MQTT Client プロバイダ

(Publisher)

Version 1.3.1

ユーザーズ ガイド

August 30 2021

【備考】

【改版履歴】

バージョン	日付	内容
1.0.0	2016-12-15	初版.
1.1.0	2017-07-19	Publish するメッセージのデータ型を文字列(VT_BSTR)と BYTE 配列(VT_UI1 | VT_ARRAY)から選択するように変更.
1.2.0	2018-05-29	Mosquitto ライブラリの初期化・終了部分に排他制御追加. SSL 通信対応.
1.2.1	2018-07-31	AddController バグ修正.
1.2.2	2019-07-24	トピックとメッセージのコードページ対応
1.3.0	2020-05-21	セキュア通信時のクライアント認証を任意に変更.
1.3.0	2020-08-31	エラーコード 0x8010000F の原因&対処方法を追記
1.3.1	2021-08-30	内部コード最適化.
	2021-11-09	誤字修正.

【対応機器】

機種	バージョン	注意事項

目次

1. はじめに

本書は，MQTT Broker に対し MQTT Client として Publish を行う CAO プロバイダのユーザーズガイドです.

本書で扱う CAO プロバイダ(CaoProvMQTT_PUBLISHER.dll)を PUBLISHER プロバイダと呼びます.

第 2 章に PUBLISHER プロバイダの概要，変数の詳細を記載しています.

PUBLISHER プロバイダでは，通信に使用する MQTT プロトコルを利用するためにオープンソースの Mosquitto ライブラリを使用しています.

MQTT プロトコルや Mosquitto ライブラリの詳細に関しては，それぞれ以下のサイトを参照してください.

MQTTClient の SUBSCRIBER としての動作は，本プロバイダとは別に SUBSCRIBER プロバイダ（CaoProvMQTT_SUBSCRIBER.dll）として実装されています.

SUBSCRIBER プロバイダの詳細については，SUBSCRIBER プロバイダのユーザーズガイドを参照してください.

このプロバイダを使用するためには，「Visual Studio 2015 の Visual C++ 再頒布可能パッケージ」が必要です.

[関連サイトリンク]

http://mqtt.org/

http://mosquitto.org/

2. プロバイダの概要

2.1. 概要

PUBLISHER プロバイダは, Mosquitto ライブラリを用いて MQTT Broker に対し Publish を行う CAO プロバイダです. そのファイル形式は DLL(Dynamic Link Library)であり, CAO エンジンから使用時に動的にロードされます. PUBLISHER プロバイダを使用するにあたっては ORiN2SDK をインストールするか, 下表を参照して手作業でレジストリ登録を行う必要があります.

表 2-1 PUBLISHER プロバイダ

ファイル名	CaoProvMQTT_PUBLISHER.dll
ProgID	CaoProv.MQTT_PUBLISHER
レジストリ登録	regsvr32 CaoProvMQTT_PUBLISHER.dll
レジストリ登録の抹消	regsvr32 /u CaoProvMQTT_PUBLISHER.dll

2.2. メソッド・プロパティ

2.2.1. CaoWorkspace::AddController メソッド

PUBLISHER プロバイダは AddController 時に通信用の接続パラメータを参照し，MQTT Broker との接続を行います．(MQTT Client として動作します)

書式　AddController(<bstrCtrlName:BSTR>,<bstrProvName:BSTR>,
<bstrPCName:BSTR>,<bstrOption:BSTR>))

bstrCtrlName : [in] コントローラ名
bstrProvName : [in] プロバイダ名．固定値 = ” CaoProv.MQTT_PUBLISHER”
bstrPcName : [in] プロバイダの実行マシン名
bstrOption : [in] オプション文字列

以下にオプション文字列に指定するリストを示します．

表 2-2 CaoWorkspace::AddController のオプション文字列

オプション [1]	説明
Conn=<host>[:<port>[:<keepalive>]]]	必須．接続パラメータ． (参照：2.2.1.1)
ID[=<ID 文字列>]	クライアントの ID 文字列． (省略時は GUID を元にユニークな ID を生成)
User[=<ユーザ名>[:<パスワード>]]	ユーザ/パスワード認証設定． (省略時は指定なし)
MqttProtocol[=<version>]	通信に用いる MQTT プロトコルバージョン． (参照：2.2.1.2)
Will[=<topic>:<payload>[:<qos>[:<retain>]]]	Will 設定． (参照：2.2.1.3)
ConnTimeout[=<タイムアウト時間>]	接続時のタイムアウト時間．(ミリ秒) （デフォルト：500）
Timeout[=<タイムアウト時間>]	要求送信時のタイムアウト時間．(ミリ秒) （デフォルト：500）
CA[=<証明書機関（CA）証明書ファイル名>][2]	証明機関（CA）の証明書ファイル名を指定します．（デフォルト：空文字）
Certificate[=<証明書ファイル名>][2]	証明書ファイル名を指定します．（デフォルト：空

[1] 角括弧(“[ ]”)内は省略可能を示します．また，各パラメータの解説中の下線部はオプションを指定しなかったときのデフォルト値になります．
[2] セキュア通信は CA オプションを指定した場合に行います．クライアント認証も行う場合は Certificate，PrivateKey，PKPassword を指定してください．

	文字)
PrivateKey[=<秘密鍵ファイル名>][2]	秘密鍵ファイル名を指定します.(デフォルト:空文字)
PKPassword[=<秘密鍵パスワード>][2]	秘密鍵のパスワードを指定します.(デフォルト:空文字)
Insecure[=<True/False>]	セキュア通信時にサーバの証明書とサーバの整合性チェックの省略設定を指定します. True:チェックを省略する. False:チェックを省略しない(デフォルト)

2.2.1.1. Conn オプション

以下に Conn オプションのパラメータ文字列を示します.

"Conn=<host>[:<port>[:<keepalive>]]]"

<host>	:	接続先ホスト名又は IP アドレス. 例:"localhost", "192.168.0.1"
<port>	:	接続ポート番号. 1883, 8883, …任意指定可能.(デフォルト:1883)
<keepalive>	:	MQTT Broker に設定するキープアライブ値. (秒) (デフォルト:60)

2.2.1.2. MqttProtocol オプション

以下に MqttProtocol オプションのパラメータ文字列を示します.

"MqttProtocol[=<version>]"

<version>	:	通信に用いる MQTT プロトコルバージョン. V3.1 と V3.1.1 が選択可能. v31, v311.(デフォルト:v311)

2.2.1.3. Will オプション

以下に Will オプションのパラメータ文字列を示します.

Will[=<topic>:<payload>[:<qos>[:<retain>]]]

<topic>	:	トピック.
<payload>	:	Will 本文.
<qos>	:	QoS. 0, 1, 2.(デフォルト:0)
<retain>	:	Retain. True, False.(デフォルト:False)

2.2.2. CaoController::AddVariable メソッド

CaoController クラスの AddVariable メソッドは，それぞれのプロバイダで Publish を行うための変数オブジェクトを作成するためのメソッドです．

Publish を実行する際には変数名をトピックとして使用します．(参照：2.2.2.1)

書式　AddVariable(<bstrVariableName:VT_BSTR>[,<bstrOption:VT_BSTR>])

<bstrVariableName>　：　[in] 変数名

<bstrOption>　：　[in] オプション文字列

以下にオプション文字列に指定するリストを示します．

表 2-3 CaoController::AddVariable のオプション文字列

オプション [3]	説明
QoS[=<0/1/2>]	Publish する際の QoS． 0, 1, 2
Retain[=<True/False>]	Publish する際の Retain． True, False
Type[=<0/1>]	Publish するメッセージのデータ型． 0 (VT_BSTR) ，1 (VT_UI1 | VT_ARRAY)
CodePage[=<コードページ>]	Publish するメッセージのコードページ. 0～（参照：2.2.2.2）

[3] 角括弧(“[ ]”)内は省略可能を示します．また，各パラメータの解説中の下線部はオプションを指定しなかったときのデフォルト値になります．

2.2.2.1. 変数名によるトピック指定

PUBLISHER プロバイダは変数名をトピックとして使用します.

トピックは“/”(スラッシュ)を区切りとした階層形式で, “#”(シャープ)や“+”(プラス)を用いたワイルドカード指定を行うことができます. (組み合わせて使用することもできます)

/ : 区切りの階層構造

: その階層以下の全てのトピック

+ : その階層はワイルドカードとして扱う

例） Office/# … “Office”以下の階層のトピック全てが該当

マッチする : Office/Tokyo

マッチする : Office/Osaka

マッチする : Office/Nagoya/4F

マッチしない : House/Tokyo/1F

例） Office/+/3F … 1 階層目と 3 階層目が一致していれば 2 階層目は問わない

マッチする : Office/Tokyo/3F

マッチする : Office/Osaka/3F

マッチしない : Office/Nagoya/4F

マッチしない : Office/Tokyo/1F

2.2.2.2. コードページ指定

コードページまたは定数を指定します.

2.2.2.2.1. コードページ

例)

932	:	日本語(シフト JIS)
1200	:	Unicode
65001	:	Unicode(UTF-8)

2.2.2.2.2. 定数

0	:	システムデフォルトの Windows ANSI コードページ
1	:	現在のシステムの OEM コードページ
2	:	現在のシステムの Macintosh コードページ
3	:	現在のスレッドの Windows ANSI コードページ
42	:	シンボルコードページ

2.2.3. CaoVariable:put_Value プロパティ

変数名をトピック, Value として指定された文字列(VT_BSTR), または BYTE 配列(VT_UI1 | VT_ARRAY) を Payload として Publish を実行します.

2.2.4. CaoVariable:get_Value プロパティ

最後に Publish を実行した値(VT_BSTR, または(VT_UI1 | VT_ARRAY))を返します.

2.2.5. CaoController::OnMessage イベント

以下の契機で CaoController クラスの OnMessage イベントが発生します.

表 2-4 メッセージ種別

メッセージ種別		発生契機
1	断線検出	何らかの要因により MQTT Broker から切断された際に発生します.

2.2.5.1. 断線検出

断線検出メッセージで得られるデータ形式を以下に示します.

Number : メッセージ種別 (1)

Value : 切断要因のレスポンスコード (VT_I4)

DateTime : タイムスタンプ

Destination : Null

Source : 接続先ホスト名又は IP アドレス

Description : レスポンスコードの説明文字列

2.3. 変数一覧

2.3.1. CaoController クラス

表 2-5 CaoController クラス ユーザ変数一覧

変数名	データ型	説明	属性	
			get	put
任意 (トピックとして使用)	VT_BSTR	put_Value で Publish を実行.	○	○

表 2-6 CaoController クラス システム変数一覧

変数名	データ型	説明	属性	
			get	put
@VERSION	VT_BSTR	プロバイダバージョン情報.	○	－
@MQTT_LIB_VERSION	VT_BSTR	Mosquitto ライブラリ バージョン情報	○	－

2.4. エラーコード

PUBLISHER プロバイダでは，以下の固有エラーコードが定義されています．

ORiN2 共通エラーについては，「ORiN2 プログラミングガイド」のエラーコードの章を参照してください．

表 2-7 固有エラーコード

エラー名	エラー番号	説明
E_MOSQ_CONN_PENDING	0x80100001	Mosquitto ライブラリのエラーコード MOSQ_ERR_CONN_PENDING が発生
E_MOSQ_NOMEM	0x80100002	Mosquitto ライブラリのエラーコード MOSQ_ERR_NOMEM が発生
E_MOSQ_PROTOCOL	0x80100003	Mosquitto ライブラリのエラーコード MOSQ_ERR_PROTOCOL が発生
E_MOSQ_INVAL	0x80100004	Mosquitto ライブラリのエラーコード MOSQ_ERR_INVAL が発生
E_MOSQ_NO_CONN	0x80100005	Mosquitto ライブラリのエラーコード MOSQ_ERR_NO_CONN が発生
E_MOSQ_CONN_REFUSED	0x80100006	Mosquitto ライブラリのエラーコード MOSQ_ERR_CONN_REFUSED が発生
E_MOSQ_NOT_FOUND	0x80100007	Mosquitto ライブラリのエラーコード MOSQ_ERR_NOT_FOUND が発生
E_MOSQ_CONN_LOST	0x80100008	Mosquitto ライブラリのエラーコード MOSQ_ERR_CONN_LOST が発生
E_MOSQ_TLS	0x80100009	Mosquitto ライブラリのエラーコード MOSQ_ERR_TLS が発生
E_MOSQ_PAYLOAD_SIZE	0x8010000A	Mosquitto ライブラリのエラーコード MOSQ_ERR_PAYLOAD_SIZE が発生
E_MOSQ_NOT_SUPPORTED	0x8010000B	Mosquitto ライブラリのエラーコード MOSQ_ERR_NOT_SUPPORTED が発生
E_MOSQ_AUTH	0x8010000C	Mosquitto ライブラリのエラーコード MOSQ_ERR_AUTH が発生
E_MOSQ_ACL_DENIED	0x8010000D	Mosquitto ライブラリのエラーコード MOSQ_ERR_ACL_DENIED が発生
E_MOSQ_UNKNOWN	0x8010000E	Mosquitto ライブラリのエラーコード MOSQ_ERR_UNKNOWN が発生

E_MOSQ_ERRNO	0x8010000F	Mosquitto ライブラリのエラーコード MOSQ_ERR_ERRNO が発生 接続先の MQTT Broker が起動していない可能性があります. MQTT Broker を起動してから再接続してください.
E_MOSQ_EAI	0x80100010	Mosquitto ライブラリのエラーコード MOSQ_ERR_EAI が発生
E_MOSQ_PROXY	0x80100011	Mosquitto ライブラリのエラーコード MOSQ_ERR_PROXY が発生

付録A. MQTT 用語集

以下に MQTT プロトコルを扱う上で登場する用語を記載します.

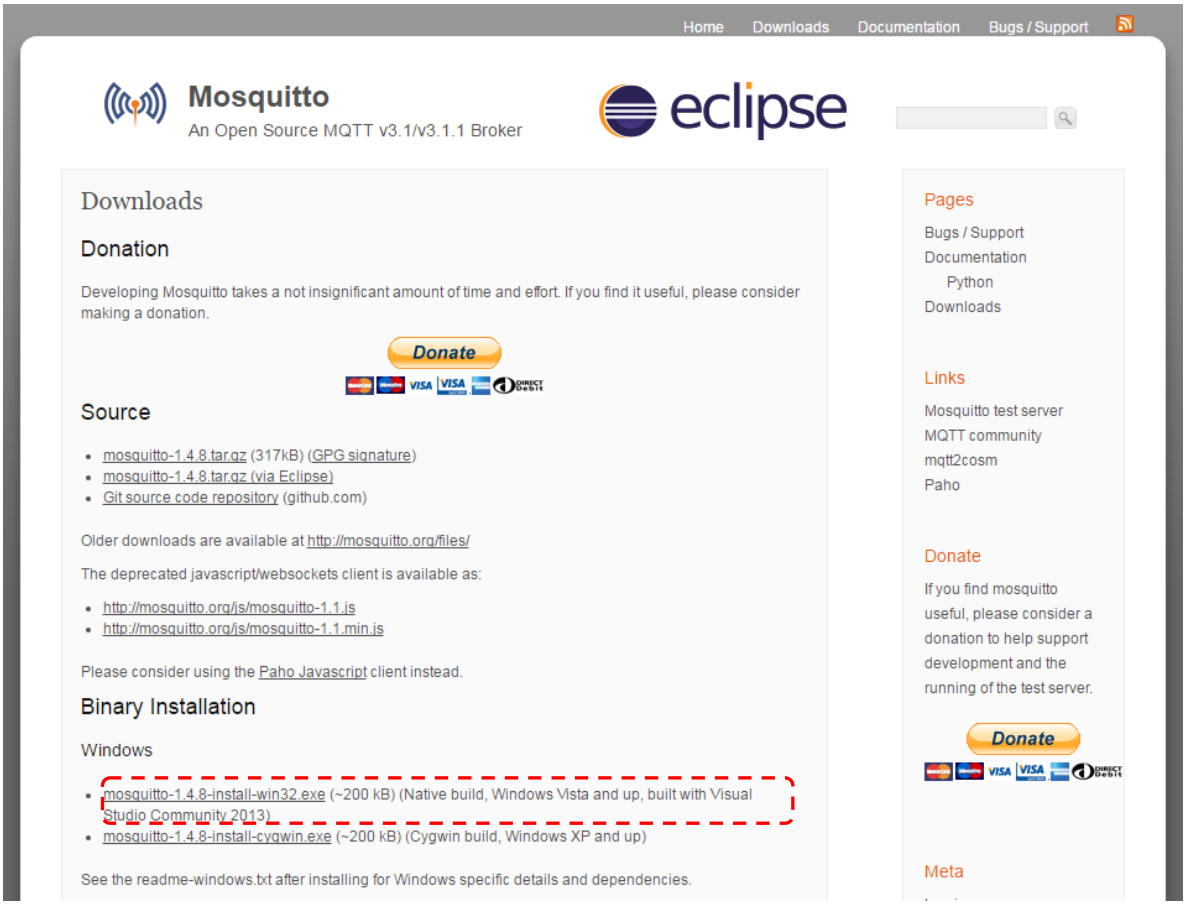
- **Broker(ブローカ)**
  MQTT プロトコル通信におけるサーバ.
  Publisher から送信されたトピックのメッセージを該当トピックの購読をしている Subscriber に配信する.
- **Subscriber(サブスクライバ)**
  MQTT プロトコル通信におけるクライアント(メッセージ受信側).
  購読したいトピックを Broker に登録(Subscribe)し, メッセージを受信する.
- **Publisher(パブリッシャ)**
  MQTT プロトコル通信におけるクライアント(メッセージ送信側).
  Subscriber を意識することなく, トピックを指定して Broker へメッセージを送信(Publish)する.
- **QoS**
  メッセージ毎の到達保障.
  QoS0 ： At most once (最高 1 回配信)
  QoS1 ： At least once (最低 1 回配信)
  QoS2 ： Exactly once (正確に 1 回配信)
- **Will**
  Will は「遺言」を意味し, Client が Broker へ接続する際に設定できる.
  Broker と Client の接続が切断された際に Will で指定されたトピックとメッセージを Broker に接続している Subscriber に送信する.
- **Retain**
  トピック毎に最後に Publish されたメッセージを Broker が保持しておき, 新たに接続してきた Subscriber へそのメッセージを送信する機能.

付録B. MQTT Broker 導入例

MQTT Broker の導入方法をオープンソースの Mosquitto を例に紹介します.

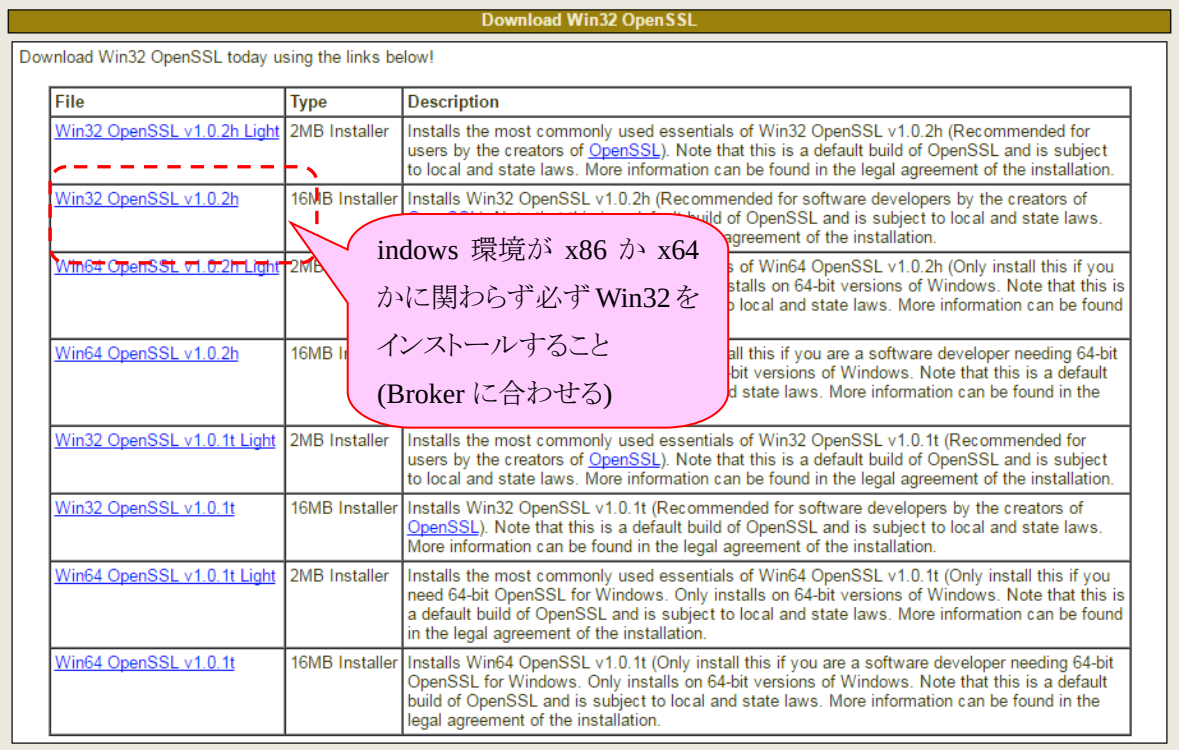
【Windows 編】

1. http://mosquitto.org/download/ からインストーラをダウンロード.



2. ダウンロードしたインストーラを実行しインストール開始
3. OpenSSL(libeay32.dll, ssleay32.dll)と pthreads(pthreadVC2.dll)を手動でインストールする必要がある旨が表示されるが, 現段階では無視して進める. (詳細は後述)
4. コンポーネントはデフォルトのままで進める.
5. インストール先はデフォルトの[C:¥Program Files (x86)¥mosquitto]から[C:¥mosquitto]等へ変更する. (パスにスペースを含んでいると設定等を変更する際に分かりにくいため)
6. インストールを完了させる.

7. http://slproweb.com/products/Win32OpenSSL.html からコンパイル済の OpenSSL の Win32 インストーラ(最新の版を推奨)をダウンロードしインストールする. (全てデフォルトで OK)



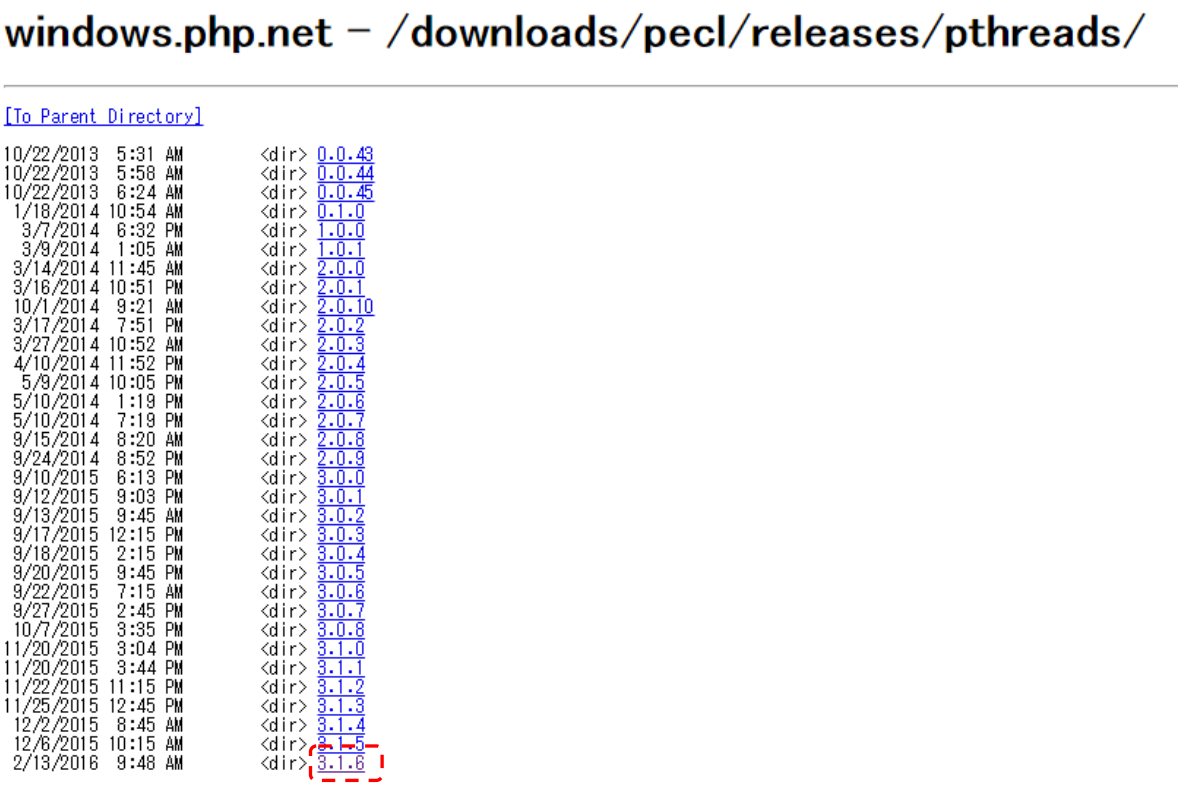
Download Win32 OpenSSL

Download Win32 OpenSSL today using the links below!

File	Type	Description
Win32 OpenSSL v1.0.2h Light	2MB Installer	Installs the most commonly used essentials of Win32 OpenSSL v1.0.2h (Recommended for users by the creators of OpenSSL). Note that this is a default build of OpenSSL and is subject to local and state laws. More information can be found in the legal agreement of the installation.
Win32 OpenSSL v1.0.2h	16MB Installer	Installs Win32 OpenSSL v1.0.2h (Recommended for software developers by the creators of OpenSSL). Note that this is a default build of OpenSSL and is subject to local and state laws. More information can be found in the legal agreement of the installation.
Win64 OpenSSL v1.0.2h Light	2MB	s of Win64 OpenSSL v1.0.2h (Only install this if you stalls on 64-bit versions of Windows. Note that this is o local and state laws. More information can be found
Win64 OpenSSL v1.0.2h	16MB I	all this if you are a software developer needing 64-bit -bit versions of Windows. Note that this is a default d state laws. More information can be found in the
Win32 OpenSSL v1.0.1t Light	2MB Installer	Installs the most commonly used essentials of Win32 OpenSSL v1.0.1t (Recommended for users by the creators of OpenSSL). Note that this is a default build of OpenSSL and is subject to local and state laws. More information can be found in the legal agreement of the installation.
Win32 OpenSSL v1.0.1t	16MB Installer	Installs Win32 OpenSSL v1.0.1t (Recommended for software developers by the creators of OpenSSL). Note that this is a default build of OpenSSL and is subject to local and state laws. More information can be found in the legal agreement of the installation.
Win64 OpenSSL v1.0.1t Light	2MB Installer	Installs the most commonly used essentials of Win64 OpenSSL v1.0.1t (Only install this if you need 64-bit OpenSSL for Windows. Only installs on 64-bit versions of Windows. Note that this is a default build of OpenSSL and is subject to local and state laws. More information can be found in the legal agreement of the installation.
Win64 OpenSSL v1.0.1t	16MB Installer	Installs Win64 OpenSSL v1.0.1t (Only install this if you are a software developer needing 64-bit OpenSSL for Windows. Only installs on 64-bit versions of Windows. Note that this is a default build of OpenSSL and is subject to local and state laws. More information can be found in the legal agreement of the installation.

indows 環境が x86 か x64 かに関わらず必ず Win32 をインストールすること (Broker に合わせる)

8. http://windows.php.net/downloads/pecl/releases/pthreads/ から pthreads の圧縮ファイル(最新の版を推奨)をダウンロードし，任意の場所へ展開する.



9. OpenSSL と pthreads の場所にパスを通す.
10. PC を再起動する.

上記の手順で Mosquitto Broker を使用することができるようになります. Mosquitto Broker はデフォルトで PC 起動時にサービスとして起動しています. コマンドラインからオプションを指定して起動したり，設定を変更させた conf ファイルを読み込ませたりしたい場合は起動中のサービスを終了させる必要があります.

【Linux(Ubuntu)編】

1. Terminal を起動し，以下のコマンドを実行します．
2. パッケージリストの更新．

```
$ sudo apt-get update
```

3. Broker の導入．

```
$ sudo apt-get install mosquitto
```

4. Client の導入．

```
$ sudo apt-get install mosquitto-clients
```

OpenSSL 等依存のあるパッケージがインストールされていない場合は別途入れる必要があります．

パッケージリストに mosquitto が出てこない場合は以下のコマンドでリポジトリを追加してください．

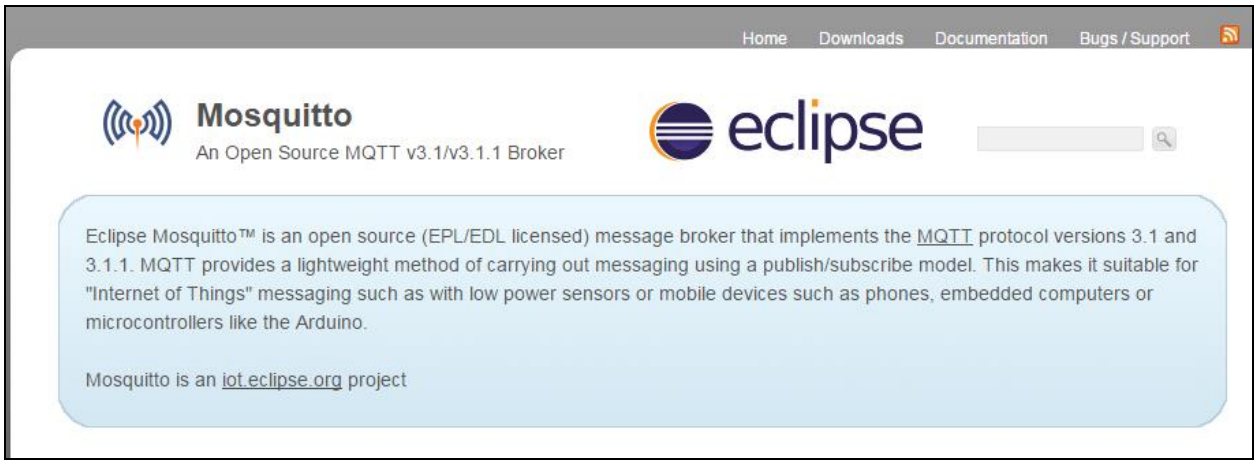
```
$ sudo add-apt-repository ppa:mosquitto-dev/mosquitto-ppa
```

Mosquitto のパッケージ導入後，Broker はサービスとして起動している状態になります．

Windows 環境と同様にオプションを指定して起動したり，設定を変更させた conf ファイルを読み込ませたりしたい場合は起動中のサービスを終了させる必要があります．

付録C. Mosquitto

URL: https://mosquitto.org/



EPL

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付録D. Pthread_win32

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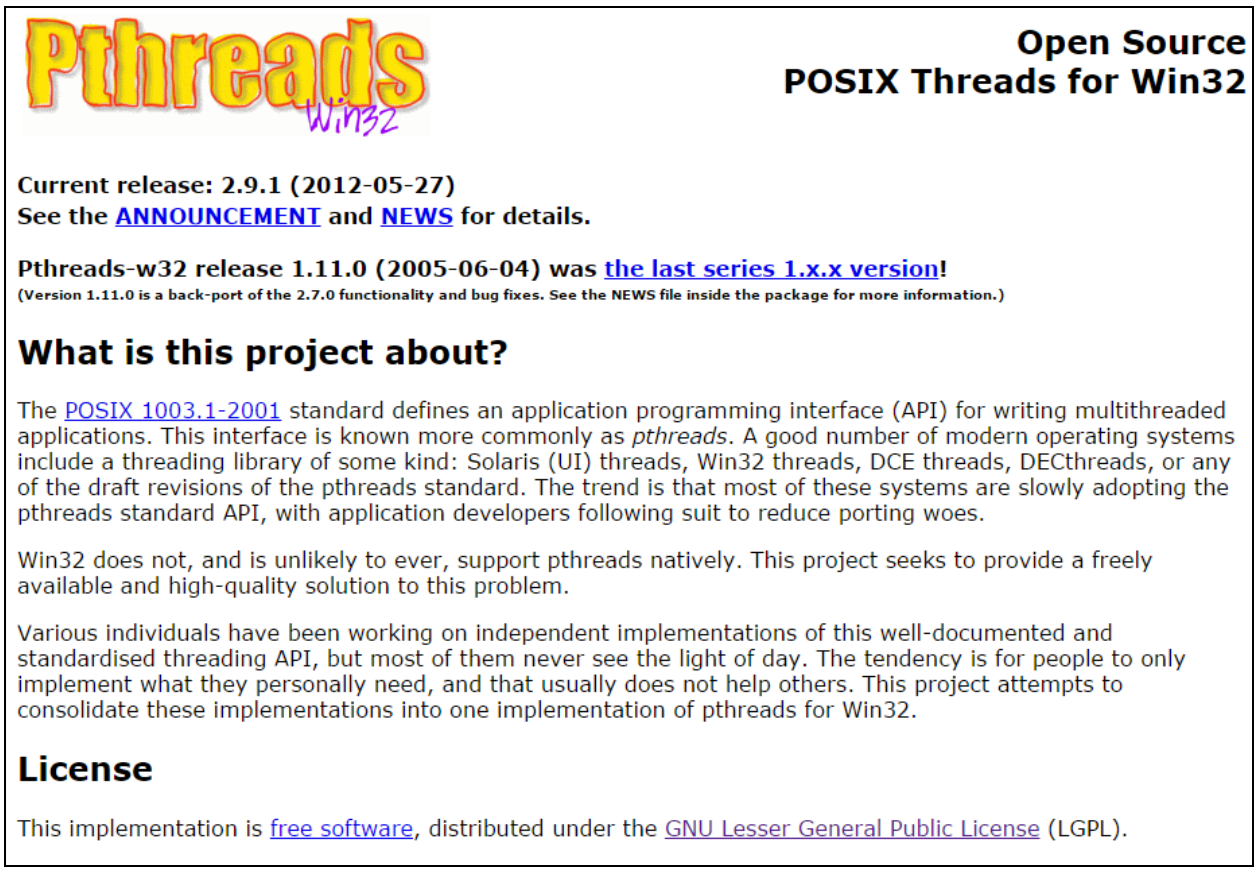

Pthreads Win32

Open Source POSIX Threads for Win32

Current release: 2.9.1 (2012-05-27)
See the ANNOUNCEMENT and NEWS for details.

Pthreads-w32 release 1.11.0 (2005-06-04) was the last series 1.x.x version!
(Version 1.11.0 is a back-port of the 2.7.0 functionality and bug fixes. See the NEWS file inside the package for more information.)

What is this project about?

The POSIX 1003.1-2001 standard defines an application programming interface (API) for writing multithreaded applications. This interface is known more commonly as *pthreads*. A good number of modern operating systems include a threading library of some kind: Solaris (UI) threads, Win32 threads, DCE threads, DECthreads, or any of the draft revisions of the pthreads standard. The trend is that most of these systems are slowly adopting the pthreads standard API, with application developers following suit to reduce porting woes.

Win32 does not, and is unlikely to ever, support pthreads natively. This project seeks to provide a freely available and high-quality solution to this problem.

Various individuals have been working on independent implementations of this well-documented and standardised threading API, but most of them never see the light of day. The tendency is for people to only implement what they personally need, and that usually does not help others. This project attempts to consolidate these implementations into one implementation of pthreads for Win32.

License

This implementation is free software, distributed under the GNU Lesser General Public License (LGPL).

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        pthreads-win32 - a POSIX threads library for Microsoft Windows


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```
      Email:  Ross Johnson
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Why pthreads-win32 did not use the GNU General Public License
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   The goal of the pthreads-win32 project has been to
   provide a quality and complete implementation of the POSIX
   threads API for Microsoft Windows within the limits imposed
   by virtue of it being a stand-alone library and not
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linked directly to other POSIX compliant libraries. For example, some functions and features, such as those based on POSIX signals, are missing.

Pthreads-win32 is a library, available in several different versions depending on supported compilers, and may be used as a dynamically linked module or a statically linked set of binary modules. It is not an application on it's own.

It was fully intended that pthreads-win32 be usable with commercial software not covered by either the GPL or the LGPL licenses. Pthreads-win32 has many contributors to it's code base, many of whom have done so because they have used the library in commercial or proprietry software projects.

Releasing pthreads-win32 under the LGPL ensures that the library can be used widely, while at the same time ensures that bug fixes and improvements to the pthreads-win32 code itself is returned to benefit all current and future users of the library.

Although pthreads-win32 makes it possible for applications that use POSIX threads to be ported to Win32 platforms, the broader goal of the project is to encourage the use of open standards, and in particular, to make it just a little easier for developers writing Win32 applications to consider widening the potential market for their products.