255e0: 207b 0a20 2020 2022 6669 656c 6431 223a     {     "field1":
0x002255f0: 2022 7661 6c75 6531 220a 2020 7d2c 200a     "value1"   },
0x00225600: 2020 226f 7269 6769 6e22 3a20 2231 3135      "origin": "115
0x00225610: 2e39 322e 3131 382e 3533 222c 200a 2020    .92.118.53",
0x00225620: 2275 726c 223a 2022 6874 7470 3a2f 2f68    "url": "http://h
0x00225630: 7474 7062 696e 2e6f 7267 2f70 6f73 7422    ttpbin.org/post"
0x00225640: 0a7d 0a.. .... .... .... .... .... ....     } ............
I (5885413) HTTP_CLIENT: HTTP client done
```

3.5 HTTPS 请求

HTTP 客户端支持使用 mbed TLS 的 SSL 连接。推荐使用 www.howsmyssl.com 作为测试服务器进行演示。

3.5.1 获取根 CA 证书

对于 HTTPS 请求，需提供根 CA 证书（PEM 文件）。以下示例演示如何使用 openssl 获取根 CA 证书并保存到文件 howsmyssl_com_root_cert.pem：

```
openssl s_client -showcerts -connect www.howsmyssl.com:443 < /dev/null
```

howsmyssl_com_root_cert.pem

```
-----BEGIN CERTIFICATE-----
MIIFBTCCAu2gAwIBAgIQS6hSk/eaL6JzBkuoBI110DANBgkqhkiG9w0BAQsFADBP
MQswCQYDVQQGEwJVUzEpMCcGA1UEChMgSW50ZXJuZXQgU2VjdXJpdHkgUmVzZWFy
Y2ggR3JvdXAxFTATBgNVBAMTDE1TUkcgUm9vdCBYMTAeFw0yNDAzMTMwMDAwMDBa
Fw0yNzAzMTIyMzU5NTlaMDMxCzAJBgNVBAYTAlVTMRYwFAYDVQQKEw1MZXQncyBF
bmNyeXB0MQwwCgYDVQQDEwNSMTAwggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEK
AoIBAQDPV+XmxFQS7bRH/sknWHZGUCiMHT6I3wWd1bUYKb3dtVq/+vbOo76vACFL
YlpaPAEvxVgD9on/jhFD68G14BQHlo9vH9fnuoE5CXVlt8KvGFs3Jijno/QHK20a
/6tYvJWuQP/py1fEtVt/eA0YYbwX51TGu0mRzW4Y0YCF7qZlNrx06rxQTOr8IfM4
FpOUurDTazgGzRYSespSdcitdrLCnF2YRVxvYXvGLe48E1KGAdlX5jgc3421H5KR
mudKHMxFqHJV8LDmowfs/acbZp4/SItxhHFYyTr6717yW0QrPHTnj7JHwQdqzZq3
DZb3EoEmUVQK7GH29/Xi8orIlQ2NAgMBAAGjgfgwgfUwDgYDVR0PAQH/BAQDAgGG
MB0GA1UdJQQWMBQGCCsGAQUFBwMCBggrBgEFBQcDATASBgNVHRMBAf8ECDAGAQH/
AgEAMB0GA1UdDgQWBBS7vMNHpeS8qcbDpHIMEI2iNeHI6DAfBgNVHSMEGDAWgBR5
tFnme7bl5AFzgAiIyBpY9umbbjAyBggrBgEFBQcBAQQmMCQwIgYIKwYBBQUHMAKG
Fmh0dHA6Ly94MS5pLmxlbmNyLm9yZy8wEwYDVR0gBAwwCjAIBgZngQwBAgEwJwYD
VR0fBCAwHjAcoBqgGIYWaHR0cDovL3gxLmMubGVuY3Iub3JnLzANBgkqhkiG9w0B
AQsFAAOCAgEAkrHnQTfreZ2B5s3iJeE6IOmQRJWjgVzPw139vaBw1bGWKCIL0vIo
zwzn1OZDjCQiHcFCktEJr59L9MhwTyAWsVrdAfYf+B9haxQnsHKNY67u4s5Lzzfd
u6PUzeetUK29v+PsPmI2cJkxp+iN3epi4hKu9ZzUPSwMqtCceb7qPVxEbpYxY1p9
1n5PJKBLBX9eb9LU6l8zSxPWV7bK3lG4XaMJgnT9x3ies7msFtpKK5bDtotij/l0
GaKeA97pb5uwD9KgWvaFXMIEt8jVTjLEvwRdvCn294GPDF08U8lAkIv7tghluaQh
1QnlE4SEN4LOECj8dsIGJXpGUk3aU3KkJz9icKy+aUgA+2cP21uh6NcDIS3XyfaZ
QjmDQ993ChII8SXWupQZVBiIpcWO4RqZk3lr7Bz5MUCwzDIA359e57SSq5CCkY0N
4B6Vulk7LktfwrdGNVI5BsC9qqxSwSKgRJeZ9wygIaehbHFHFhcBaMDKpiZlBHyz
rsnnlFXCb5s8HKn5LsUgGvB24L7sGNZP2CX7dhHov+YhD+jozLW2p9W4959Bz2Ei
RmqDtmiXLnzqTpXbI+suyCsohKRg6Un0RC47+cpiVwHiXZAW+cn8eiNIjqbVgXLx
KPpdzvvtTnOPlC7SQZSYmdunr3Bf9b77AiC/ZidstK36dRILKz7OA54=
-----END CERTIFICATE-----
```


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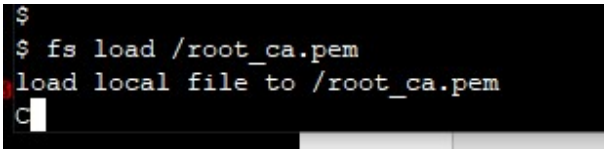
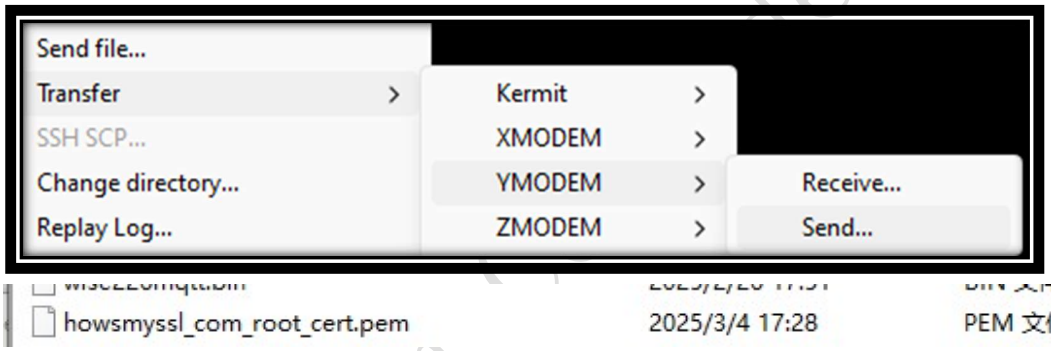
3.5.2 上传根 CA 证书文件

在此演示中，使用 fs load 命令上传证书文件。请按照以下步骤将文件上传到 WISE 进行演示：

使用 fs load 命令，并指定要保存上传文件的文件名。



从 YMODEM 选择您要上传的文件。



使用 fs read 命令并指定文件名，以读取该文件的内容。

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```
$
$ fs read /root_ca.pem
read /root_ca.pem
size: 1801
-----BEGIN CERTIFICATE-----
MIIFBTCCAu2gAwIBAgIQS6hSk/eaL6JzBkuoBIll0DANBgkqhkiG9w0BAQsFADBP
MQswCQYDVQQGEwJVUzEpMCcGA1UEChMgSW50ZXJuZXQgU2VjdXJpdHkgUmVzZWFy
Y2ggR3JvdXAxFTATBgNVBAMTDElTUkcgUm9vdCBYMTAeFw0yNDAzMTMwMDAwMDBa
Fw0yNzAzMTIyMzU5NTlaMDMxCzAJBgNVBAYTAlVTMRYwFAYDVQQKEw1MZXQncyBF
bmNyeXB0MQwwCgYDVQQDEwNSMTAwggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEK
AoIBAQDPV+XmxFQS7bRH/sknWHZGUCiMHT6I3wWdlbUYKb3dtVq/+vbOo76vACFL
YlpaPAEvxVgD9on/jhFD68G14BQHlo9vH9fnuoE5CXVlt8KvGFs3Jijno/QHK20a
/6tYvJWuQP/py1fEtVt/eA0YYbwX51TGu0mRzW4Y0YCF7qZlNrx06rxQTOr8IfM4
FpOUurDTazgGzRYSespSdcitdrLCnF2YRVxvYXvGLe48ElKGAdlX5jgc342lH5KR
mudKHMxFqHJV8LDmowfs/acbZp4/SItxhHFYyTr6717yW0QrPHTnj7JHwQdqzZq3
DZb3EoEmUVQK7GH29/Xi8orIlQ2NAgMBAAGjgfgwgfUwDgYDVR0PAQH/BAQDAgGG
MB0GA1UdJQQWMBQGCCsGAQUFBwMCBggrBgEFBQcDATASBgNVHRMBAf8ECDAGAQH/
AgEAMB0GA1UdDgQWBBS7vMNHpeS8qcbDpHIMEI2iNeHI6DAfBgNVHSMEGDAWgBR5
tFnme7bl5AFzgAiIyBpY9umbbjAyBggrBgEFBQcBAQQmMCQwIgYIKwYBBQUHMAKG
Fmh0dHA6Ly94MS5pLmxlbmNyLm9yZy8wEwYDVR0gBAwwCjAIBgZngQwBAgEwJwYD
VR0fBCAwHjAcoBqgGIYWaHR0cDovL3gxLmMubGVuY3Iub3JnLzANBgkqhkiG9w0B
AQsFAAOCAgEAkrHnQTfreZ2B5s3iJeE6IOmQRJWjgVzPwl39vaBwlbGWKCIL0vIo
zwznlOZDjCQiHcFCktEJr59L9MhwTyAWsVrdAfYf+B9haxQnsHKNY67u4s5Lzzfd
u6PUzeetUK29v+PsPmI2cJkxp+iN3epi4hKu9ZzUPSwMqtCceb7qPVxEbpYxYlp9
ln5PJKBLBX9eb9LU6l8zSxPWV7bK3lG4XaMJgnT9x3ies7msFtpKK5bDtotij/l0
GaKeA97pb5uwD9KgWvaFXMIEt8jVTjLEvwRdvCn294GPDF08U8lAkIv7tghluaQh
lQnlE4SEN4LOECj8dsIGJXpGUk3aU3KkJz9icKy+aUgA+2cP2luh6NcDIS3XyfaZ
QjmDQ993ChII8SXWupQZVBiIpcWO4RqZk3lr7Bz5MUCwzDIA359e57SSq5CCkY0N
4B6Vulk7LktfwrdGNVI5BsC9qqxSwSKgRJeZ9wygIaehbHFHFhcBaMDKpiZlBHyz
rsnnlFXCb5s8HKn5LsUgGvB24L7sGNZP2CX7dhHov+YhD+jozLW2p9W4959Bz2Ei
RmqDtmiXLnzqTpXbI+suyCsohKRg6Un0RC47+cpiVwHiXZAW+cn8eiNIjqbVgXLx
KPpdzvvtTnOPlC7SQZSYmdunr3Bf9b77AiC/ZidstK36dRILKz7OA54=
-----END CERTIFICATE-----
```

3.5.3 HTTPS 时间同步

为了进行 HTTPS 身份验证，设备时间必须同步。SCM1612 SDK 支持使用 STNP 进行时间同步。

- 如果时间未同步

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```
$ httpc secure url
$ I (6556543) HTTP_CLIENT: HTTP client Start
E (6557199) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x2700
I (6557200) esp-tls-mbedtls: Failed to verify peer certificate!
E (6557201) esp-tls: Failed to open new connection
E (6557201) transport_base: Failed to open a new connection
E (6557204) HTTP_CLIENT: Connection failed, sock < 0
E (6557208) HTTP_CLIENT: Error perform http request 0x    7002
E (6557214) HTTP_CLIENT: Last esp error code : 0x801a
E (6557219) HTTP_CLIENT: Last mbedtls failure: 0x2700
I (6557226) HTTP_CLIENT: HTTP client done
```

- 时间同步完成

```
$ sntp setserver pool.ntp.org
host name [pool.ntp.org]
$ sntp init
$ sntp time
UTC Time : 2024-09-23 01:33:50
$
```

- 时间同步后，进行 HTTPS 请求

  httpc secure url /root_ca.pem

```
$ httpc secure url /root_ca.pem
$ I (5023019) HTTP_CLIENT: HTTP client Start
I (5024824) HTTP_CLIENT: HTTPS Status = 200, content_length = 0x20f1
I (5024825) HTTP_CLIENT: HTTP client done
```

  httpc secure hostname /root_ca.pem

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