

**NAME**

EC\_GROUP\_get\_ecparameters, EC\_GROUP\_get\_ecpkparameters, EC\_GROUP\_new\_from\_params, EC\_GROUP\_new\_from\_ecparameters, EC\_GROUP\_new\_from\_ecpkparameters, EC\_GROUP\_new, EC\_GROUP\_free, EC\_GROUP\_clear\_free, EC\_GROUP\_new\_curve\_GFp, EC\_GROUP\_new\_curve\_GF2m, EC\_GROUP\_new\_by\_curve\_name\_ex, EC\_GROUP\_new\_by\_curve\_name, EC\_GROUP\_set\_curve, EC\_GROUP\_get\_curve, EC\_GROUP\_set\_curve\_GFp, EC\_GROUP\_get\_curve\_GFp, EC\_GROUP\_set\_curve\_GF2m, EC\_GROUP\_get\_curve\_GF2m, EC\_get\_builtin\_curves, OSSL\_EC\_curve\_nid2name - Functions for creating and destroying EC\_GROUP objects

**SYNOPSIS**

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

```
EC_GROUP *EC_GROUP_new_from_params(const OSSL_PARAM params[],
                                   OSSL_LIB_CTX *libctx, const char *propq);
EC_GROUP *EC_GROUP_new_from_ecparameters(const ECPARAMETERS *params);
EC_GROUP *EC_GROUP_new_from_ecpkparameters(const ECPKPARAMETERS *params);
void EC_GROUP_free(EC_GROUP *group);

EC_GROUP *EC_GROUP_new_curve_GFp(const BIGNUM *p, const BIGNUM *a,
                                  const BIGNUM *b, BN_CTX *ctx);
EC_GROUP *EC_GROUP_new_curve_GF2m(const BIGNUM *p, const BIGNUM *a,
                                   const BIGNUM *b, BN_CTX *ctx);
EC_GROUP *EC_GROUP_new_by_curve_name_ex(OSSL_LIB_CTX *libctx, const char *propq,
                                        int nid);
EC_GROUP *EC_GROUP_new_by_curve_name(int nid);

int EC_GROUP_set_curve(EC_GROUP *group, const BIGNUM *p, const BIGNUM *a,
                      const BIGNUM *b, BN_CTX *ctx);
int EC_GROUP_get_curve(const EC_GROUP *group, BIGNUM *p, BIGNUM *a, BIGNUM *b,
                      BN_CTX *ctx);

ECPARAMETERS *EC_GROUP_get_ecparameters(const EC_GROUP *group,
                                         ECPARAMETERS *params);
ECPKPARAMETERS *EC_GROUP_get_ecpkparameters(const EC_GROUP *group,
                                             ECPKPARAMETERS *params);

size_t EC_get_builtin_curves(EC_builtin_curve *r, size_t nitems);
const char *OSSL_EC_curve_nid2name(int nid);
```

The following functions have been deprecated since OpenSSL 3.0, and can be hidden entirely by defining **OPENSSL\_API\_COMPAT** with a suitable version value, see **openssl\_user\_macros(7)**:

```
EC_GROUP *EC_GROUP_new(const EC_METHOD *meth);
void EC_GROUP_clear_free(EC_GROUP *group);

int EC_GROUP_set_curve_GFp(EC_GROUP *group, const BIGNUM *p,
                           const BIGNUM *a, const BIGNUM *b, BN_CTX *ctx);
int EC_GROUP_get_curve_GFp(const EC_GROUP *group, BIGNUM *p,
                           BIGNUM *a, BIGNUM *b, BN_CTX *ctx);
int EC_GROUP_set_curve_GF2m(EC_GROUP *group, const BIGNUM *p,
                            const BIGNUM *a, const BIGNUM *b, BN_CTX *ctx);
int EC_GROUP_get_curve_GF2m(const EC_GROUP *group, BIGNUM *p,
                            BIGNUM *a, BIGNUM *b, BN_CTX *ctx);
```

## DESCRIPTION

Within the library there are two forms of elliptic curve that are of interest. The first form is those defined over the prime field  $F_p$ . The elements of  $F_p$  are the integers 0 to  $p-1$ , where  $p$  is a prime number. This gives us a revised elliptic curve equation as follows:

$$y^2 \bmod p = x^3 + ax + b \bmod p$$

The second form is those defined over a binary field  $F_2^m$  where the elements of the field are integers of length at most  $m$  bits. For this form the elliptic curve equation is modified to:

$$y^2 + xy = x^3 + ax^2 + b \text{ (where } b \neq 0 \text{)}$$

Operations in a binary field are performed relative to an **irreducible polynomial**. All such curves with OpenSSL use a trinomial or a pentanomial for this parameter.

Although deprecated since OpenSSL 3.0 and should no longer be used, a new curve can be constructed by calling **EC\_GROUP\_new()**, using the implementation provided by *meth* (see **EC\_GFp\_simple\_method(3)**) and associated with the library context *ctx* (see **OSSL\_LIB\_CTX(3)**). The *ctx* parameter may be NULL in which case the default library context is used. It is then necessary to call **EC\_GROUP\_set\_curve()** to set the curve parameters. Applications should instead use one of the other **EC\_GROUP\_new\_\*** constructors.

**EC\_GROUP\_new\_from\_params()** creates a group with parameters specified by *params*. The library context *libctx* (see **OSSL\_LIB\_CTX(3)**) and property query string *propq* are used to fetch algorithms from providers. *params* may be either a list of explicit params or a named group. The values for *ctx*

and *propq* may be NULL. The *params* that can be used are described in **EVP\_PKEY-EC(7)**.

**EC\_GROUP\_new\_from\_ecparameters()** will create a group from the specified *params* and **EC\_GROUP\_new\_from\_ecpkparameters()** will create a group from the specific PK *params*.

**EC\_GROUP\_set\_curve()** sets the curve parameters *p*, *a* and *b*. For a curve over  $F_p$  *p* is the prime for the field. For a curve over  $F_{2^m}$  *p* represents the irreducible polynomial - each bit represents a term in the polynomial. Therefore, there will either be three or five bits set dependent on whether the polynomial is a trinomial or a pentanomial. In either case, *a* and *b* represents the coefficients *a* and *b* from the relevant equation introduced above.

**EC\_group\_get\_curve()** obtains the previously set curve parameters.

**EC\_GROUP\_set\_curve\_GFp()** and **EC\_GROUP\_set\_curve\_GF2m()** are synonyms for **EC\_GROUP\_set\_curve()**. They are defined for backwards compatibility only and should not be used.

**EC\_GROUP\_get\_curve\_GFp()** and **EC\_GROUP\_get\_curve\_GF2m()** are synonyms for **EC\_GROUP\_get\_curve()**. They are defined for backwards compatibility only and should not be used.

The functions **EC\_GROUP\_new\_curve\_GFp()** and **EC\_GROUP\_new\_curve\_GF2m()** are shortcuts for calling **EC\_GROUP\_new()** and then the **EC\_GROUP\_set\_curve()** function. An appropriate default implementation method will be used.

Whilst the library can be used to create any curve using the functions described above, there are also a number of predefined curves that are available. In order to obtain a list of all of the predefined curves, call the function **EC\_get\_builtin\_curves()**. The parameter *r* should be an array of **EC\_builtin\_curve** structures of size *nitems*. The function will populate the *r* array with information about the built-in curves. If *nitems* is less than the total number of curves available, then the first *nitems* curves will be returned. Otherwise the total number of curves will be provided. The return value is the total number of curves available (whether that number has been populated in *r* or not). Passing a NULL *r*, or setting *nitems* to 0 will do nothing other than return the total number of curves available. The **EC\_builtin\_curve** structure is defined as follows:

```
typedef struct {
    int nid;
    const char *comment;
} EC_builtin_curve;
```

Each **EC\_builtin\_curve** item has a unique integer id (*nid*), and a human readable comment string describing the curve.

In order to construct a built-in curve use the function **EC\_GROUP\_new\_by\_curve\_name\_ex()** and provide the *nid* of the curve to be constructed, the associated library context to be used in *ctx* (see **OSSL\_LIB\_CTX(3)**) and any property query string in *propq*. The *ctx* value may be NULL in which case the default library context is used. The *propq* value may also be NULL.

**EC\_GROUP\_new\_by\_curve\_name()** is the same as **EC\_GROUP\_new\_by\_curve\_name\_ex()** except that the default library context is always used along with a NULL property query string.

**EC\_GROUP\_free()** frees the memory associated with the EC\_GROUP. If *group* is NULL nothing is done.

**EC\_GROUP\_clear\_free()** is deprecated: it was meant to destroy any sensitive data held within the EC\_GROUP and then free its memory, but since all the data stored in the EC\_GROUP is public anyway, this function is unnecessary. Its use can be safely replaced with **EC\_GROUP\_free()**. If *group* is NULL nothing is done.

**OSSL\_EC\_curve\_nid2name()** converts a curve *nid* into the corresponding name.

## RETURN VALUES

All **EC\_GROUP\_new\*** functions return a pointer to the newly constructed group, or NULL on error.

**EC\_get\_builtin\_curves()** returns the number of built-in curves that are available.

**EC\_GROUP\_set\_curve\_GFp()**, **EC\_GROUP\_get\_curve\_GFp()**, **EC\_GROUP\_set\_curve\_GF2m()**, **EC\_GROUP\_get\_curve\_GF2m()** return 1 on success or 0 on error.

**OSSL\_EC\_curve\_nid2name()** returns a character string constant, or NULL on error.

## SEE ALSO

**crypto(7)**, **EC\_GROUP\_copy(3)**, **EC\_POINT\_new(3)**, **EC\_POINT\_add(3)**, **EC\_KEY\_new(3)**, **EC\_GFp\_simple\_method(3)**, **d2i\_ECPKParameters(3)**, **OSSL\_LIB\_CTX(3)**, **EVP\_PKEY-EC(7)**

## HISTORY

⊕ **EC\_GROUP\_new()** was deprecated in OpenSSL 3.0.

**EC\_GROUP\_new\_by\_curve\_name\_ex()** and **EC\_GROUP\_new\_from\_params()** were added in OpenSSL 3.0.

⊕ **EC\_GROUP\_clear\_free()** was deprecated in OpenSSL 3.0; use **EC\_GROUP\_free()** instead.

⊕

EC\_GROUP\_set\_curve\_GFp(), EC\_GROUP\_get\_curve\_GFp(),  
EC\_GROUP\_set\_curve\_GF2m() and EC\_GROUP\_get\_curve\_GF2m() were deprecated in  
OpenSSL 3.0; use EC\_GROUP\_set\_curve() and EC\_GROUP\_get\_curve() instead.

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