VLT Software Workshop - May 97

Event Handler (EVH)

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INTRODUCTION

The Event Handling Toolkit is a set of C++ classes to develop event driven applications on workstations.
Development of applications requires a knowledge of concepts for event driven programs and object-oriented programming techniques.

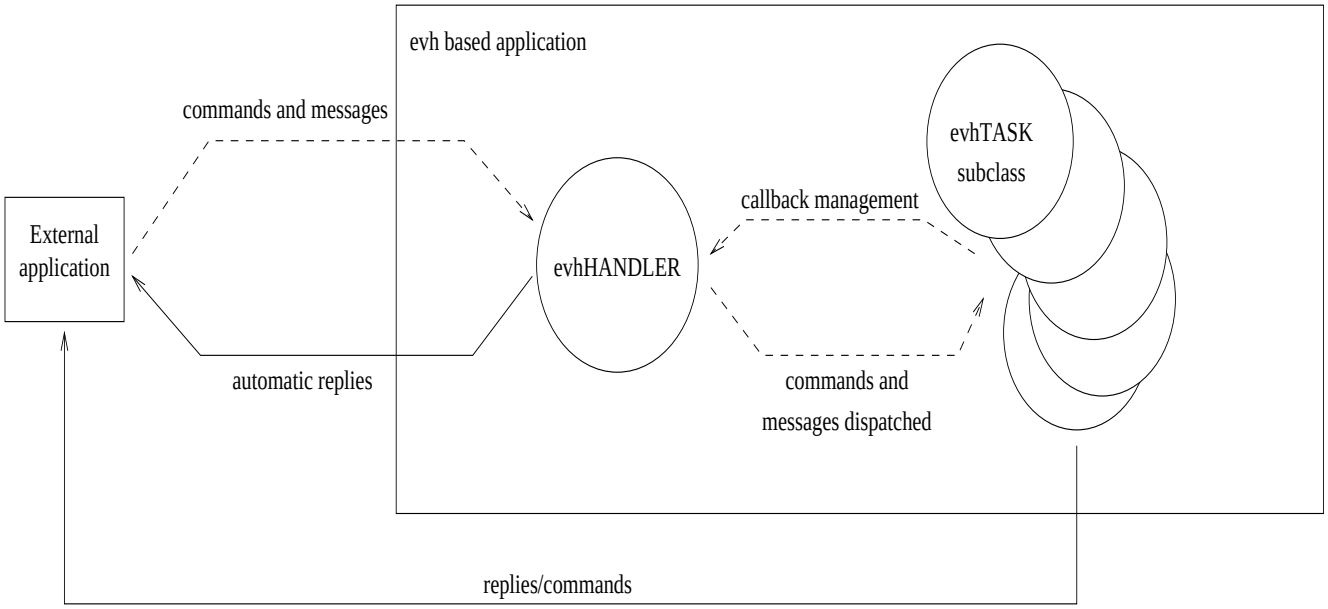
It runs only on Workstation.

Purpose of EVH is:

- Provide a framework to implement easily workstation applications that receive and send commands and messages.
- Implement in a standard way common application patterns
- Prevent common errors in applications
- Support object-oriented design and development
- Provide tools for testing and debugging of applications.

The main loop

- Processes are designed in an event driven way
- The implementation is based around the *evhHANDLER* class



The design of every process consists mainly in the design of the independent objects providing the methods to be attached as callbacks to the events

evh features

- The following events are handled:
  - commands
  - replies and error replies
  - time out notifications
  - cyclic timers
  - data base events
  - alarms
  - signals
  - file input
- callbacks are stored in a dynamic dictionary
- callbacks must return within a "command response time" of 1 second
- a wide set of ready-made classes implements standard behaviors and event handling protocols

Using EVH

In the Makefile:

- link the CCS standard libraries
- link the C++ standard libraries (`the vltMakefile define C++ should be used`)
- link the required support library `fnd`
- link the ECCS library `eccs`
- link the EVH library `evh`

```
Example:

EXECUTABLE=evhTest

evhTest_OBJECTS= eccsTest
evhTest_LIBS   = evh eccs fnd C++ CCS
```

In the code:

```
#include "evhHANDLER.h"
int main(int, char *argv[])
{
    ccsCOMPL_STAT stat;
    stat = ccsInit(argv[0]);
    eccsErrLog(stat,"Error in Init ");

    evhHandler->MainLoop();

    stat = ccsExit();
    eccsErrLog(stat,"Error in ccsExit");
}
```

Example 1: The basic code structure

```
#define _POSIX_SOURCE 1
#include "vltPort.h"

// Include files for EasyCCS and Evh Toolkit
#include "ECCS.h"
#include "evhHANDLER.h"

// Include for the basic class
#include "evhTASK.h"

/*****************************************/
/* Definition for the APPLICATION class   */
/*****************************************/
class APPLICATION: public evhTASK
{
  public:
    APPLICATION();

    // Definition for the callback to be used receiving the
    // "SAMPLE" command
    evhCB_COMPL_STAT  SampleCB(msgMESSAGE &msg, void *udata);

}; /* end class APPLICATION */


/* Body of the constructor method.              */
/* It is called whenever an instance is created */
APPLICATION::APPLICATION()
{
    /* This variable is used to define the event:    */
    /* a message of type msgTYPE_COMMAND, with       */
    /* Command="SAMPLE", no regard for the CommandId */
    evhMSG_TYPE_KEY key(msgTYPE_COMMAND,"SAMPLE");

    /* This variable is used to define the callback:     */
```

```
    /* It is a method of this object, no user parameters */
    evhOBJ_CALLBACK cb(this,(evhCB_METHOD)SampleCB);

    /* Then the callback is attached to the event handler */
    evhHandler->AddCallback(key,cb);
}

evhCB_COMPL_STAT  APPLICATION::SampleCB(msgMESSAGE &msg, void *)
{
    printf("Received a SAMPLE command: %s\n", msg.Buffer());

    /* Send back the reply to the command */
    msg.SendReply("Command received!");

    /* The callback must remain installed for another command */
    return evhCB_NO_DELETE;
}



/*********************************/
/* main procedure                */
/*********************************/

int main(int , char *argv[])
{
    ccsInit(argv[0]);

    /* Create the instance of APPLICATION */
    APPLICATION app; USE(app);

    /* enter the main loop */
    evhHandler->MainLoop();

    ccsExit();
}
```

The standard VLT application

A standard VLT application can be implemented based on the evhSTD_COMMAND_CLASS, that provides:

- Standard commands:
  - PING
  - INIT
  - STATE,STATUS
  - STANDBY,ONLINE,OFF
  - SELFTEST, TEST
  - SIMULAT, STOPSIM
  - VERBOSE
  - VERSION
  - STOP
  - EXIT, KILL, BREAK
- Standard database point:

```
CLASS evhSTD_COMMANDS
BEGIN
    ATTRIBUTE INT32 state evhSTATE_OFF
    ATTRIBUTE LOGICAL simulation
    ATTRIBUTE LOGICAL verbose
END
```

Example 2: standard application

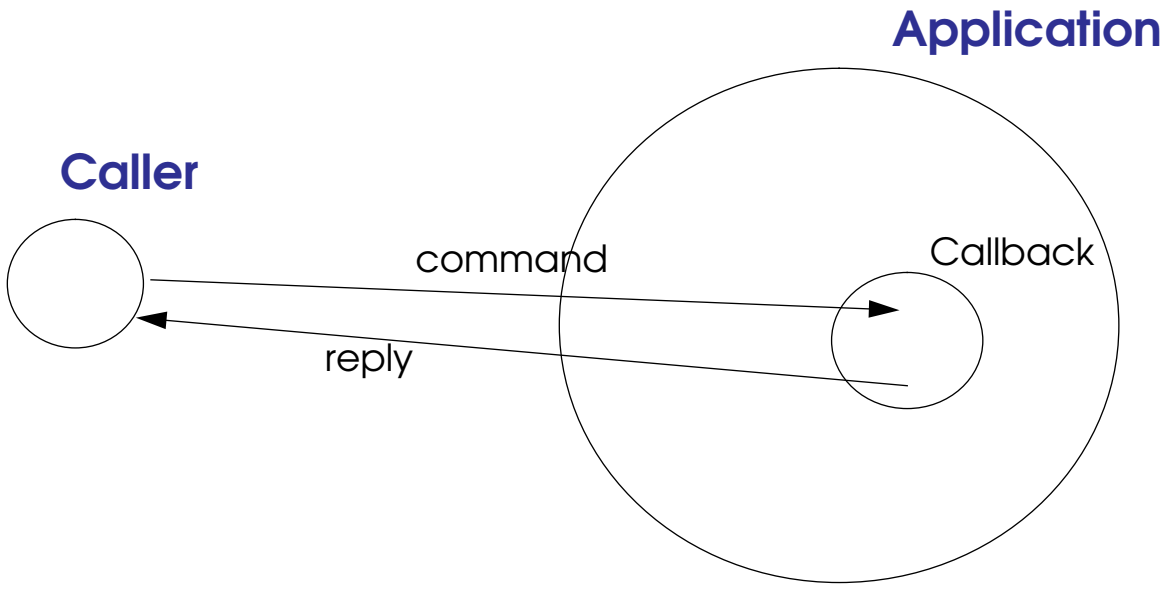
The following code (plus a proper point in the online database) defines a simple application fully compliant to VLT standards:

```
// Include files for EasyCCS and Evh Toolkit
#include "ECCS.h"
#include "evhHANDLER.h"

// Include for the basic class
#include "evhSTD_COMMANDS.h"


/*********************************/
/* main procedure                */
/*********************************/

int main(int , char *argv[])
{
    ccsInit(argv[0]);

    /* Create the instance of APPLICATION */
    /* The call to the macro USE() prevents the GCC compiler     */
    /* from issuing a warning: it assumes that app is not used ! */
    evhSTD_COMMANDS app("Appl_data:evhTest"); USE(app);

    printf("Entering the main loop and waiting for commands!\n");

    /* enter the main loop */
    evhHandler->MainLoop();

    ccsExit();
}
```

Handling “immediate” commands

“Immediade” commands are the simples case: an application receive a command, deals with it and sends an immediate reply to the originator.

“Immediate” commands are implemented writing yust one callback to receive the command.



Example 3: an immediate command

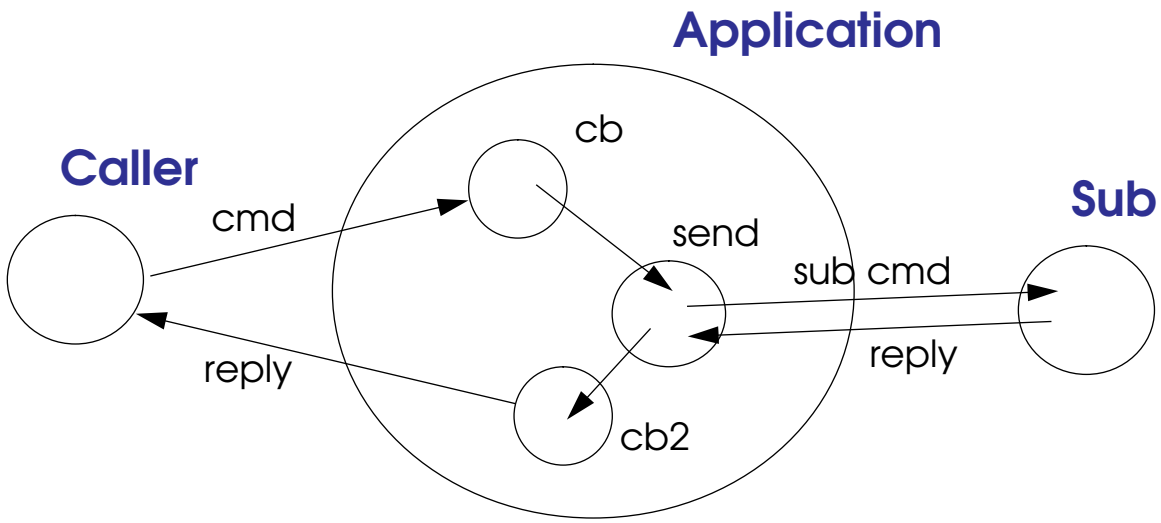
```
// Include files for EasyCCS and Evh Toolkit
#include "ECCS.h"
#include "evhHANDLER.h"

// Include for the basic class
#include "evhSTD_COMMANDS.h"

class APPLICATION: public evhSTD_COMMANDS
{
  public:
    APPLICATION(const dbSYMADDRESS  dbPoint);

    // Definition for the callback to be used receiving the
    // "SAMPLE" command
    evhCB_COMPL_STAT  SampleCB(msgMESSAGE &msg, void *udata);

}; /* end class APPLICATION */


/* Body of the constructor method.              */
/* It is called whenever an instance is created */
APPLICATION::APPLICATION(const dbSYMADDRESS  dbPoint) :
    evhSTD_COMMANDS(dbPoint)
{
    /* This variable is used to define the event:    */
    /* a message of type msgTYPE_COMMAND, with       */
    /* Command="SAMPLE", no regard for the CommandId */
    evhMSG_TYPE_KEY key(msgTYPE_COMMAND,"SAMPLE");

    /* This variable is used to define the callback:     */
    /* It is a method of this object, no user parameters */
    evhOBJ_CALLBACK cb(this,(evhCB_METHOD)SampleCB);

    /* Then the callback is attached to the event handler */
    evhHandler->AddCallback(key,cb);
```

```
}

/* Body for the callback */
evhCB_COMPL_STAT  APPLICATION::SampleCB(msgMESSAGE &msg, void *)
{
    /* Just print the message buffer on stdout */
    printf("Received a SAMPLE command: %s\n", msg.Buffer());

    /* Send back the reply to the command */
    msg.SendReply("Command received!");

    /* The callback must remain installed for another command */
    return evhCB_NO_DELETE;
}


/**********************************/
/* main procedure                 */
/**********************************/

int main(int , char *argv[])
{
    ccsInit(argv[0]);

    /* Create the instance of APPLICATION */
    APPLICATION app("Appl_data:evhTest"); USE(app);

    printf("Entering the main loop and waiting for commands!\n");

    /* enter the main loop */
    evhHandler->MainLoop();

    ccsExit();
}
```

Handling “tranfer” commands

“Transfer” commands are a typical case for workstation coordination applications: an application receives a command, deals with it and send one sub-command to the controlled processes. When they are done it must sends the final reply to the originator.

“Transfer” commands are implemented using the evhCOMMAND or the evhDB_CMD_SEND class and some support callbacks to receive the command and send the replies.



Example 4: a transfer command

```
#define _POSIX_SOURCE 1
#include "vltPort.h"

#include "ECCS.h"
#include "evhHANDLER.h"
#include "evhCOMMAND.h"
#include "evhSTD_COMMANDS.h"

class APPLICATION: public evhSTD_COMMANDS
{
  public:
    APPLICATION(const dbSYMADDRESS  dbPoint);

    // Definition for the callback to be used receiving the
    // "SAMPLE" command
    evhCB_COMPL_STAT  SampleCB(msgMESSAGE &msg, void *udata);
    evhCB_COMPL_STAT  EndSampleCB(msgMESSAGE &msg, void *udata);
    evhCB_COMPL_STAT  ErrSampleCB(msgMESSAGE &msg, void *udata);
    evhCB_COMPL_STAT  TimeoutSampleCB(msgMESSAGE &msg, void *udata);

  private:
    evhCOMMAND cmd;
    msgMESSAGE origMsg;

}; /* end class APPLICATION */


/* Body of the constructor method.              */
/* It is called whenever an instance is created */
APPLICATION::APPLICATION(const dbSYMADDRESS  dbPoint) :
    evhSTD_COMMANDS(dbPoint)
{
    evhMSG_TYPE_KEY key(msgTYPE_COMMAND);
    evhOBJ_CALLBACK cb(this,(evhCB_METHOD)SampleCB);
    ccsTIMEVAL      interval;
```

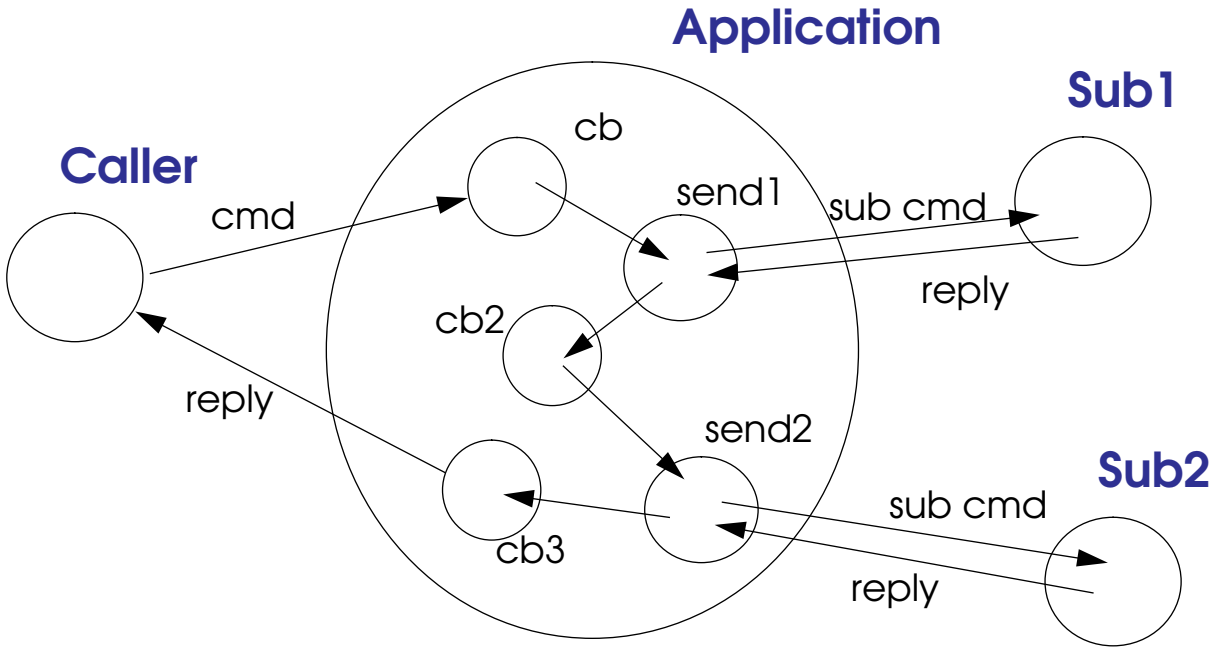
```
    /* Then the callback is attached to the event handler */
    evhHandler->AddCallback(key.Command("SAMPLE"),
                cb.Proc((evhCB_METHOD)SampleCB));

    interval.tv_sec  = 5;
    interval.tv_usec = 0;

    cmd.Reply(cb.Proc((evhCB_METHOD)EndSampleCB));
    cmd.ErrReply(cb.Proc((evhCB_METHOD)ErrSampleCB));
    cmd.Timeout(cb.Proc((evhCB_METHOD)TimeoutSampleCB),interval);
}

evhCB_COMPL_STAT  APPLICATION::SampleCB(msgMESSAGE &msg, void *)
{
    /* Just print the message buffer on stdout */
    printf("Received a SAMPLE command: %s\n", msg.Buffer());

    /* Stores the original message */
    origMsg = msg;

    /* Send the new message */
    msgMESSAGE send;

    send.Command("TRANS");
    send.Destenv(getenv("RTAPENV"));
    send.Buffer("test buffer");
    send.Destproc("evhDummy");

    cmd.Send(send);

    /* The callback must remain installed for another command */
    return evhCB_NO_DELETE;
}

evhCB_COMPL_STAT  APPLICATION::EndSampleCB(msgMESSAGE &msg, void *)
{
    printf("Received a reply to TRANSFER command: %s\n", msg.Buffer());
```

```
    /* Send back the reply to the command */
    if( msg.LastReply() )
        {
        origMsg.SendReply("Command completed!");
        }
    /* The callback must remain installed for another command */
    return evhCB_DELETE;
}

evhCB_COMPL_STAT  APPLICATION::ErrSampleCB(msgMESSAGE &, void *)
{
    printf("Received an error reply to TRANSFER command\n");

    ErrAdd("eccs",eccsERR_GENERIC,__FILE_LINE__);
    if( origMsg.SendReply(ErrStack()) == FAILURE )
        ErrAdd("eccs",eccsERR_GENERIC,__FILE_LINE__);
    ErrStackClose();    // Error has no consequences here
                        // and can be recovered

    return evhCB_DELETE;
}

evhCB_COMPL_STAT  APPLICATION::TimeoutSampleCB(msgMESSAGE &, void *)
{
    printf("Timeout in TRANSFER command\n");

    ErrAdd("eccs",eccsERR_GENERIC,__FILE_LINE__);
    if( origMsg.SendReply(ErrStack()) == FAILURE )
        ErrAdd("eccs",eccsERR_GENERIC,__FILE_LINE__);
    ErrStackClose();    // Error has no consequences here
                        // and can be recovered

    return evhCB_DELETE;
}
```

Multi step commands

In "multi step" an application receives a command, deals with it and send one sub-command a controlled processes. When the reply comes, some new elaboration is done and a new command is sent and so on for as many steps are needed.

"Multi step" commands are implemented using the evhCOMMAND or the evhDB_CMD_SEND class.



Example 5: a multi step command

```
class APPLICATION: public evhSTD_COMMANDS
{
  public:
    APPLICATION(const dbSYMADDRESS  dbPoint);

    evhCB_COMPL_STAT  SampleCB(msgMESSAGE &msg, void *udata);
    evhCB_COMPL_STAT  Step1SampleCB(msgMESSAGE &msg, void *udata);
    evhCB_COMPL_STAT  EndSampleCB(msgMESSAGE &msg, void *udata);
    evhCB_COMPL_STAT  ErrSampleCB(msgMESSAGE &msg, int step);
    evhCB_COMPL_STAT  TimeoutSampleCB(msgMESSAGE &msg, int step);

  private:
    evhCOMMAND cmd1;
    evhCOMMAND cmd2;
    msgMESSAGE origMsg;

}; /* end class APPLICATION */

APPLICATION::APPLICATION(const dbSYMADDRESS  dbPoint) :
    evhSTD_COMMANDS(dbPoint)
{
    evhMSG_TYPE_KEY key(msgTYPE_COMMAND);
    evhOBJ_CALLBACK cb(this,(evhCB_METHOD)SampleCB);
    ccsTIMEVAL      interval;

    evhHandler->AddCallback(key.Command("SAMPLE"),
                cb.Proc((evhCB_METHOD)SampleCB));

    interval.tv_sec  = 5;
    interval.tv_usec = 0;

    cmd1.Reply(cb.Proc((evhCB_METHOD)Step1SampleCB));
    cmd1.ErrReply(cb.Proc((evhCB_METHOD)ErrSampleCB).UserData((void*)1));
    cmd1.Timeout(cb.Proc((evhCB_METHOD)TimeoutSampleCB).UserData((void*)1),
         interval);
```

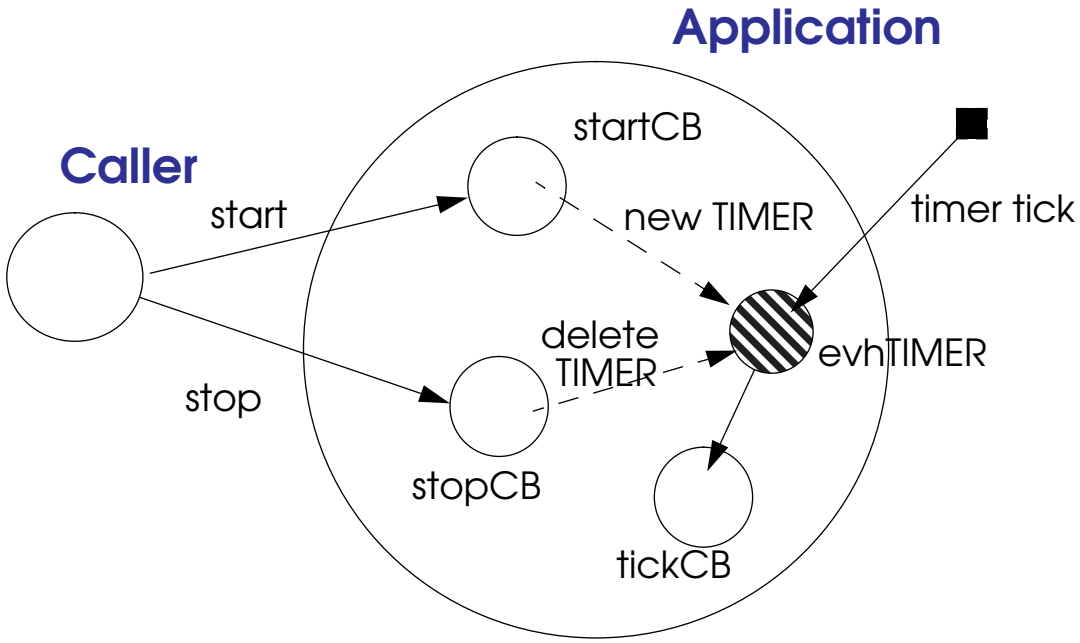
```
    cmd2.Reply(cb.Proc((evhCB_METHOD)EndSampleCB));
    cmd2.ErrReply(cb.Proc((evhCB_METHOD)ErrSampleCB).UserData((void*)2));
   cmd2.Timeout(cb.Proc((evhCB_METHOD)TimeoutSampleCB).UserData((void*)2),
            interval);
}

evhCB_COMPL_STAT  APPLICATION::SampleCB(msgMESSAGE &msg, void *)
{
    printf("Received a SAMPLE command: %s\n", msg.Buffer());

    origMsg = msg;

    msgMESSAGE send;

    send.Command("TRANS");
    send.Destenv(getenv("RTAPENV"));
    send.Buffer("test buffer");
    send.Destproc("evhDummy");

    cmd1.Send(send);

    return evhCB_NO_DELETE;
}

evhCB_COMPL_STAT  APPLICATION::Step1SampleCB(msgMESSAGE &msg, void *)
{
    printf("Received a reply to TRANSFER command: %s\n", msg.Buffer());

    /* Send the message for the second step */
    msgMESSAGE send;

    send.Command("TRANS_2");
    send.Destenv(getenv("RTAPENV"));
    send.Buffer("test buffer");
    send.Destproc("evhDummy");

    cmd2.Send(send);
```

```
    return evhCB_DELETE;
}

evhCB_COMPL_STAT  APPLICATION::EndSampleCB(msgMESSAGE &msg, void *)
{
    printf("Received a reply to TRANSFER_2 command: %s\n", msg.Buffer());

    /* Send back the reply to the command */
    if( msg.LastReply() )
        origMsg.SendReply("Command completed!");
    return evhCB_DELETE;
}

evhCB_COMPL_STAT  APPLICATION::ErrSampleCB(msgMESSAGE &,  int step)
{
    printf("Received an error reply on step %d\n",step);

    ErrAdd("eccs",eccsERR_GENERIC,__FILE_LINE__);
    if( origMsg.SendReply(ErrStack()) == FAILURE )
        ErrAdd("eccs",eccsERR_GENERIC,__FILE_LINE__);
    ErrStackClose();
    return evhCB_DELETE;
}

evhCB_COMPL_STAT  APPLICATION::TimeoutSampleCB(msgMESSAGE &,  int step)
{
    printf("Timeout in step %d\n",step);

    ErrAdd("eccs",eccsERR_GENERIC,__FILE_LINE__);
    if( origMsg.SendReply(ErrStack()) == FAILURE )
        ErrAdd("eccs",eccsERR_GENERIC,__FILE_LINE__);
    ErrStackClose();
    return evhCB_DELETE;
}
```

Cyclical timers

Another typical design pattern involves starting and stopping (for example via commands) a cyclical timer.

"Cyclical timers" are implemented using the evhTIMER class.



Example 6: Cyclical timer

```
#define _POSIX_SOURCE 1
#include "vltPort.h"
#include "ECCS.h"
#include "evhHANDLER.h"

// Include for the basic class
#include "evhCOMMAND.h"
#include "evhSTD_COMMANDS.h"
#include "evhTIMER.h"

class APPLICATION: public evhSTD_COMMANDS
{
  public:
    APPLICATION(const dbSYMADDRESS  dbPoint);

    evhCB_COMPL_STAT  TimerStartCB(msgMESSAGE &msg, void *udata);
    evhCB_COMPL_STAT  TimerStopCB(msgMESSAGE &msg, void *udata);
    evhCB_COMPL_STAT  TickCB(msgMESSAGE &msg, void *udata);

  private:
    evhTIMER *timer;

}; /* end class APPLICATION */

APPLICATION::APPLICATION(const dbSYMADDRESS  dbPoint) :
    evhSTD_COMMANDS(dbPoint)
{
    evhMSG_TYPE_KEY key(msgTYPE_COMMAND);
    evhOBJ_CALLBACK cb(this);

    evhHandler->AddCallback(key.Command("TSTART"),
                cb.Proc((evhCB_METHOD)TimerStartCB));
    evhHandler->AddCallback(key.Command("TSTOP"),
                cb.Proc((evhCB_METHOD)TimerStopCB));
}
```

```
evhCB_COMPL_STAT  APPLICATION::TimerStartCB(msgMESSAGE &msg, void *)
{
    printf("Received a TSTART command: %s\n", msg.Buffer());

    evhOBJ_CALLBACK cb(this,(evhCB_METHOD)TickCB);
    ccsTIMEVAL      interval;

    interval.tv_sec  = 2;

    /* If the timer already exist, return an error */
    if(timer)
    {
    ErrAdd("eccs",eccsERR_GENERIC,__FILE_LINE__);
    if( msg.SendReply(ErrStack()) == FAILURE )
        ErrAdd("eccs",eccsERR_GENERIC,__FILE_LINE__);
    ErrStackClose();   // Error has no consequences here
    }
    else
    {
    /* The   new evhTIMER()     call, returns a pointer to the       */
    /* newly created object. This pointer can be stored to delete    */
    /* explicitly the timeout object                                  */
    timer = new evhTIMER(cb,interval);

    /* Send back the reply to the command */
    if( msg.SendReply("Command completed!") == FAILURE )
        {
        ErrAdd("eccs",eccsERR_GENERIC,__FILE_LINE__);
        ErrStackClose();   // Error has no consequences here
        }
    }
    return evhCB_NO_DELETE;
}

evhCB_COMPL_STAT  APPLICATION::TimerStopCB(msgMESSAGE &msg, void *)
{
    printf("Received a TSTOP command: %s\n", msg.Buffer());
```

```
    /* If the timer is not running, return an error */
    if(!timer)
    {
    ErrAdd("eccs",eccsERR_GENERIC,__FILE_LINE__);
    if( msg.SendReply(ErrStack()) == FAILURE )
        ErrAdd("eccs",eccsERR_GENERIC,__FILE_LINE__);
    ErrStackClose();   // Error has no consequences here
    }
    else
    {
    delete timer;
    timer = NULL;

    /* Send back the reply to the command */
    if( msg.SendReply("Command completed!") == FAILURE )
        {
        ErrAdd("eccs",eccsERR_GENERIC,__FILE_LINE__);
        ErrStackClose();   // Error has no consequences here
        }
    }
    return evhCB_NO_DELETE;
}

evhCB_COMPL_STAT  APPLICATION::TickCB(msgMESSAGE &, void *)
{
    printf("TICK: a new tick in my timer\n");

    return evhCB_NO_DELETE;
}
```

Conclusion

This presentation has shown only some of the most important aspects of the library.

For more details look at:

- VLT Software - CCS Event Tool Kit User Manual (VLT-MAN-ESO-17210-0771)

- Code examples in evh <mod>/test directory