

**NAME**

SSL\_CTX\_set\_alpn\_protos, SSL\_set\_alpn\_protos, SSL\_CTX\_set\_alpn\_select\_cb, SSL\_CTX\_set\_next\_proto\_select\_cb, SSL\_CTX\_set\_next\_protos\_advertised\_cb, SSL\_select\_next\_proto, SSL\_get0\_alpn\_selected, SSL\_get0\_next\_proto\_negotiated - handle application layer protocol negotiation (ALPN)

**SYNOPSIS**

```
#include <openssl/ssl.h>
```

```
int SSL_CTX_set_alpn_protos(SSL_CTX *ctx, const unsigned char *protos,
                           unsigned int protos_len);
```

```
int SSL_set_alpn_protos(SSL *ssl, const unsigned char *protos,
                       unsigned int protos_len);
```

```
void SSL_CTX_set_alpn_select_cb(SSL_CTX *ctx,
                                int (*cb) (SSL *ssl,
                                             const unsigned char **out,
                                             unsigned char *outlen,
                                             const unsigned char *in,
                                             unsigned int inlen,
                                             void *arg), void *arg);
```

```
void SSL_get0_alpn_selected(const SSL *ssl, const unsigned char **data,
                           unsigned int *len);
```

```
void SSL_CTX_set_next_protos_advertised_cb(SSL_CTX *ctx,
                                             int (*cb)(SSL *ssl,
                                                       const unsigned char **out,
                                                       unsigned int *outlen,
                                                       void *arg),
                                             void *arg);
```

```
void SSL_CTX_set_next_proto_select_cb(SSL_CTX *ctx,
                                       int (*cb)(SSL *s,
                                                 unsigned char **out,
                                                 unsigned char *outlen,
                                                 const unsigned char *in,
                                                 unsigned int inlen,
                                                 void *arg),
                                       void *arg);
```

```
int SSL_select_next_proto(unsigned char **out, unsigned char *outlen,
                         const unsigned char *server,
                         unsigned int server_len,
```

```

    const unsigned char *client,
        unsigned int client_len);
void SSL_get0_next_proto_negotiated(const SSL *s, const unsigned char **data,
    unsigned *len);

```

## DESCRIPTION

**SSL\_CTX\_set\_alpn\_protos()** and **SSL\_set\_alpn\_protos()** are used by the client to set the list of protocols available to be negotiated. The **protos** must be in protocol-list format, described below. The length of **protos** is specified in **protos\_len**.

**SSL\_CTX\_set\_alpn\_select\_cb()** sets the application callback **cb** used by a server to select which protocol to use for the incoming connection. When **cb** is NULL, ALPN is not used. The **arg** value is a pointer which is passed to the application callback.

**cb** is the application defined callback. The **in**, **inlen** parameters are a vector in protocol-list format. The value of the **out**, **outlen** vector should be set to the value of a single protocol selected from the **in**, **inlen** vector. The **out** buffer may point directly into **in**, or to a buffer that outlives the handshake. The **arg** parameter is the pointer set via **SSL\_CTX\_set\_alpn\_select\_cb()**.

**SSL\_select\_next\_proto()** is a helper function used to select protocols. It implements the standard protocol selection. It is expected that this function is called from the application callback **cb**. The protocol data in **server**, **server\_len** and **client**, **client\_len** must be in the protocol-list format described below. The first item in the **server**, **server\_len** list that matches an item in the **client**, **client\_len** list is selected, and returned in **out**, **outlen**. The **out** value will point into either **server** or **client**, so it should be copied immediately. If no match is found, the first item in **client**, **client\_len** is returned in **out**, **outlen**. This function can also be used in the NPN callback.

**SSL\_CTX\_set\_next\_proto\_select\_cb()** sets a callback **cb** that is called when a client needs to select a protocol from the server's provided list, and a user-defined pointer argument **arg** which will be passed to this callback. For the callback itself, **out** must be set to point to the selected protocol (which may be within **in**). The length of the protocol name must be written into **outlen**. The server's advertised protocols are provided in **in** and **inlen**. The callback can assume that **in** is syntactically valid. The client must select a protocol. It is fatal to the connection if this callback returns a value other than **SSL\_TLSEXT\_ERR\_OK**. The **arg** parameter is the pointer set via **SSL\_CTX\_set\_next\_proto\_select\_cb()**.

**SSL\_CTX\_set\_next\_protos\_advertised\_cb()** sets a callback **cb** that is called when a TLS server needs a list of supported protocols for Next Protocol Negotiation. The returned list must be in protocol-list format, described below. The list is returned by setting **out** to point to it and **outlen** to its length. This memory will not be modified, but the **SSL** does keep a reference to it. The callback should return

**SSL\_TLSEXT\_ERR\_OK** if it wishes to advertise. Otherwise, no such extension will be included in the ServerHello.

**SSL\_get0\_alpn\_selected()** returns a pointer to the selected protocol in **data** with length **len**. It is not NUL-terminated. **data** is set to NULL and **len** is set to 0 if no protocol has been selected. **data** must not be freed.

**SSL\_get0\_next\_proto\_negotiated()** sets **data** and **len** to point to the client's requested protocol for this connection. If the client did not request any protocol or NPN is not enabled, then **data** is set to NULL and **len** to 0. Note that the client can request any protocol it chooses. The value returned from this function need not be a member of the list of supported protocols provided by the callback.

## NOTES

The protocol-lists must be in wire-format, which is defined as a vector of nonempty, 8-bit length-prefixed, byte strings. The length-prefix byte is not included in the length. Each string is limited to 255 bytes. A byte-string length of 0 is invalid. A truncated byte-string is invalid. The length of the vector is not in the vector itself, but in a separate variable.

Example:

```
unsigned char vector[] = {
    6, 's', 'p', 'd', 'y', '/', '1',
    8, 'h', 't', 't', 'p', '/', '1', '.', '1'
};
unsigned int length = sizeof(vector);
```

The ALPN callback is executed after the servername callback; as that servername callback may update the SSL\_CTX, and subsequently, the ALPN callback.

If there is no ALPN proposed in the ClientHello, the ALPN callback is not invoked.

## RETURN VALUES

**SSL\_CTX\_set\_alpn\_protos()** and **SSL\_set\_alpn\_protos()** return 0 on success, and non-0 on failure. WARNING: these functions reverse the return value convention.

**SSL\_select\_next\_proto()** returns one of the following:

OPENSSL\_NPN\_NEGOTIATED

A match was found and is returned in **out**, **outlen**.

#### OPENSSL\_NPN\_NO\_OVERLAP

No match was found. The first item in **client**, **client\_len** is returned in **out**, **outlen**.

The ALPN select callback **cb**, must return one of the following:

#### SSL\_TLSEXT\_ERR\_OK

ALPN protocol selected.

#### SSL\_TLSEXT\_ERR\_ALERT\_FATAL

There was no overlap between the client's supplied list and the server configuration.

#### SSL\_TLSEXT\_ERR\_NOACK

ALPN protocol not selected, e.g., because no ALPN protocols are configured for this connection.

The callback set using **SSL\_CTX\_set\_next\_proto\_select\_cb()** should return **SSL\_TLSEXT\_ERR\_OK** if successful. Any other value is fatal to the connection.

The callback set using **SSL\_CTX\_set\_next\_protos\_advertised\_cb()** should return **SSL\_TLSEXT\_ERR\_OK** if it wishes to advertise. Otherwise, no such extension will be included in the ServerHello.

#### SEE ALSO

**ssl(7)**, **SSL\_CTX\_set\_tlsext\_servername\_callback(3)**, **SSL\_CTX\_set\_tlsext\_servername\_arg(3)**

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