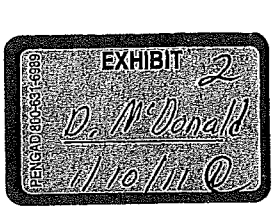
Exhibit 14



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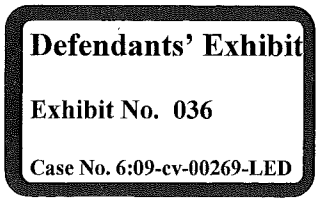

```
/*---------------------------------------------------------------------
 * key.h :     Declarations and Definitions for Key Engine for BSD.
 *
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70  official policies, either expressed or implied, of the US Naval
71  Research Laboratory (NRL).
72
73  ----------------------------------------------------------------------*/
74
75  #ifdef linux
76  #include <netkey/osdep_linux.h>
77  #else /* linux */
78  #include <netkey/osdep_44bsd.h>
79  #endif /* linux */
80
81  /*
82   * PF_KEY messages
83   */
84
85  #define KEY_ADD          1
86  #define KEY_DELETE       2
87  #define KEY_UPDATE       3
88  #define KEY_GET          4
89  #define KEY_ACQUIRE      5
90  #define KEY_GETSPI       6
91  #define KEY_REGISTER     7
92  #define KEY_EXPIRE       8
93  #define KEY_DUMP         9
94  #define KEY_FLUSH        10
95
96  #define KEY_VERSION      1
97  #define POLICY_VERSION   1
98
99  #define SECURITY_TYPE_NONE    0
100
101 #define KEY_TYPE_AH           1
102 #define KEY_TYPE_ESP          2
103 #define KEY_TYPE_RSVP         3
104 #define KEY_TYPE_OSPF         4
105 #define KEY_TYPE_RIPV2        5
106 #define KEY_TYPE_MIPV4        6
```

```
107 #define KEY_TYPE_MIPV6        7
108 #define KEY_TYPE_MAX          7
109
110 /*
111  * Security association state
112  */
113
114 #define K_USED           0x1    /* Key used/not used */
115 #define K_UNIQUE         0x2    /* Key unique/reusable */
116 #define K_LARVAL         0x4    /* SPI assigned, but sa incomplete */
117 #define K_ZOMBIE         0x8    /* sa expired but still useable */
118 #define K_DEAD           0x10   /* sa marked for deletion, ready for reaping */
119 #define K_INBOUND        0x20   /* sa for inbound packets, ie. dst=myhost */
120 #define K_OUTBOUND       0x40   /* sa for outbound packets, ie. src=myhost */
121
122
123 #ifndef MAX_SOCKADDR_SZ
124 #ifdef INET6
125 #define MAX_SOCKADDR_SZ (sizeof(struct sockaddr_in6))
126 #else /* INET6 */
127 #define MAX_SOCKADDR_SZ (sizeof(struct sockaddr_in))
128 #endif /* INET6 */
129 #endif /* MAX_SOCKADDR_SZ */
130
131 #ifndef MAX_KEY_SZ
132 #define MAX_KEY_SZ 16
133 #endif /* MAX_KEY_SZ */
134
135 #ifndef MAX_IV_SZ
136 #define MAX_IV_SZ 16
137 #endif /* MAX_IV_SZ */
138
139 /* Security association data for IP Security */
140 struct key_secassoc {
141   u_int8  len;                  /* Length of the data (for radix) */
142   u_int8  type;                 /* Type of association */
143   u_int8  state;                /* State of the association */
144   u_int8  label;                /* Sensitivity label (unused) */
145   u_int32 spi;                  /* SPI */
146   u_int8  keylen;   /* Key length */
147   u_int8  ivlen;    /* Initialization vector length */
148   u_int8  algorithm;    /* Algorithm switch index */
149   u_int8  lifetype;             /* Type of lifetime */
150   caddr_t iv;     /* Initialization vector */
151   caddr_t key;      /* Key */
152   u_int32 lifetime1;            /* Lifetime value 1 */
153   u_int32 lifetime2;            /* Lifetime value 2 */
154   SOCKADDR *src;                /* Source host address */
155   SOCKADDR *dst;                /* Destination host address */
156   SOCKADDR *from;               /* Originator of association */
157 };
158
159 /*
```

```
160  * Structure for key message header.
161  * PF_KEY message consists of key_msghdr followed by
162  * src sockaddr, dest sockaddr, from sockaddr, key, and iv.
163  * Assumes size of key message header less than MHLEN.
164  */
165
166 struct key_msghdr {
167   u_short key_msglen;   /* length of message including src/dst/from/key/iv */
168   u_char  key_msgvers;  /* key version number */
169   u_char  key_msgtype;  /* key message type, eg. KEY_ADD */
170   pid_t   key_pid;      /* process id of message sender */
171   int     key_seq;      /* message sequence number */
172   int     key_errno;    /* error code */
173   u_int8  type;         /* type of security association */
174   u_int8  state;        /* state of security association */
175   u_int8  label;        /* sensitivity level */
176   u_int8  pad;          /* padding for allignment */
177   u_int32 spi;          /* spi value */
178   u_int8  keylen;       /* key length */
179   u_int8  ivlen;        /* iv length */
180   u_int8  algorithm;    /* algorithm identifier */
181   u_int8  lifetype;     /* type of lifetime */
182   u_int32 lifetime1;    /* lifetime value 1 */
183   u_int32 lifetime2;    /* lifetime value 2 */
184 };
185
186 struct key_msgdata {
187   SOCKADDR *src;    /* source host address */
188   SOCKADDR *dst;    /* destination host address */
189   SOCKADDR *from;   /* originator of security association */
190   caddr_t iv;             /* initialization vector */
191   caddr_t key;            /* key */
192   int ivlen;              /* key length */
193   int keylen;             /* iv length */
194 };
195
196 struct policy_msghdr {
197   u_short policy_msglen;   /* message length */
198   u_char  policy_msgvers;  /* message version */
199   u_char  policy_msgtype;  /* message type */
200   int     policy_seq;      /* message sequence number */
201   int     policy_errno;    /* error code */
202 };
203
204 #ifdef KERNEL
205
206 /*
207  * Key engine table structures
208  */
209
210 struct socketlist {
211   struct socket *socket;     /* pointer to socket */
212   struct socketlist *next;   /* next */
```

```
213 };
214
215 struct key_tblnode {
216   int alloc_count;              /* number of sockets allocated to secassoc */
217   int ref_count;                /* number of sockets referencing secassoc */
218   struct socketlist *solist;    /* list of sockets allocated to secassoc */
219   struct key_secassoc *secassoc; /* security association */
220   struct key_tblnode *next;     /* next node */
221 };
222
223 struct key_allocnode {
224   struct key_tblnode *keynode;
225   struct key_allocnode *next;
226 };
227
228 struct key_so2spinode {
229   struct socket *socket;        /* socket pointer */
230   struct key_tblnode *keynode;  /* pointer to tblnode containing secassoc */
231         /*  info for socket  */
232   struct key_so2spinode *next;
233 };
234
235 struct key_registry {
236   u_int8 type;            /* secassoc type that key mgnt. daemon can acquire */
237   struct socket *socket;  /* key management daemon socket pointer */
238   struct key_registry *next;
239 };
240
241 struct key_acquirelist {
242   u_int8 type;                  /* secassoc type to acquire */
243   SOCKADDR *target;             /* destination address of secassoc */
244   u_int32 count;                /* number of acquire messages sent */
245   u_long expiretime;            /* expiration time for acquire message */
246   struct key_acquirelist *next;
247 };
248
249 struct keyso_cb {
250   int ip4_count;          /* IPv4 */
251 #ifdef INET6
252   int ip6_count;          /* IPv6 */
253 #endif /* INET6 */
254   int any_count;          /* Sum of above counters */
255 };
256
257 #endif
258
259 /*
260  * Useful macros
261  */
262
263 #if 0
264 #define KMALLOC(p, t, n) (p = (t) malloc((unsigned int)(n)))
265 #define KFREE(p) free((char *)p);
```

```
266 #endif /* 0 */
267
268 #ifdef KERNEL
269 #ifdef __P
270 void    key_init __P((void));
271 void    key_cbinit __P((void));
272 int     key_inittables __P((void));
273 int     key_secassoc2msghdr __P((struct key_secassoc *, struct key_msghdr *,
274          struct key_msgdata *));
275 int     key_msghdr2secassoc __P((struct key_secassoc *, struct key_msghdr *,
276          struct key_msgdata *));
277 int     key_add __P((struct key_secassoc *));
278 int     key_delete __P((struct key_secassoc *));
279 int     key_get __P((u_int, SOCKADDR *, SOCKADDR *, u_int32,
280          struct key_secassoc **));
281 void    key_flush __P((void));
282 int     key_dump __P((struct socket *));
283 int     key_getspi __P((u_int, SOCKADDR *, SOCKADDR *,
284              u_int32, u_int32, u_int32 *));
285 int     key_update __P((struct key_secassoc *));
286 int     key_register __P((struct socket *, u_int));
287 void    key_unregister __P((struct socket *, u_int, int));
288 int     key_acquire __P((u_int, SOCKADDR *, SOCKADDR *));
289 int     getassocbyspi __P((u_int, SOCKADDR *, SOCKADDR *,
290               u_int32, struct key_tblnode **));
291 int     getassocbysocket __P((u_int, SOCKADDR *, SOCKADDR *,
292              struct socket *, u_int, struct key_tblnode **));
293 void    key_free __P((struct key_tblnode *));
294 int key_parse __P((struct key_msghdr **km, struct socket *so, int *));
295 #endif /* __P */
296 #endif
```

```
/*-----------------------------------------------------------------------
  key.c :          Key Management Engine for BSD

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71  Research Laboratory (NRL).
72
73  ----------------------------------------------------------------------*/
74
75  #ifdef linux
76  #include <netkey/osdep_linux.h>
77  #else /* linux */
78  #include <sys/param.h>
79  #include <sys/proc.h>
80  #include <sys/mbuf.h>
81  #include <sys/socket.h>
82  #include <sys/socketvar.h>
83  #include <sys/time.h>
84  #include <sys/kernel.h>
85  #include <net/raw_cb.h>
86  #include <net/if.h>
87  #include <net/if_types.h>
88  #include <net/if_dl.h>
89  #include <net/route.h>
90  #include <netkey/osdep_44bsd.h>
91  #include <netinet/in_var.h>
92  #include <netinet/if_ether.h>
93  #endif /* linux */
94
95  #ifdef INET6
96  #include <netinet6/in6.h>
97  #include <netinet6/in6_var.h>
98  #endif /* INET6 */
99
100 #include <netkey/key.h>
101
102 #include <netkey/key_debug.h>
103
104 #define MAXHASHKEYLEN (2 * sizeof(int) + 2 * sizeof(struct sockaddr_in6))
105
106
```

```
107  /*
108   *  Not clear whether these values should be
109   *  tweakable at kernel config time.
110   */
111  #define KEYTBLSIZE 61
112  #define KEYALLOCTBLSIZE 61
113  #define SO2SPITBLSIZE 61
114
115  /*
116   *  These values should be tweakable...
117   *  perhaps by using sysctl
118   */
119
120  #define MAXLARVALTIME 240;   /* Lifetime of a larval key table entry */
121  #define MAXKEYACQUIRE 1;     /* Max number of key acquire messages sent */
122                               /*   per destination address               */
123  #define MAXACQUIRETIME 15;   /* Lifetime of acquire message */
124
125  /*
126   *  Key engine tables and global variables
127   */
128
129  struct key_tblnode keytable[KEYTBLSIZE];
130  struct key_allocnode keyalloctbl[KEYALLOCTBLSIZE];
131  struct key_so2spinode so2spitbl[SO2SPITBLSIZE];
132
133  struct keyso_cb keyso_cb;
134  struct key_tblnode nullkeynode  = { 0, 0, 0, 0, 0 };
135  struct key_registry *keyregtable;
136  struct key_acquirelist *key_acquirelist;
137  u_long maxlarvallifetime = MAXLARVALTIME;
138  int maxkeyacquire = MAXKEYACQUIRE;
139  u_long maxacquiretime = MAXACQUIRETIME;
140
141  extern SOCKADDR key_addr;
142
143  #define ROUNDUP(a) \
144    ((a) > 0 ? (1 + (((a) - 1) | (sizeof(long) - 1))) : sizeof(long))
145  #define ADVANCE(x, n) \
146      { x += ROUNDUP(n); }
147
148  int my_addr __P((SOCKADDR *));
149  int key_sendup __P((struct socket *, struct key_msghdr *));
150
151  /*-------------------------------------------------------------------
152   * key_secassoc2msghdr():
153   *      Copy info from a security association into a key message buffer.
154   *      Assume message buffer is sufficiently large to hold all security
155   *      association information including src, dst, from, key and iv.
156   -------------------------------------------------------------------*/
157  int key_secassoc2msghdr DEFARGS((secassoc, km, keyinfo),
158  struct key_secassoc *secassoc AND
159  struct key_msghdr *km AND
```

```
160  struct key_msgdata *keyinfo)
161  {
162    char *cp;
163    DPRINTF(IDL_FINISHED, ("Entering key_secassoc2msghdr\n"));
164
165    if ((km == 0) || (keyinfo == 0) || (secassoc == 0))
166      return(-1);
167
168    km->type = secassoc->type;
169    km->state = secassoc->state;
170    km->label = secassoc->label;
171    km->spi = secassoc->spi;
172    km->keylen = secassoc->keylen;
173    km->ivlen = secassoc->ivlen;
174    km->algorithm = secassoc->algorithm;
175    km->lifetype = secassoc->lifetype;
176    km->lifetime1 = secassoc->lifetime1;
177    km->lifetime2 = secassoc->lifetime2;
178
179    /*
180     *  Stuff src/dst/from/key/iv in buffer after
181     *  the message header.
182     */
183    cp = (char *)(km + 1);
184
185    DPRINTF(IDL_FINISHED, ("sa2msghdr: 1\n"));
186    keyinfo->src = (SOCKADDR *)cp;
187    if (secassoc->src->sa_len) {
188      bcopy(secassoc->src, cp, secassoc->src->sa_len);
189      ADVANCE(cp, secassoc->src->sa_len);
190    } else {
191      bzero(cp, MAX_SOCKADDR_SZ);
192      ADVANCE(cp, MAX_SOCKADDR_SZ);
193    }
194
195    DPRINTF(IDL_FINISHED, ("sa2msghdr: 2\n"));
196    keyinfo->dst = (SOCKADDR *)cp;
197    if (secassoc->dst->sa_len) {
198      bcopy(secassoc->dst, cp, secassoc->dst->sa_len);
199      ADVANCE(cp, secassoc->dst->sa_len);
200    } else {
201      bzero(cp, MAX_SOCKADDR_SZ);
202      ADVANCE(cp, MAX_SOCKADDR_SZ);
203    }
204
205    DPRINTF(IDL_FINISHED, ("sa2msghdr: 3\n"));
206    keyinfo->from = (SOCKADDR *)cp;
207    if (secassoc->from->sa_len) {
208      bcopy(secassoc->from, cp, secassoc->from->sa_len);
209      ADVANCE(cp, secassoc->from->sa_len);
210    } else {
211      bzero(cp, MAX_SOCKADDR_SZ);
212      ADVANCE(cp, MAX_SOCKADDR_SZ);
```

```
213    }
214
215    DPRINTF(IDL_FINISHED, ("sa2msghdr: 4\n"));
216
217    keyinfo->key = cp;
218    keyinfo->keylen = secassoc->keylen;
219    if (secassoc->keylen) {
220      bcopy((char *)(secassoc->key), cp, secassoc->keylen);
221      ADVANCE(cp, secassoc->keylen);
222    }
223
224    DPRINTF(IDL_FINISHED, ("sa2msghdr: 5\n"));
225    keyinfo->iv = cp;
226    keyinfo->ivlen = secassoc->ivlen;
227    if (secassoc->ivlen) {
228      bcopy((char *)(secassoc->iv), cp, secassoc->ivlen);
229      ADVANCE(cp, secassoc->ivlen);
230    }
231
232    DDO(IDL_FINISHED,printf("msgbuf(len=%d):\n",(char *)cp - (char *)km));
233    DDO(IDL_FINISHED,dump_buf((char *)km, (char *)cp - (char *)km));
234    DPRINTF(IDL_FINISHED, ("sa2msghdr: 6\n"));
235    return(0);
236  }
237
238
239  /*-------------------------------------------------------------------------
240   * key_msghdr2secassoc():
241   *      Copy info from a key message buffer into a key_secassoc
242   *      structure
243   -------------------------------------------------------------------------*/
244  int key_msghdr2secassoc DEFARGS((secassoc, km, keyinfo),
245  struct key_secassoc *secassoc AND
246  struct key_msghdr *km AND
247  struct key_msgdata *keyinfo)
248  {
249    DPRINTF(IDL_FINISHED, ("Entering key_msghdr2secassoc\n"));
250
251    if ((km == 0) || (keyinfo == 0) || (secassoc == 0))
252      return(-1);
253
254    secassoc->len = sizeof(*secassoc);
255    secassoc->type = km->type;
256    secassoc->state = km->state;
257    secassoc->label = km->label;
258    secassoc->spi = km->spi;
259    secassoc->keylen = km->keylen;
260    secassoc->ivlen = km->ivlen;
261    secassoc->algorithm = km->algorithm;
262    secassoc->lifetype = km->lifetype;
263    secassoc->lifetime1 = km->lifetime1;
264    secassoc->lifetime2 = km->lifetime2;
265
```

```
266   if (keyinfo->src) {
267     KMALLOC(secassoc->src, SOCKADDR *, keyinfo->src->sa_len);
268     if (!secassoc->src) {
269       DPRINTF(IDL_ERROR,("msghdr2secassoc: can't allocate mem for src\n"));
270       return(-1);
271     }
272     bcopy((char *)keyinfo->src, (char *)secassoc->src,
273     keyinfo->src->sa_len);
274   } else
275     secassoc->src = NULL;
276
277   if (keyinfo->dst) {
278     KMALLOC(secassoc->dst, SOCKADDR *, keyinfo->dst->sa_len);
279     if (!secassoc->dst) {
280       DPRINTF(IDL_ERROR,("msghdr2secassoc: can't allocate mem for dst\n"));
281       return(-1);
282     }
283     bcopy((char *)keyinfo->dst, (char *)secassoc->dst,
284     keyinfo->dst->sa_len);
285   } else
286     secassoc->dst = NULL;
287
288   if (keyinfo->from) {
289     KMALLOC(secassoc->from, SOCKADDR *, keyinfo->from->sa_len);
290     if (!secassoc->from) {
291       DPRINTF(IDL_ERROR,("msghdr2secassoc: can't allocate mem for from\n"));
292       return(-1);
293     }
294     bcopy((char *)keyinfo->from, (char *)secassoc->from,
295     keyinfo->from->sa_len);
296   } else
297     secassoc->from = NULL;
298
299   /*
300    *  Make copies of key and iv
301    */
302   if (secassoc->ivlen) {
303     KMALLOC(secassoc->iv, caddr_t, secassoc->ivlen);
304     if (secassoc->iv == 0) {
305       DPRINTF(IDL_ERROR,("msghdr2secassoc: can't allocate mem for iv\n"));
306       return(-1);
307     }
308     bcopy((char *)keyinfo->iv, (char *)secassoc->iv, secassoc->ivlen);
309   } else
310     secassoc->iv = NULL;
311
312   if (secassoc->keylen) {
313     KMALLOC(secassoc->key, caddr_t, secassoc->keylen);
314     if (secassoc->key == 0) {
315       DPRINTF(IDL_ERROR,("msghdr2secassoc: can't allocate mem for key\n"));
316       if (secassoc->iv)
317   KFREE(secassoc->iv);
318       return(-1);
```

```
319       }
320       bcopy((char *)keyinfo->key, (char *)secassoc->key, secassoc->keylen);
321     } else
322       secassoc->key = NULL;
323     return(0);
324   }
325
326
327   /*------------------------------------------------------------------------
328    * addrpart_equal():
329    *      Determine if the address portion of two sockaddrs are equal.
330    *      Currently handles only AF_INET and AF_INET6 address families.
331    ------------------------------------------------------------------------*/
332   int addrpart_equal DEFARGS((sa1, sa2),
333   SOCKADDR *sa1 AND
334   SOCKADDR *sa2)
335   {
336     if ((sa1->sa_family != sa2->sa_family) ||
337         (sa1->sa_len != sa2->sa_len))
338       return 0;
339
340     switch(sa1->sa_family) {
341     case AF_INET:
342       return (((struct sockaddr_in *)sa1)->sin_addr.s_addr ==
343         ((struct sockaddr_in *)sa2)->sin_addr.s_addr);
344   #ifdef INET6
345     case AF_INET6:
346       return (IN6_ADDR_EQUAL(((struct sockaddr_in6 *)sa1)->sin6_addr,
347           ((struct sockaddr_in6 *)sa2)->sin6_addr));
348   #endif /* INET6 */
349     }
350     return(0);
351   }
352
353   /*------------------------------------------------------------------------
354    * key_inittables():
355    *      Allocate space and initialize key engine tables
356    ------------------------------------------------------------------------*/
357   int key_inittables __P((void))
358   {
359     int i;
360
361     KMALLOC(keyregtable, struct key_registry *, sizeof(struct key_registry));
362     if (!keyregtable)
363       return -1;
364     bzero((char *)keyregtable, sizeof(struct key_registry));
365     KMALLOC(key_acquirelist, struct key_acquirelist *,
366        sizeof(struct key_acquirelist));
367     if (!key_acquirelist)
368       return -1;
369     bzero((char *)key_acquirelist, sizeof(struct key_acquirelist));
370     for (i = 0; i < KEYTBLSIZE; i++)
371       bzero((char *)&keytable[i], sizeof(struct key_tblnode));
```

```
372   for (i = 0; i < KEYALLOCTBLSIZE; i++)
373     bzero((char *)&keyalloctbl[i], sizeof(struct key_allocnode));
374   for (i = 0; i < SO2SPITBLSIZE; i++)
375     bzero((char *)&so2spitbl[i], sizeof(struct key_so2spinode));
376
377   return 0;
378 }
379
380 int key_freetables __P((void))
381 {
382   KFREE(keyregtable);
383   keyregtable = NULL;
384   KFREE(key_acquirelist);
385   key_acquirelist = NULL;
386   return 0;
387 }
388
389 /*-------------------------------------------------------------------------
390  * key_gethashval():
391  *      Determine keytable hash value.
392  -------------------------------------------------------------------------*/
393 int key_gethashval DEFARGS((buf, len, tblsize),
394 char *buf AND
395 int len AND
396 int tblsize)
397 {
398   int i, j = 0;
399
400   /*
401    * Todo: Use word size xor and check for alignment
402    *       and zero pad if necessary.  Need to also pick
403    *       a good hash function and table size.
404    */
405   if (len <= 0) {
406     DPRINTF(IDL_ERROR,("key_gethashval got bogus len!\n"));
407     return(-1);
408   }
409   for(i = 0; i < len; i++) {
410     j ^=  (u_int8)(*(buf + i));
411   }
412   return (j % tblsize);
413 }
414
415
416 /*-------------------------------------------------------------------------
417  * key_createkey():
418  *      Create hash key for hash function
419  *      key is: type+src+dst if keytype = 1
420  *              type+src+dst+spi if keytype = 0
421  *      Uses only the address portion of the src and dst sockaddrs to
422  *      form key.  Currently handles only AF_INET and AF_INET6 sockaddrs
423  -------------------------------------------------------------------------*/
424 int key_createkey DEFARGS((buf, type, src, dst, spi, keytype),
```

```
425       char *buf AND
426       u_int type AND
427       SOCKADDR *src AND
428       SOCKADDR *dst AND
429       u_int32 spi AND
430       u_int keytype)
431  {
432    char *cp, *p;
433
434    DPRINTF(IDL_FINISHED,("Entering key_createkey\n"));
435
436    if (!buf || !src || !dst)
437      return(-1);
438
439    cp = buf;
440    bcopy((char *)&type, cp, sizeof(type));
441    cp += sizeof(type);
442
443  #ifdef INET6
444    /*
445     * Assume only IPv4 and IPv6 addresses.
446     */
447  #define ADDRPART(a) \
448      ((a)->sa_family == AF_INET6) ? \
449      (char *)&(((struct sockaddr_in6 *)(a))->sin6_addr) : \
450      (char *)&(((struct sockaddr_in *)(a))->sin_addr)
451
452  #define ADDRSIZE(a) \
453      ((a)->sa_family == AF_INET6) ? sizeof(struct in_addr6) : \
454      sizeof(struct in_addr)
455  #else /* INET6 */
456  #define ADDRPART(a) (char *)&(((struct sockaddr_in *)(a))->sin_addr)
457  #define ADDRSIZE(a) sizeof(struct in_addr)
458  #endif /* INET6 */
459
460    DPRINTF(IDL_FINISHED,("src addr:\n"));
461    DDO(IDL_FINISHED,dump_smart_sockaddr(src));
462    DPRINTF(IDL_FINISHED,("dst addr:\n"));
463    DDO(IDL_FINISHED,dump_smart_sockaddr(dst));
464
465    p = ADDRPART(src);
466    bcopy(p, cp, ADDRSIZE(src));
467    cp += ADDRSIZE(src);
468
469    p = ADDRPART(dst);
470    bcopy(p, cp, ADDRSIZE(dst));
471    cp += ADDRSIZE(dst);
472
473  #undef ADDRPART
474  #undef ADDRSIZE
475
476    if (keytype == 0) {
477      bcopy((char *)&spi, cp, sizeof(spi));
```

```
478       cp += sizeof(spi);
479     }
480
481     DPRINTF(IDL_FINISHED,("hash key:\n"));
482     DDO(IDL_FINISHED, dump_buf(buf, cp - buf));
483     return(cp - buf);
484   }
485
486
487   /*-----------------------------------------------------------------------
488    * key_sosearch():
489    *       Search the so2spi table for the security association allocated to
490    *       the socket.  Returns pointer to a struct key_so2spinode which can
491    *       be used to locate the security association entry in the keytable.
492    -----------------------------------------------------------------------*/
493   struct key_so2spinode *key_sosearch DEFARGS((type, src, dst, so),
494        u_int type AND
495        SOCKADDR *src AND
496        SOCKADDR *dst AND
497        struct socket *so)
498   {
499     struct key_so2spinode *np = 0;
500
501     if (!(src && dst)) {
502       DPRINTF(IDL_ERROR,("key_sosearch: got null src or dst pointer!\n"));
503       return(NULL);
504     }
505
506     for (np = so2spitbl[((u_int32)so) % SO2SPITBLSIZE].next; np; np = np->next) {
507       if ((so == np->socket) && (type == np->keynode->secassoc->type)
508     && addrpart_equal(src, np->keynode->secassoc->src)
509     && addrpart_equal(dst, np->keynode->secassoc->dst))
510         return(np);
511     }
512     return(NULL);
513   }
514
515
516   /*-----------------------------------------------------------------------
517    * key_sodelete():
518    *       Delete entries from the so2spi table.
519    *         flag = 1  purge all entries
520    *         flag = 0  delete entries with socket pointer matching socket
521    -----------------------------------------------------------------------*/
522   void key_sodelete DEFARGS((socket, flag),
523        struct socket *socket AND
524        int flag)
525   {
526     struct key_so2spinode *prevnp, *np;
527     CRITICAL_DCL
528
529     CRITICAL_START;
530
```

```
531    DPRINTF(IDL_EVENT,("Entering keysodelete w/so=0x%x flag=%d\n",
532            (unsigned int)socket,flag));
533
534    if (flag) {
535      int i;
536
537      for (i = 0; i < SO2SPITBLSIZE; i++)
538        for(np = so2spitbl[i].next; np; np = np->next) {
539    KFREE(np);
540        }
541      CRITICAL_END;
542      return;
543    }
544
545    prevnp = &so2spitbl[((u_int32)socket) % SO2SPITBLSIZE];
546    for(np = prevnp->next; np; np = np->next) {
547      if (np->socket == socket) {
548        struct socketlist *socklp, *prevsocklp;
549
550        (np->keynode->alloc_count)--;
551
552        /*
553         * If this socket maps to a unique secassoc,
554         * we go ahead and delete the secassoc, since it
555         * can no longer be allocated or used by any other
556         * socket.
557         */
558        if (np->keynode->secassoc->state & K_UNIQUE) {
559    if (key_delete(np->keynode->secassoc) != 0)
560      panic("key_sodelete");
561    np = prevnp;
562    continue;
563        }
564
565        /*
566         * We traverse the socketlist and remove the entry
567         * for this socket
568         */
569        DPRINTF(IDL_FINISHED,("keysodelete: deleting from socklist..."));
570        prevsocklp = np->keynode->solist;
571        for (socklp = prevsocklp->next; socklp; socklp = socklp->next) {
572    if (socklp->socket == socket) {
573      prevsocklp->next = socklp->next;
574      KFREE(socklp);
575      break;
576    }
577    prevsocklp = socklp;
578        }
579        DPRINTF(IDL_FINISHED,("done\n"));
580        prevnp->next = np->next;
581        KFREE(np);
582        np = prevnp;
583      }
```

```
584       prevnp = np;
585     }
586     CRITICAL_END;
587   }
588
589
590   /*-----------------------------------------------------------------------
591    * key_deleteacquire():
592    *       Delete an entry from the key_acquirelist
593    -----------------------------------------------------------------------*/
594   void key_deleteacquire DEFARGS((type, target),
595       u_int type AND
596       SOCKADDR *target)
597   {
598     struct key_acquirelist *ap, *prev;
599
600     prev = key_acquirelist;
601     for(ap = key_acquirelist->next; ap; ap = ap->next) {
602       if (addrpart_equal(target, (SOCKADDR *)&(ap->target)) &&
603     (type == ap->type)) {
604         DPRINTF(IDL_EVENT,("Deleting entry from acquire list!\n"));
605         prev->next = ap->next;
606         KFREE(ap);
607         ap = prev;
608       }
609       prev = ap;
610     }
611   }
612
613
614   /*-----------------------------------------------------------------------
615    * key_search():
616    *       Search the key table for an entry with same type, src addr, dest
617    *       addr, and spi.  Returns a pointer to struct key_tblnode if found
618    *       else returns null.
619    -----------------------------------------------------------------------*/
620   struct key_tblnode *key_search DEFARGS(
621               (type, src, dst, spi, indx, prevkeynode),
622       u_int type AND
623       SOCKADDR *src AND
624       SOCKADDR *dst AND
625       u_int32 spi AND
626       int indx AND
627       struct key_tblnode **prevkeynode)
628   {
629     struct key_tblnode *keynode, *prevnode;
630
631     if (indx > KEYTBLSIZE || indx < 0)
632       return (NULL);
633     if (!(&keytable[indx]))
634       return (NULL);
635
636   #define sec_type keynode->secassoc->type
```

```
637 #define sec_spi keynode->secassoc->spi
638 #define sec_src keynode->secassoc->src
639 #define sec_dst keynode->secassoc->dst
640
641   prevnode = &keytable[indx];
642   for (keynode = keytable[indx].next; keynode; keynode = keynode->next) {
643     if ((type == sec_type) && (spi == sec_spi) &&
644   addrpart_equal(src, sec_src)
645   && addrpart_equal(dst, sec_dst))
646       break;
647     prevnode = keynode;
648   }
649   *prevkeynode = prevnode;
650   return(keynode);
651 }
652
653
654 /*---------------------------------------------------------------------
655  * key_addnode():
656  *      Insert a key_tblnode entry into the key table.  Returns a pointer
657  *      to the newly created key_tblnode.
658  ---------------------------------------------------------------------*/
659 struct key_tblnode *key_addnode DEFARGS((indx, secassoc),
660      int indx AND
661      struct key_secassoc *secassoc)
662 {
663   struct key_tblnode *keynode;
664
665   DPRINTF(IDL_FINISHED,("Entering key_addnode w/indx=%d secassoc=0x%x\n",
666       indx, (unsigned int)secassoc));
667
668   if (!(&keytable[indx]))
669     return(NULL);
670   if (!secassoc) {
671     panic("key_addnode: Someone passed in a null secassoc!\n");
672   }
673
674   KMALLOC(keynode, struct key_tblnode *, sizeof(struct key_tblnode));
675   if (keynode == 0)
676     return(NULL);
677   bzero((char *)keynode, sizeof(struct key_tblnode));
678
679   KMALLOC(keynode->solist, struct socketlist *, sizeof(struct socketlist));
680   if (keynode->solist == 0) {
681     KFREE(keynode);
682     return(NULL);
683   }
684   bzero((char *)(keynode->solist), sizeof(struct socketlist));
685
686   keynode->secassoc = secassoc;
687   keynode->solist->next = NULL;
688   keynode->next = keytable[indx].next;
689   keytable[indx].next = keynode;
```

```
690     return(keynode);
691   }
692
693
694   /*-----------------------------------------------------------------------
695    * key_add():
696    *      Add a new security association to the key table.  Caller is
697    *      responsible for allocating memory for the key_secassoc as
698    *      well as the buffer space for the key and iv.  Assumes the security
699    *      association passed in is well-formed.
700    -----------------------------------------------------------------------*/
701   int
702   key_add DEFARGS((secassoc),
703        struct key_secassoc *secassoc)
704   {
705     char buf[MAXHASHKEYLEN];
706     int len, indx;
707     int inbound = 0;
708     int outbound = 0;
709     struct key_tblnode *keynode, *prevkeynode;
710     struct key_allocnode *np = NULL;
711     CRITICAL_DCL
712
713     DPRINTF(IDL_FINISHED, ("Entering key_add w/secassoc=0x%x\n",
714          (unsigned int)secassoc));
715
716     if (!secassoc) {
717       panic("key_add: who the hell is passing me a null pointer");
718     }
719
720     /*
721      * Should we allow a null key to be inserted into the table ?
722      * or can we use null key to indicate some policy action...
723      */
724
725   #if 0
726     /*
727      *  For esp using des-cbc or tripple-des we call
728      * des_set_odd_parity.
729      */
730     if (secassoc->key && (secassoc->type == KEY_TYPE_ESP) &&
731         ((secassoc->algorithm == IPSEC_ALGTYPE_ESP_DES_CBC) ||
732          (secassoc->algorithm == IPSEC_ALGTYPE_ESP_3DES)))
733       des_set_odd_parity(secassoc->key);
734   #endif /* 0 */
735
736     /*
737      *  Check if secassoc with same spi exists before adding
738      */
739     bzero((char *)&buf, sizeof(buf));
740     len = key_createkey((char *)&buf, secassoc->type, secassoc->src,
741             secassoc->dst, secassoc->spi, 0);
742     indx = key_gethashval((char *)&buf, len, KEYTBLSIZE);
```

```
743     DPRINTF(IDL_FINISHED,("keyadd: keytbl hash position=%d\n", indx));
744     keynode = key_search(secassoc->type, secassoc->src, secassoc->dst,
745             secassoc->spi, indx, &prevkeynode);
746     if (keynode) {
747       DPRINTF(IDL_EVENT,("keyadd: secassoc already exists!\n"));
748       return(-2);
749     }
750
751     inbound = my_addr(secassoc->dst);
752     outbound = my_addr(secassoc->src);
753     DPRINTF(IDL_FINISHED,("inbound=%d outbound=%d\n", inbound, outbound));
754
755     /*
756      * We allocate mem for an allocation entry if needed.
757      * This is done here instead of in the allocaton code
758      * segment so that we can easily recover/cleanup from a
759      * memory allocation error.
760      */
761     if (outbound || (!inbound && !outbound)) {
762       KMALLOC(np, struct key_allocnode *, sizeof(struct key_allocnode));
763       if (np == 0) {
764         DPRINTF(IDL_ERROR,("keyadd: can't allocate allocnode!\n"));
765         return(-1);
766       }
767     }
768
769     CRITICAL_START;
770
771     if ((keynode = key_addnode(indx, secassoc)) == NULL) {
772       DPRINTF(IDL_ERROR,("keyadd: key_addnode failed!\n"));
773       if (np)
774         KFREE(np);
775       CRITICAL_END;
776       return(-1);
777     }
778     DPRINTF(IDL_GROSS_EVENT,("Added new keynode:\n"));
779     DDO(IDL_FINISHED, dump_keytblnode(keynode));
780     DDO(IDL_FINISHED, dump_secassoc(keynode->secassoc));
781
782     /*
783      *  We add an entry to the allocation table for
784      *  this secassoc if the interfaces are up and
785      *  the secassoc is outbound.  In the case
786      *  where the interfaces are not up, we go ahead
787      *  and do it anyways.  This wastes an allocation
788      *  entry if the secassoc later turned out to be
789      *  inbound when the interfaces are ifconfig up.
790      */
791     if (outbound || (!inbound && !outbound)) {
792       len = key_createkey((char *)&buf, secassoc->type, secassoc->src,
793         secassoc->dst, 0, 1);
794       indx = key_gethashval((char *)&buf, len, KEYALLOCTBLSIZE);
795       DPRINTF(IDL_FINISHED,("keyadd: keyalloc hash position=%d\n", indx));
```

```
796       np->keynode = keynode;
797       np->next = keyalloctbl[indx].next;
798       keyalloctbl[indx].next = np;
799     }
800     if (inbound)
801       secassoc->state |= K_INBOUND;
802     if (outbound)
803       secassoc->state |= K_OUTBOUND;
804
805     key_deleteacquire(secassoc->type, secassoc->dst);
806
807     CRITICAL_END;
808     return 0;
809   }
810
811
812   /*-----------------------------------------------------------------------
813    * key_get():
814    *      Get a security association from the key table.
815    -----------------------------------------------------------------------*/
816   int key_get DEFARGS((type, src, dst, spi, secassoc),
817        u_int type AND
818        SOCKADDR *src AND
819        SOCKADDR *dst AND
820        u_int32 spi AND
821        struct key_secassoc **secassoc)
822   {
823     char buf[MAXHASHKEYLEN];
824     struct key_tblnode *keynode, *prevkeynode;
825     int len, indx;
826
827     bzero(&buf, sizeof(buf));
828     *secassoc = NULL;
829     len = key_createkey((char *)&buf, type, src, dst, spi, 0);
830     indx = key_gethashval((char *)&buf, len, KEYTBLSIZE);
831     DPRINTF(IDL_FINISHED,("keyget: indx=%d\n",indx));
832     keynode = key_search(type, src, dst, spi, indx, &prevkeynode);
833     if (keynode) {
834       DPRINTF(IDL_GROSS_EVENT,("keyget: found it! keynode=0x%x",
835              (unsigned int)keynode));
836       *secassoc = keynode->secassoc;
837       return(0);
838     } else
839       return(-1);  /* Not found */
840   }
841
842
843   /*-----------------------------------------------------------------------
844    * key_dump():
845    *      Dump all valid entries in the keytable to a pf_key socket.  Each
846    *      security associaiton is sent one at a time in a pf_key message.  A
847    *      message with seqno = 0 signifies the end of the dump transaction.
848    -----------------------------------------------------------------------*/
```

```
849  int key_dump DEFARGS((so),
850       struct socket *so)
851  {
852    int len, i;
853    int seq = 1;
854    struct key_msgdata keyinfo;
855    struct key_msghdr *km;
856    struct key_tblnode *keynode;
857    extern SOCKADDR key_addr;
858
859    /*
860     * Routine to dump the key table to a routing socket
861     * Use for debugging only!
862     */
863
864    KMALLOC(km, struct key_msghdr *, sizeof(struct key_msghdr) +
865      3 * MAX_SOCKADDR_SZ + MAX_KEY_SZ + MAX_IV_SZ);
866    if (!km)
867      return(ENOBUFS);
868
869    DPRINTF(IDL_FINISHED,("Entering key_dump()"));
870    /*
871     * We need to speed this up later.  Fortunately, key_dump
872     * messages are not sent often.
873     */
874    for (i = 0; i < KEYTBLSIZE; i++) {
875      for (keynode = keytable[i].next; keynode; keynode = keynode->next) {
876        /*
877         * We exclude dead/larval/zombie security associations for now
878         * but it may be useful to also send these up for debugging purposes
879         */
880        if (keynode->secassoc->state & (K_DEAD | K_LARVAL | K_ZOMBIE))
881    continue;
882
883        len = (sizeof(struct key_msghdr) +
884         ROUNDUP(keynode->secassoc->src->sa_len) +
885         ROUNDUP(keynode->secassoc->dst->sa_len) +
886         ROUNDUP(keynode->secassoc->from->sa_len) +
887         ROUNDUP(keynode->secassoc->keylen) +
888         ROUNDUP(keynode->secassoc->ivlen));
889
890        if (key_secassoc2msghdr(keynode->secassoc, km, &keyinfo) != 0)
891    panic("key_dump");
892
893        km->key_msglen = len;
894        km->key_msgvers = KEY_VERSION;
895        km->key_msgtype = KEY_DUMP;
896        km->key_pid = CURRENT_PID;
897        km->key_seq = seq++;
898        km->key_errno = 0;
899
900        key_sendup(so, km);
901      }
```

```
902     }
903     bzero((char *)km, sizeof(struct key_msghdr));
904     km->key_msglen = sizeof(struct key_msghdr);
905     km->key_msgvers = KEY_VERSION;
906     km->key_msgtype = KEY_DUMP;
907     km->key_pid = CURRENT_PID;
908     km->key_seq = 0;
909     km->key_errno = 0;
910
911     key_sendup(so, km);
912     KFREE(km);
913     DPRINTF(IDL_FINISHED,("Leaving key_dump()\n"));
914     return(0);
915   }
916
917   /*---------------------------------------------------------------------
918    * key_delete():
919    *      Delete a security association from the key table.
920    ---------------------------------------------------------------------*/
921   int key_delete DEFARGS((secassoc),
922       struct key_secassoc *secassoc)
923   {
924     char buf[MAXHASHKEYLEN];
925     int len, indx;
926     struct key_tblnode *keynode = 0;
927     struct key_tblnode *prevkeynode = 0;
928     struct socketlist *socklp, *deadsocklp;
929     struct key_so2spinode *np, *prevnp;
930     struct key_allocnode *ap, *prevap;
931     CRITICAL_DCL
932
933     DPRINTF(IDL_FINISHED,("Entering key_delete w/secassoc=0x%x\n",
934         (unsigned int)secassoc));
935
936     bzero((char *)&buf, sizeof(buf));
937     len = key_createkey((char *)&buf, secassoc->type, secassoc->src,
938             secassoc->dst, secassoc->spi, 0);
939     indx = key_gethashval((char *)&buf, len, KEYTBLSIZE);
940     DPRINTF(IDL_FINISHED,("keydelete: keytbl hash position=%d\n", indx));
941     keynode = key_search(secassoc->type, secassoc->src, secassoc->dst,
942              secassoc->spi, indx, &prevkeynode);
943
944     if (keynode) {
945       CRITICAL_START;
946       DPRINTF(IDL_GROSS_EVENT,("keydelete: found keynode to delete\n"));
947       keynode->secassoc->state |= K_DEAD;
948
949       if (keynode->ref_count > 0) {
950         DPRINTF(IDL_EVENT,("keydelete: secassoc still held, marking for deletion
          only!\n"));
951         CRITICAL_END;
952         return(0);
953       }
```

```
954
955       prevkeynode->next = keynode->next;
956
957       /*
958        *  Walk the socketlist and delete the
959        *  entries mapping sockets to this secassoc
960        *  from the so2spi table.
961        */
962       DPRINTF(IDL_FINISHED,("keydelete: deleting socklist..."));
963       for(socklp = keynode->solist->next; socklp; ) {
964         prevnp = &so2spitbl[((u_int32)(socklp->socket)) % SO2SPITBLSIZE];
965         for(np = prevnp->next; np; np = np->next) {
966     if ((np->socket == socklp->socket) && (np->keynode == keynode)) {
967       prevnp->next = np->next;
968       KFREE(np);
969       break;
970     }
971     prevnp = np;
972         }
973         deadsocklp = socklp;
974         socklp = socklp->next;
975         KFREE(deadsocklp);
976       }
977       DPRINTF(IDL_FINISHED,("done\n"));
978       /*
979        * If an allocation entry exist for this
980        * secassoc, delete it.
981        */
982       bzero((char *)&buf, sizeof(buf));
983       len = key_createkey((char *)&buf, secassoc->type, secassoc->src,
984         secassoc->dst, 0, 1);
985       indx = key_gethashval((char *)&buf, len, KEYALLOCTBLSIZE);
986       DPRINTF(IDL_FINISHED,("keydelete: alloctbl hash position=%d\n", indx));
987       prevap = &keyalloctbl[indx];
988       for (ap = prevap->next; ap; ap = ap->next) {
989         if (ap->keynode == keynode) {
990     prevap->next = ap->next;
991     KFREE(ap);
992     break;
993         }
994         prevap = ap;
995       }
996
997       if (keynode->secassoc->iv)
998         KFREE(keynode->secassoc->iv);
999       if (keynode->secassoc->key)
1000        KFREE(keynode->secassoc->key);
1001      KFREE(keynode->secassoc);
1002      if (keynode->solist)
1003        KFREE(keynode->solist);
1004      KFREE(keynode);
1005      CRITICAL_END;
1006      return(0);
```

```
1007   }
1008   return(-1);
1009 }
1010
1011
1012 /*------------------------------------------------------------------------
1013  * key_flush():
1014  *      Delete all entries from the key table.
1015  ------------------------------------------------------------------------*/
1016 void key_flush __P((void))
1017 {
1018   struct key_tblnode *keynode;
1019   int i;
1020
1021   /*
1022    * This is slow, but simple.
1023    */
1024   DPRINTF(IDL_FINISHED,("Flushing key table..."));
1025   for (i = 0; i < KEYTBLSIZE; i++) {
1026     while ((keynode = keytable[i].next))
1027       if (key_delete(keynode->secassoc) != 0)
1028   panic("key_flush");
1029   }
1030   DPRINTF(IDL_FINISHED,("done\n"));
1031 }
1032
1033
1034 /*------------------------------------------------------------------------
1035  * key_getspi():
1036  *      Get a unique spi value for a key management daemon/program.  The
1037  *      spi value, once assigned, cannot be assigned again (as long as the
1038  *      entry with that same spi value remains in the table).
1039  ------------------------------------------------------------------------*/
1040 int key_getspi DEFARGS((type, src, dst, lowval, highval, spi),
1041      u_int type AND
1042      SOCKADDR *src AND
1043      SOCKADDR *dst AND
1044      u_int32 lowval AND
1045      u_int32 highval AND
1046      u_int32 *spi)
1047 {
1048   struct key_secassoc *secassoc;
1049   struct key_tblnode *keynode, *prevkeynode;
1050   int count, done, len, indx;
1051   int maxcount = 1000;
1052   u_int32 val;
1053   char buf[MAXHASHKEYLEN];
1054   CRITICAL_DCL
1055
1056   DPRINTF(IDL_EVENT,("Entering getspi w/type=%d,low=%u,high=%u\n",
1057          type, lowval, highval));
1058   if (!(src && dst))
1059     return(EINVAL);
```

```
1060
1061    if ((lowval == 0) || (highval == 0))
1062      return(EINVAL);
1063
1064    if (lowval > highval) {
1065      u_int32 temp;
1066      temp = lowval;
1067      lowval = highval;
1068      highval = lowval;
1069    }
1070
1071    done = count = 0;
1072    do {
1073      count++;
1074      /*
1075       *  This may not be "random enough".
1076       */
1077      val = lowval + (random() % (highval - lowval + 1));
1078
1079      if (lowval == highval)
1080        count = maxcount;
1081      DPRINTF(IDL_FINISHED,("%u ",val));
1082      if (val) {
1083        DPRINTF(IDL_FINISHED,("\n"));
1084        bzero(&buf, sizeof(buf));
1085        len = key_createkey((char *)&buf, type, src, dst, val, 0);
1086        indx = key_gethashval((char *)&buf, len, KEYTBLSIZE);
1087        if (!key_search(type, src, dst, val, indx, &prevkeynode)) {
1088  CRITICAL_START;
1089  KMALLOC(secassoc, struct key_secassoc *, sizeof(struct key_secassoc));
1090  if (secassoc == 0) {
1091    DPRINTF(IDL_ERROR,("key_getspi: can't allocate memory\n"));
1092    CRITICAL_END;
1093    return(ENOBUFS);
1094  }
1095  bzero((char *)secassoc, sizeof(*secassoc));
1096
1097  DPRINTF(IDL_FINISHED,("getspi: indx=%d\n",indx));
1098  secassoc->len = sizeof(struct key_secassoc);
1099  secassoc->type = type;
1100  secassoc->spi = val;
1101  secassoc->state |= K_LARVAL;
1102  if (my_addr(secassoc->dst))
1103    secassoc->state |= K_INBOUND;
1104  if (my_addr(secassoc->src))
1105    secassoc->state |= K_OUTBOUND;
1106
1107  bcopy((char *)src, (char *)secassoc->src, src->sa_len);
1108  bcopy((char *)dst, (char *)secassoc->dst, dst->sa_len);
1109
1110  /* We fill this in with a plausable value now to insure
1111     that other routines don't break. These will get
1112     overwritten later with the correct values. */
```

```
1113 #ifdef INET6
1114   secassoc->from->sa_family = AF_INET6;
1115   secassoc->from->sa_len = sizeof(struct sockaddr_in6);
1116 #else /* INET6 */
1117   secassoc->from->sa_family = AF_INET;
1118   secassoc->from->sa_len = sizeof(struct sockaddr_in);
1119 #endif /* INET6 */
1120
1121   /*
1122    * We need to add code to age these larval key table
1123    * entries so they don't linger forever waiting for
1124    * a KEY_UPDATE message that may not come for various
1125    * reasons.  This is another task that key_reaper can
1126    * do once we have it coded.
1127    */
1128   secassoc->lifetime1 += TIME_SECONDS + maxlarvallifetime;
1129
1130   if (!(keynode = key_addnode(indx, secassoc))) {
1131     DPRINTF(IDL_ERROR,("key_getspi: can't add node\n"));
1132     CRITICAL_END;
1133     return(ENOBUFS);
1134   }
1135   DPRINTF(IDL_FINISHED,("key_getspi: added node 0x%x\n",
1136             (unsigned int)keynode));
1137   done++;
1138   CRITICAL_END;
1139       }
1140     }
1141   } while ((count < maxcount) && !done);
1142   DPRINTF(IDL_EVENT,("getspi returns w/spi=%u,count=%d\n",val,count));
1143   if (done) {
1144     *spi = val;
1145     return(0);
1146   } else {
1147     *spi = 0;
1148     return(EADDRNOTAVAIL);
1149   }
1150 }
1151
1152
1153 /*-------------------------------------------------------------------------
1154  * key_update():
1155  *      Update a keytable entry that has an spi value assigned but is
1156  *      incomplete (e.g. no key/iv).
1157  -------------------------------------------------------------------------*/
1158 int key_update DEFARGS((secassoc),
1159      struct key_secassoc *secassoc)
1160 {
1161   struct key_tblnode *keynode, *prevkeynode;
1162   struct key_allocnode *np = 0;
1163   u_int8 newstate;
1164   int len, indx, inbound, outbound;
1165   char buf[MAXHASHKEYLEN];
```

```
1166  CRITICAL_DCL
1167
1168  bzero(&buf, sizeof(buf));
1169  len = key_createkey((char *)&buf, secassoc->type, secassoc->src,
1170          secassoc->dst, secassoc->spi, 0);
1171  indx = key_gethashval((char *)&buf, len, KEYTBLSIZE);
1172  if(!(keynode = key_search(secassoc->type, secassoc->src, secassoc->dst,
1173          secassoc->spi, indx, &prevkeynode))) {
1174    return(ESRCH);
1175  }
1176  if (keynode->secassoc->state & K_DEAD)
1177    return(ESRCH);
1178
1179  /* Should we also restrict updating of only LARVAL entries ? */
1180
1181  CRITICAL_START;
1182
1183  inbound = my_addr(secassoc->dst);
1184  outbound = my_addr(secassoc->src);
1185
1186  newstate = keynode->secassoc->state;
1187  newstate &= ~K_LARVAL;
1188
1189  if (inbound)
1190    newstate |= K_INBOUND;
1191  if (outbound)
1192    newstate |= K_OUTBOUND;
1193
1194  if (outbound || (!inbound && !outbound)) {
1195    KMALLOC(np, struct key_allocnode *, sizeof(struct key_allocnode));
1196    if (np == 0) {
1197      DPRINTF(IDL_ERROR,("keyupdate: can't allocate allocnode!\n"));
1198      CRITICAL_END;
1199      return(ENOBUFS);
1200    }
1201  }
1202
1203  /*
1204   *  Free the old key and iv if they're there.
1205   */
1206  if (keynode->secassoc->key)
1207    KFREE(keynode->secassoc->key);
1208  if (keynode->secassoc->iv)
1209    KFREE(keynode->secassoc->iv);
1210
1211  /*
1212   *  We now copy the secassoc over. We don't need to copy
1213   *  the key and iv into new buffers since the calling routine
1214   *  does that already.
1215   */
1216
1217  *(keynode->secassoc) = *secassoc;
1218  keynode->secassoc->state = newstate;
```

```
1219
1220   /*
1221    * Should we allow a null key to be inserted into the table ?
1222    * or can we use null key to indicate some policy action...
1223    */
1224
1225 #if 0
1226   if (keynode->secassoc->key &&
1227        (keynode->secassoc->type == KEY_TYPE_ESP) &&
1228        ((keynode->secassoc->algorithm == IPSEC_ALGTYPE_ESP_DES_CBC) ||
1229   (keynode->secassoc->algorithm == IPSEC_ALGTYPE_ESP_3DES)))
1230       des_set_odd_parity(keynode->secassoc->key);
1231 #endif /* 0 */
1232
1233   /*
1234    *  We now add an entry to the allocation table for this
1235    *  updated key table entry.
1236    */
1237   if (outbound || (!inbound && !outbound)) {
1238     len = key_createkey((char *)&buf, secassoc->type, secassoc->src,
1239       secassoc->dst, 0, 1);
1240     indx = key_gethashval((char *)&buf, len, KEYALLOCTBLSIZE);
1241     DPRINTF(IDL_FINISHED,("keyupdate: keyalloc hash position=%d\n", indx));
1242     np->keynode = keynode;
1243     np->next = keyalloctbl[indx].next;
1244     keyalloctbl[indx].next = np;
1245   }
1246
1247   key_deleteacquire(secassoc->type, (SOCKADDR *)&(secassoc->dst));
1248
1249   CRITICAL_END;
1250   return(0);
1251 }
1252
1253 /*-------------------------------------------------------------------------
1254  * key_register():
1255  *      Register a socket as one capable of acquiring security associations
1256  *      for the kernel.
1257  -------------------------------------------------------------------------*/
1258 int key_register DEFARGS((socket, type),
1259      struct socket *socket AND
1260      u_int type)
1261 {
1262   struct key_registry *p, *new;
1263   CRITICAL_DCL
1264
1265   CRITICAL_START;
1266
1267   DPRINTF(IDL_EVENT,("Entering key_register w/so=0x%x,type=%d\n",
1268          (unsigned int)socket,type));
1269
1270   if (!(keyregtable && socket))
1271     panic("key_register");
```

```
1272
1273    /*
1274     * Make sure entry is not already in table
1275     */
1276    for(p = keyregtable->next; p; p = p->next) {
1277      if ((p->type == type) && (p->socket == socket)) {
1278        CRITICAL_END;
1279        return(EEXIST);
1280      }
1281    }
1282
1283    KMALLOC(new, struct key_registry *, sizeof(struct key_registry));
1284    if (new == 0) {
1285      CRITICAL_END;
1286      return(ENOBUFS);
1287    }
1288    new->type = type;
1289    new->socket = socket;
1290    new->next = keyregtable->next;
1291    keyregtable->next = new;
1292    CRITICAL_END;
1293    return(0);
1294  }
1295
1296  /*-----------------------------------------------------------------------
1297   * key_unregister():
1298   *      Delete entries from the registry list.
1299   *         allflag = 1 : delete all entries with matching socket
1300   *         allflag = 0 : delete only the entry matching socket and type
1301   -----------------------------------------------------------------------*/
1302  void key_unregister DEFARGS((socket, type, allflag),
1303       struct socket *socket AND
1304       u_int type AND
1305       int allflag)
1306  {
1307    struct key_registry *p, *prev;
1308    CRITICAL_DCL
1309
1310    CRITICAL_START;
1311
1312    DPRINTF(IDL_EVENT,("Entering key_unregister w/so=0x%x,type=%d,flag=%d\n",
1313           (unsigned int)socket, type, allflag));
1314
1315    if (!(keyregtable && socket))
1316      panic("key_register");
1317    prev = keyregtable;
1318    for(p = keyregtable->next; p; p = p->next) {
1319      if ((allflag && (p->socket == socket)) ||
1320    ((p->type == type) && (p->socket == socket))) {
1321        prev->next = p->next;
1322        KFREE(p);
1323        p = prev;
1324      }
```

```
1325      prev = p;
1326    }
1327    CRITICAL_END;
1328  }
1329
1330
1331  /*----------------------------------------------------------------------
1332   * key_acquire():
1333   *      Send a key_acquire message to all registered key mgnt daemons
1334   *      capable of acquire security association of type type.
1335   *
1336   *      Return: 0 if succesfully called key mgnt. daemon(s)
1337   *              -1 if not successfull.
1338   ----------------------------------------------------------------------*/
1339  int key_acquire DEFARGS((type, src, dst),
1340       u_int type AND
1341       SOCKADDR *src AND
1342       SOCKADDR *dst)
1343  {
1344    struct key_registry *p;
1345    struct key_acquirelist *ap, *prevap;
1346    int success = 0, created = 0;
1347    u_int etype;
1348    struct key_msghdr *km = NULL;
1349    int len;
1350
1351    DPRINTF(IDL_EVENT,("Entering key_acquire()\n"));
1352
1353    if (!keyregtable || !src || !dst)
1354      return (-1);
1355
1356    /*
1357     * We first check the acquirelist to see if a key_acquire
1358     * message has been sent for this destination.
1359     */
1360    etype = type;
1361    prevap = key_acquirelist;
1362    for(ap = key_acquirelist->next; ap; ap = ap->next) {
1363      if (addrpart_equal(dst, ap->target) &&
1364    (etype == ap->type)) {
1365        DPRINTF(IDL_EVENT,("acquire message previously sent!\n"));
1366        if (ap->expiretime < TIME_SECONDS) {
1367    DPRINTF(IDL_EVENT,("acquire message has expired!\n"));
1368    ap->count = 0;
1369    break;
1370        }
1371        if (ap->count < maxkeyacquire) {
1372    DPRINTF(IDL_EVENT,("max acquire messages not yet exceeded!\n"));
1373    break;
1374        }
1375        return(0);
1376      } else if (ap->expiretime < TIME_SECONDS) {
1377        /*
```

```
1378        *  Since we're already looking at the list, we may as
1379        *  well delete expired entries as we scan through the list.
1380        *  This should really be done by a function like key_reaper()
1381        *  but until we code key_reaper(), this is a quick and dirty
1382        *  hack.
1383        */
1384       DPRINTF(IDL_EVENT,("found an expired entry...deleting it!\n"));
1385       prevap->next = ap->next;
1386       KFREE(ap);
1387       ap = prevap;
1388     }
1389     prevap = ap;
1390   }
1391
1392   /*
1393    * Scan registry and send KEY_ACQUIRE message to
1394    * appropriate key management daemons.
1395    */
1396   for(p = keyregtable->next; p; p = p->next) {
1397     if (p->type != type)
1398       continue;
1399
1400     if (!created) {
1401       len = sizeof(struct key_msghdr) + ROUNDUP(src->sa_len) +
1402   ROUNDUP(dst->sa_len);
1403       KMALLOC(km, struct key_msghdr *, len);
1404       if (!km) {
1405   DPRINTF(IDL_ERROR,("key_acquire: no memory\n"));
1406   return(-1);
1407       }
1408       DPRINTF(IDL_FINISHED,("key_acquire/created: 1\n"));
1409       bzero((char *)km, len);
1410       km->key_msglen = len;
1411       km->key_msgvers = KEY_VERSION;
1412       km->key_msgtype = KEY_ACQUIRE;
1413       km->type = type;
1414       DPRINTF(IDL_FINISHED,("key_acquire/created: 2\n"));
1415       /*
1416        * This is inefficient and slow.
1417        */
1418
1419       /*
1420        * We zero out sin_zero here for AF_INET addresses because
1421        * ip_output() currently does not do it for performance reasons.
1422        */
1423       if (src->sa_family == AF_INET)
1424   bzero((char *)(((struct sockaddr_in *)src)->sin_zero),
1425         sizeof(((struct sockaddr_in *)src)->sin_zero));
1426       if (dst->sa_family == AF_INET)
1427   bzero((char *)(((struct sockaddr_in *)dst)->sin_zero),
1428         sizeof(((struct sockaddr_in *)dst)->sin_zero));
1429
1430       bcopy((char *)src, (char *)(km + 1), src->sa_len);
```

```
1431        bcopy((char *)dst, (char *)((int)(km + 1) + ROUNDUP(src->sa_len)),
1432        dst->sa_len);
1433        DPRINTF(IDL_FINISHED,("key_acquire/created: 3\n"));
1434        created++;
1435      }
1436      if (key_sendup(p->socket, km))
1437        success++;
1438    }
1439
1440    if (km)
1441      KFREE(km);
1442
1443    /*
1444     *  Update the acquirelist
1445     */
1446    if (success) {
1447      if (!ap) {
1448        DPRINTF(IDL_EVENT,("Adding new entry in acquirelist\n"));
1449        KMALLOC(ap, struct key_acquirelist *, sizeof(struct key_acquirelist));
1450        if (ap == 0)
1451    return(success ? 0 : -1);
1452        bzero((char *)ap, sizeof(struct key_acquirelist));
1453        bcopy((char *)dst, (char *)ap->target, dst->sa_len);
1454        ap->type = etype;
1455        ap->next = key_acquirelist->next;
1456        key_acquirelist->next = ap;
1457      }
1458      DPRINTF(IDL_GROSS_EVENT,("Updating acquire counter and expiration time\n"));
1459      ap->count++;
1460      ap->expiretime = TIME_SECONDS + maxacquiretime;
1461    }
1462    DPRINTF(IDL_EVENT,("key_acquire: done! success=%d\n",success));
1463    return(success ? 0 : -1);
1464  }
1465
1466  /*----------------------------------------------------------------------
1467   * key_alloc():
1468   *      Allocate a security association to a socket.  A socket requesting
1469   *      unique keying (per-socket keying) is assigned a security assocation
1470   *      exclusively for its use.  Sockets not requiring unique keying are
1471   *      assigned the first security association which may or may not be
1472   *      used by another socket.
1473   ----------------------------------------------------------------------*/
1474  int key_alloc DEFARGS((type, src, dst, socket, unique_key, keynodep),
1475       u_int type AND
1476       SOCKADDR *src AND
1477       SOCKADDR *dst AND
1478       struct socket *socket AND
1479       u_int  unique_key AND
1480       struct key_tblnode **keynodep)
1481  {
1482    struct key_tblnode *keynode;
1483    char buf[MAXHASHKEYLEN];
```

```
1484   struct key_allocnode *np, *prevnp;
1485   struct key_so2spinode *newnp;
1486   int len;
1487   int indx;
1488
1489   DPRINTF(IDL_FINISHED,("Entering key_alloc w/type=%u!\n",type));
1490   if (!(src && dst)) {
1491     DPRINTF(IDL_ERROR,("key_alloc: received null src or dst!\n"));
1492     return(-1);
1493   }
1494
1495   /*
1496    * Search key allocation table
1497    */
1498   bzero((char *)&buf, sizeof(buf));
1499   len = key_createkey((char *)&buf, type, src, dst, 0, 1);
1500   indx = key_gethashval((char *)&buf, len, KEYALLOCTBLSIZE);
1501
1502 #define np_type np->keynode->secassoc->type
1503 #define np_state np->keynode->secassoc->state
1504 #define np_src np->keynode->secassoc->src
1505 #define np_dst np->keynode->secassoc->dst
1506
1507   prevnp = &keyalloctbl[indx];
1508   for (np = keyalloctbl[indx].next; np; np = np->next) {
1509     if ((type == np_type) && addrpart_equal(src, np_src) &&
1510   addrpart_equal(dst, np_dst) &&
1511   !(np_state & (K_LARVAL | K_DEAD | K_UNIQUE))) {
1512       if (!(unique_key))
1513   break;
1514       if (!(np_state & K_USED))
1515   break;
1516     }
1517     prevnp = np;
1518   }
1519
1520   if (np) {
1521     struct socketlist *newsp;
1522     CRITICAL_DCL
1523
1524     CRITICAL_START;
1525
1526     DPRINTF(IDL_EVENT,("key_alloc: found node to allocate\n"));
1527     keynode = np->keynode;
1528
1529     KMALLOC(newnp, struct key_so2spinode *, sizeof(struct key_so2spinode));
1530     if (newnp == 0) {
1531       DPRINTF(IDL_ERROR,("key_alloc: Can't alloc mem for so2spi node!\n"));
1532       CRITICAL_END;
1533       return(ENOBUFS);
1534     }
1535     KMALLOC(newsp, struct socketlist *, sizeof(struct socketlist));
1536     if (newsp == 0) {
```

```
1537        DPRINTF(IDL_ERROR,("key_alloc: Can't alloc mem for socketlist!\n"));
1538        if (newnp)
1539    KFREE(newnp);
1540        CRITICAL_END;
1541        return(ENOBUFS);
1542      }
1543
1544      /*
1545       * Add a hash entry into the so2spi table to
1546       * map socket to allocated secassoc.
1547       */
1548      DPRINTF(IDL_FINISHED,("key_alloc: adding entry to so2spi table..."));
1549      newnp->keynode = keynode;
1550      newnp->socket = socket;
1551      newnp->next = so2spitbl[((u_int32)socket) % SO2SPITBLSIZE].next;
1552      so2spitbl[((u_int32)socket) % SO2SPITBLSIZE].next = newnp;
1553      DPRINTF(IDL_FINISHED,("done\n"));
1554
1555      if (unique_key) {
1556        /*
1557         * Need to remove the allocation entry
1558         * since the secassoc is now unique and
1559         * can't be allocated to any other socket
1560         */
1561        DPRINTF(IDL_EVENT,("key_alloc: making keynode unique..."));
1562        keynode->secassoc->state |= K_UNIQUE;
1563        prevnp->next = np->next;
1564        KFREE(np);
1565        DPRINTF(IDL_EVENT,("done\n"));
1566      }
1567      keynode->secassoc->state |= K_USED;
1568      keynode->secassoc->state |= K_OUTBOUND;
1569      keynode->alloc_count++;
1570
1571      /*
1572       * Add socket to list of socket using secassoc.
1573       */
1574      DPRINTF(IDL_FINISHED,("key_alloc: adding so to solist..."));
1575      newsp->socket = socket;
1576      newsp->next = keynode->solist->next;
1577      keynode->solist->next = newsp;
1578      DPRINTF(IDL_FINISHED,("done\n"));
1579      *keynodep = keynode;
1580      CRITICAL_END;
1581      return(0);
1582    }
1583    *keynodep = NULL;
1584    return(0);
1585  }
1586
1587
1588  /*-------------------------------------------------------------------
1589   * key_free():
```

```
1590  *      Decrement the refcount for a key table entry.  If the entry is
1591  *      marked dead, and the refcount is zero, we go ahead and delete it.
1592  ----------------------------------------------------------------------*/
1593 void key_free DEFARGS((keynode),
1594      struct key_tblnode *keynode)
1595 {
1596   DPRINTF(IDL_GROSS_EVENT,("Entering key_free w/keynode=0x%x\n",
1597          (unsigned int)keynode));
1598   if (!keynode) {
1599     DPRINTF(IDL_ERROR,("Warning: key_free got null pointer\n"));
1600     return;
1601   }
1602   (keynode->ref_count)--;
1603   if (keynode->ref_count < 0) {
1604     DPRINTF(IDL_ERROR,("Warning: key_free decremented refcount to
      %d\n",keynode->ref_count));
1605   }
1606   if ((keynode->secassoc->state & K_DEAD) && (keynode->ref_count <= 0)) {
1607     DPRINTF(IDL_GROSS_EVENT,("key_free: calling key_delete\n"));
1608     key_delete(keynode->secassoc);
1609   }
1610 }
1611
1612 /*----------------------------------------------------------------------
1613  * getassocbyspi():
1614  *      Get a security association for a given type, src, dst, and spi.
1615  *
1616  *      Returns: 0 if sucessfull
1617  *               -1 if error/not found
1618  *
1619  *      Caller must convert spi to host order.  Function assumes spi is
1620  *      in host order!
1621  ----------------------------------------------------------------------*/
1622 int getassocbyspi DEFARGS((type, src, dst, spi, keyentry),
1623      u_int type AND
1624      SOCKADDR *src AND
1625      SOCKADDR *dst AND
1626      u_int32 spi AND
1627      struct key_tblnode **keyentry)
1628 {
1629   char buf[MAXHASHKEYLEN];
1630   int len, indx;
1631   struct key_tblnode *keynode, *prevkeynode = 0;
1632
1633   DPRINTF(IDL_FINISHED,("Entering getassocbyspi w/type=%u spi=%u\n",type,spi));
1634
1635   *keyentry = NULL;
1636   bzero(&buf, sizeof(buf));
1637   len = key_createkey((char *)&buf, type, src, dst, spi, 0);
1638   indx = key_gethashval((char *)&buf, len, KEYTBLSIZE);
1639   DPRINTF(IDL_FINISHED,("getassocbyspi: indx=%d\n",indx));
1640   DDO(IDL_FINISHED,dump_sockaddr(src);dump_sockaddr(dst));
1641   keynode = key_search(type, src, dst, spi, indx, &prevkeynode);
```

```
1642   DPRINTF(IDL_FINISHED,("getassocbyspi: keysearch ret=0x%x\n",
1643       (unsigned int)keynode));
1644   if (keynode && !(keynode->secassoc->state & (K_DEAD | K_LARVAL))) {
1645     DPRINTF(IDL_GROSS_EVENT,("getassocbyspi: found secassoc!\n"));
1646     (keynode->ref_count)++;
1647     keynode->secassoc->state |= K_USED;
1648     *keyentry = keynode;
1649   } else {
1650     DPRINTF(IDL_EVENT,("getassocbyspi: secassoc not found!\n"));
1651     return (-1);
1652   }
1653   return(0);
1654 }
1655
1656
1657 /*-------------------------------------------------------------------------
1658  * getassocbysocket():
1659  *      Get a security association for a given type, src, dst, and socket.
1660  *      If not found, try to allocate one.
1661  *      Returns: 0 if successfull
1662  *               -1 if error condition/secassoc not found (*keyentry = NULL)
1663  *                1 if secassoc temporarily unavailable (*keynetry = NULL)
1664  *                  (e.g., key mgnt. daemon(s) called)
1665  -------------------------------------------------------------------------*/
1666 int getassocbysocket DEFARGS((type, src, dst, socket, unique_key, keyentry),
1667      u_int type AND
1668      SOCKADDR *src AND
1669      SOCKADDR *dst AND
1670      struct socket *socket AND
1671      u_int unique_key AND
1672      struct key_tblnode **keyentry)
1673 {
1674   struct key_tblnode *keynode = 0;
1675   struct key_so2spinode *np;
1676   u_int realtype;
1677
1678   DPRINTF(IDL_FINISHED,("Entering getassocbysocket w/type=%u so=0x%x\n",
1679       type,(unsigned int)socket));
1680
1681   /*
1682    *  We treat esp-transport mode and esp-tunnel mode
1683    *  as a single type in the keytable.  This has a side
1684    *  effect that socket using both esp-transport and
1685    *  esp-tunnel will use the same security association
1686    *  for both modes.  Is this a problem?
1687    */
1688   realtype = type;
1689   if ((np = key_sosearch(type, src, dst, socket))) {
1690     if (np->keynode && np->keynode->secassoc &&
1691   !(np->keynode->secassoc->state & (K_DEAD | K_LARVAL))) {
1692       DPRINTF(IDL_FINISHED,("getassocbysocket: found secassoc!\n"));
1693       (np->keynode->ref_count)++;
1694       *keyentry = np->keynode;
```

```
1695        return(0);
1696      }
1697    }
1698
1699    /*
1700     * No secassoc has been allocated to socket,
1701     * so allocate one, if available
1702     */
1703    DPRINTF(IDL_GROSS_EVENT,("getassocbyso: can't find it, trying to allocate!\n"));
1704    if (key_alloc(realtype, src, dst, socket, unique_key, &keynode) == 0) {
1705      if (keynode) {
1706        DPRINTF(IDL_GROSS_EVENT,("getassocbyso: key_alloc found secassoc!\n"));
1707        keynode->ref_count++;
1708        *keyentry = keynode;
1709        return(0);
1710      } else {
1711        /*
1712         * Kick key mgnt. daemon(s)
1713         * (this should be done in ipsec_output_policy() instead or
1714         * selectively called based on a flag value)
1715         */
1716        DPRINTF(IDL_FINISHED,("getassocbyso: calling key mgnt daemons!\n"));
1717        *keyentry = NULL;
1718        if (key_acquire(realtype, src, dst) == 0)
1719    return (1);
1720        else
1721    return(-1);
1722      }
1723    }
1724    *keyentry = NULL;
1725    return(-1);
1726  }
1727
1728  /*-----------------------------------------------------------------------
1729   * key_xdata():
1730   *      Parse message buffer for src/dst/from/iv/key if parseflag = 0
1731   *      else parse for src/dst only.
1732   -----------------------------------------------------------------------*/
1733  int key_xdata DEFARGS((km, kip, parseflag),
1734       struct key_msghdr *km AND
1735       struct key_msgdata *kip AND
1736       int parseflag)
1737  {
1738    char *cp, *cpmax;
1739
1740    if (!km || (km->key_msglen <= 0))
1741      return (-1);
1742
1743    cp = (caddr_t)(km + 1);
1744    cpmax = (caddr_t)km + km->key_msglen;
1745
1746    /*
1747     * Assumes user process passes message with
```

```
1748     * correct word alignment.
1749     */
1750
1751    /*
1752     * Need to clean up this code later.
1753     */
1754
1755    /* Grab src addr */
1756    kip->src = (SOCKADDR *)cp;
1757    if (!kip->src->sa_len) {
1758      DPRINTF(IDL_MAJOR_EVENT,("key_xdata couldn't parse src addr\n"));
1759      return(-1);
1760    }
1761
1762    ADVANCE(cp, kip->src->sa_len);
1763
1764    /* Grab dest addr */
1765    kip->dst = (SOCKADDR *)cp;
1766    if (!kip->dst->sa_len) {
1767      DPRINTF(IDL_MAJOR_EVENT,("key_xdata couldn't parse dest addr\n"));
1768      return(-1);
1769    }
1770
1771    ADVANCE(cp, kip->dst->sa_len);
1772    if (parseflag == 1) {
1773      kip->from = 0;
1774      kip->key = kip->iv = 0;
1775      kip->keylen = kip->ivlen = 0;
1776      return(0);
1777    }
1778
1779    /* Grab from addr */
1780    kip->from = (SOCKADDR *)cp;
1781    if (!kip->from->sa_len) {
1782      DPRINTF(IDL_MAJOR_EVENT,("key_xdata couldn't parse from addr\n"));
1783      return(-1);
1784    }
1785
1786    ADVANCE(cp, kip->from->sa_len);
1787
1788    /* Grab key */
1789    if ((kip->keylen = km->keylen)) {
1790      kip->key = cp;
1791      ADVANCE(cp, km->keylen);
1792    } else
1793      kip->key = 0;
1794
1795    /* Grab iv */
1796    if ((kip->ivlen = km->ivlen))
1797      kip->iv = cp;
1798    else
1799      kip->iv = 0;
1800
```

```
1801   return (0);
1802 }
1803
1804
1805 int key_parse DEFARGS((kmp, so, dstfamily),
1806 struct key_msghdr **kmp AND
1807 struct socket *so AND
1808 int *dstfamily)
1809 {
1810   int error = 0, keyerror = 0;
1811   struct key_msgdata keyinfo;
1812   struct key_secassoc *secassoc = NULL;
1813   struct key_msghdr *km = *kmp;
1814
1815   DPRINTF(IDL_MAJOR_EVENT, ("Entering key_parse\n"));
1816
1817 #define senderr(e) \
1818   { error = (e); goto flush; }
1819
1820   if (km->key_msgvers != KEY_VERSION) {
1821     DPRINTF(IDL_CRITICAL,("keyoutput: Unsupported key message version!\n"));
1822     senderr(EPROTONOSUPPORT);
1823   }
1824
1825   km->key_pid = CURRENT_PID;
1826
1827   DDO(IDL_MAJOR_EVENT, printf("keymsghdr:\n"); dump_keymsghdr(km));
1828
1829   /*
1830    * Parse buffer for src addr, dest addr, from addr, key, iv
1831    */
1832   bzero((char *)&keyinfo, sizeof(keyinfo));
1833
1834   switch (km->key_msgtype) {
1835   case KEY_ADD:
1836     DPRINTF(IDL_MAJOR_EVENT,("key_output got KEY_ADD msg\n"));
1837
1838     if (key_xdata(km, &keyinfo, 0) < 0)
1839       goto parsefail;
1840
1841     /*
1842      * Allocate the secassoc structure to insert
1843      * into key table here.
1844      */
1845     KMALLOC(secassoc, struct key_secassoc *, sizeof(struct key_secassoc));
1846     if (secassoc == 0) {
1847       DPRINTF(IDL_CRITICAL,("keyoutput: No more memory!\n"));
1848       senderr(ENOBUFS);
1849     }
1850
1851     if (key_msghdr2secassoc(secassoc, km, &keyinfo) < 0) {
1852       DPRINTF(IDL_CRITICAL,("keyoutput: key_msghdr2secassoc failed!\n"));
1853       KFREE(secassoc);
```

```
1854        senderr(EINVAL);
1855      }
1856      DPRINTF(IDL_MAJOR_EVENT,("secassoc to add:\n"));
1857      DDO(IDL_MAJOR_EVENT,dump_secassoc(secassoc));
1858
1859      if ((keyerror = key_add(secassoc)) != 0) {
1860        DPRINTF(IDL_CRITICAL,("keyoutput: key_add failed\n"));
1861        if (secassoc->key)
1862    KFREE(secassoc->key);
1863        if (secassoc->iv)
1864    KFREE(secassoc->iv);
1865        KFREE(secassoc);
1866        if (keyerror == -2) {
1867    senderr(EEXIST);
1868        } else {
1869    senderr(ENOBUFS);
1870        }
1871      }
1872      break;
1873    case KEY_DELETE:
1874      DPRINTF(IDL_MAJOR_EVENT,("key_output got KEY_DELETE msg\n"));
1875
1876      if (key_xdata(km, &keyinfo, 1) < 0)
1877        goto parsefail;
1878
1879      KMALLOC(secassoc, struct key_secassoc *, sizeof(struct key_secassoc));
1880      if (secassoc == 0) {
1881        senderr(ENOBUFS);
1882      }
1883      if (key_msghdr2secassoc(secassoc, km, &keyinfo) < 0) {
1884        KFREE(secassoc);
1885        senderr(EINVAL);
1886      }
1887      if (key_delete(secassoc) != 0) {
1888        if (secassoc->iv)
1889    KFREE(secassoc->iv);
1890        if (secassoc->key)
1891    KFREE(secassoc->key);
1892        KFREE(secassoc);
1893        senderr(ESRCH);
1894      }
1895      if (secassoc->iv)
1896        KFREE(secassoc->iv);
1897      if (secassoc->key)
1898        KFREE(secassoc->key);
1899      KFREE(secassoc);
1900      break;
1901    case KEY_UPDATE:
1902      DPRINTF(IDL_EVENT,("key_output got KEY_UPDATE msg\n"));
1903
1904      if (key_xdata(km, &keyinfo, 0) < 0)
1905        goto parsefail;
1906
```

```
1907      KMALLOC(secassoc, struct key_secassoc *, sizeof(struct key_secassoc));
1908      if (secassoc == 0) {
1909        senderr(ENOBUFS);
1910      }
1911      if (key_msghdr2secassoc(secassoc, km, &keyinfo) < 0) {
1912        KFREE(secassoc);
1913        senderr(EINVAL);
1914      }
1915      if ((keyerror = key_update(secassoc)) != 0) {
1916        DPRINTF(IDL_CRITICAL,("Error updating key entry\n"));
1917        if (secassoc->iv)
1918    KFREE(secassoc->iv);
1919        if (secassoc->key)
1920    KFREE(secassoc->key);
1921        KFREE(secassoc);
1922        senderr(keyerror);
1923      }
1924      KFREE(secassoc);
1925      break;
1926    case KEY_GET:
1927      DPRINTF(IDL_EVENT,("key_output got KEY_GET msg\n"));
1928
1929      if (key_xdata(km, &keyinfo, 1) < 0)
1930        goto parsefail;
1931
1932      if (key_get(km->type, (SOCKADDR *)keyinfo.src,
1933      (SOCKADDR *)keyinfo.dst,
1934      km->spi, &secassoc) != 0) {
1935        DPRINTF(IDL_EVENT,("keyoutput: can't get key\n"));
1936        senderr(ESRCH);
1937      }
1938
1939      if (secassoc) {
1940        int newlen;
1941
1942        DPRINTF(IDL_EVENT,("keyoutput: Found secassoc!\n"));
1943        newlen = sizeof(struct key_msghdr) + ROUNDUP(secassoc->src->sa_len) +
1944    ROUNDUP(secassoc->dst->sa_len) + ROUNDUP(secassoc->from->sa_len) +
1945      ROUNDUP(secassoc->keylen) + ROUNDUP(secassoc->ivlen);
1946        DPRINTF(IDL_EVENT,("keyoutput: newlen=%d\n", newlen));
1947        if (newlen > km->key_msglen) {
1948    struct key_msghdr *newkm;
1949
1950    DPRINTF(IDL_EVENT,("keyoutput: Allocating new buffer!\n"));
1951    KMALLOC(newkm, struct key_msghdr *, newlen);
1952    if (newkm == 0) {
1953      senderr(ENOBUFS);
1954    }
1955    bcopy((char *)km, (char *)newkm, km->key_msglen);
1956    DPRINTF(IDL_FINISHED,("keyoutput: 1\n"));
1957    KFREE(km);
1958    *kmp = km = newkm;
1959    DPRINTF(IDL_CRITICAL, ("km->key_msglen = %d, newlen = %d\n",
```

```
1960                km->key_msglen, newlen));
1961    km->key_msglen = newlen;
1962        }
1963        DPRINTF(IDL_FINISHED,("keyoutput: 2\n"));
1964        if (key_secassoc2msghdr(secassoc, km, &keyinfo)) {
1965    DPRINTF(IDL_CRITICAL,("keyoutput: Can't create msghdr!\n"));
1966    senderr(EINVAL);
1967        }
1968        DPRINTF(IDL_FINISHED,("keyoutput: 3\n"));
1969      }
1970      break;
1971    case KEY_GETSPI:
1972      DPRINTF(IDL_EVENT,("key_output got KEY_GETSPI msg\n"));
1973
1974      if (key_xdata(km, &keyinfo, 1) < 0)
1975        goto parsefail;
1976
1977      if ((keyerror = key_getspi(km->type, keyinfo.src, keyinfo.dst,
1978                km->lifetime1, km->lifetime2,
1979                &(km->spi))) != 0) {
1980        DPRINTF(IDL_CRITICAL,("keyoutput: getspi failed error=%d\n", keyerror));
1981        senderr(keyerror);
1982      }
1983      break;
1984    case KEY_REGISTER:
1985      DPRINTF(IDL_EVENT,("key_output got KEY_REGISTER msg\n"));
1986      key_register(so, km->type);
1987      break;
1988    case KEY_DUMP:
1989      DPRINTF(IDL_EVENT,("key_output got KEY_DUMP msg\n"));
1990      error = key_dump(so);
1991      return(error);
1992      break;
1993    case KEY_FLUSH:
1994      DPRINTF(IDL_EVENT,("key_output got KEY_FLUSH msg\n"));
1995      key_flush();
1996      break;
1997    default:
1998      DPRINTF(IDL_CRITICAL,("key_output got unsupported msg type=%d\n",
1999              km->key_msgtype));
2000      senderr(EOPNOTSUPP);
2001    }
2002
2003    goto flush;
2004
2005  parsefail:
2006    keyinfo.dst = NULL;
2007    error = EINVAL;
2008
2009  flush:
2010    if (km)
2011      km->key_errno = error;
2012
```

```
2013   if (dstfamily)
2014     *dstfamily = keyinfo.dst ? keyinfo.dst->sa_family : 0;
2015
2016   DPRINTF(IDL_MAJOR_EVENT, ("key_parse exiting with error=%d\n", error));
2017   return error;
2018 }
```