The Melody Controller Emulator is a software allowing to run Melody logic on a MS Windows machine. No Melody Controller hardware is necessary. Each physical controller (PM875) is mapped into a soft controller running in a separate task on the Windows machine.

The Emulator software provides all functionalities needed in a training simulation environment such as loading and saving control system states. Furthermore it may be used for testing the control logic during design and engineering.

The complete simulation environment may be used to verify changes in the control logic before implementation in the plant or for optimization and modification studies of the plant or the control logic.

The Melody Controller Emulator provides all Interfaces needed for use in a simulation environment.
Technical description
Melody logic is exported from the Melody engineering tool (Composer) in form of files, which then are loaded into the emulator. From version 5.2 on no special version of the Composer Software is necessary. Software add-ons needed for earlier versions of Composer are added in form of parcels.

With the Melody Controller Emulator the current state of the control logic can be saved and loaded, allowing simulator environments to be started in different operating conditions.

With the change of the control logic the initial conditions (ICs) of the logic are no longer valid, as functions may not even exist anymore or new functions may have been added. However, the ICs can be upgraded to match with the new logic as described in the following section.

The emulator software can be controlled remotely from another machine in the network using DCOM, allowing saving of ICs of the Melody system synchronously with the plant simulation. ICs can be saved periodically, which allows jumping back into the past of the training simulation session for a certain time span (backtracking) to e.g. repeat operator control actions during a training.

An overall time synchronisation for the complete simulator system (plant simulation, Melody Controller emulation, HSI system) is possible using NTP.

All systems run with the same current time, so that after loading an IC no historical data will be overwritten.

The simulation speed may be adjusted e.g. in order to move quickly through less interesting time spans during training.

The data exchange for the signals between the process simulator and the emulator is done via an OPC DA server integrated in the emulator. These data correspond to the data exchanged via the I/O cards of the real system. The name space of the OPC server is automatically built from the current control logic. A list of all data to be exchanged with the process simulator is generated automatically.

Upgrading of initial conditions
Initial conditions (ICs) can be upgraded using a tool coming with the emulator software. As a prerequisite to apply that tool the old application with its ICs and the new application have to exist already.

The workflow loading the emulator is:
- create a new emulator application,
- load it with the current version of the control logic and then
- upgrade the ICs of the old application into the new emulator application.

Online loading mode
For commissioning in a simulator environment online loading mode is possible. For each Melody function modified (released & commissioned) in Composer a disassembler file of the corresponding controller is created and loaded into the emulator. Only the affected controller needs to be shutdown. The loading process will take a few minutes. ICs are upgraded in the background. The coupling to the HSI is updated automatically.

Figure 1 Data exchange diagram
System requirements
The emulation software has already been used in following Windows versions:
- MS Windows NT
- MS Windows 2000
- MS Windows XP (32 and 64 bit) up to SP2
- MS Windows Server 2003 (R2, 32 and 64 bit)
- MS Windows Server 2008 32 bit
- MS Windows Server 2008 R2

The software is compatible to other Microsoft Windows operation systems. Also some extra software support by ABB might be necessary.

Hardware requirements depend on the size of the Melody system. As a rough guideline 100 MB memory for each PM875 plus 1 GB for the system should be available. Also the number of CPUs depend on the size of the system. As a very rough guide one core for up to 10 Melody controllers is necessary.

Examples:
- 18 controllers on a virtual machine on an ESX server using 4 CPU cores (Intel Xeon X5350 (2,67GHz)) and 3 GB memory with a system load of around 50%
- 40 controllers (~ 30,000 IO signals) on a machine with 2 Intel Xeon X5550 (2,67GHz) and 12 GB RAM on Windows Server 2003 run with a system load of 25-30%.

Restrictions of the Melody Controller Emulator
There are some restrictions of the Emulation software as compared to the real system:
- Not all Melody I/O blocks using the peripheral units CAC10 and CBC11 are yet fully supported in the emulation software. For a list of supported I/O blocks and their supported configuration parameters see the AC 870P/Melody Emulator HTML documentation (chapter 1, IDxx) which can be requested from ABB AG, Power Systems Division (see contact information).
- Not all parameters are evaluated within the emulation, e.g. CAC10 or CBC11 parameters which are not reasonable within a simulation environment, such as voltage observation.
- Signal simulations forcing in Composer differ from simulations in the original system. If a simulation is inserted in the Composer of an emulated system the signal value will change globally. Here it is not possible to change a block input without changing the value of the same signal at all other block inputs.
- The emulator does not emulate the behaviour of the Control network (CNet). In the original system the data which are exchanged between the different Controllers are exchanged via the network. This results in minor delays according to the network topology. In the emulator the data are written to the PrimoS database. That means that the data is available in the whole system without any delay.
- The emulator emulates the task scheduler of the controllers. Due to the fact that the emulator is triggered at a minimum cycle time configured in the database and depending on the cycle time of the process simulator, the tasks can only be calculated with this as a minimum cycle time. Usually the minimum cycle time is 100 ms.
Cycle time
The minimal cycle of the emulator depends on the size of the control system and the hardware the emulator is running on. Usually minimum cycle times of 100ms are configured.

Installation
The emulator software includes all needed software, the documentation and a demo application. Within the documentation the setup of the emulator system and a new emulator application is explained in detail. The demo project contains some simple control logic functions on one AC 870P controller to test the emulator software installation.

Overview of the components of the Melody Controller Emulator
The basis of the Melody Controller Emulator is a PrimoS database (see figure 2).

The database holds the current state of the emulated control logic. Each PM875 is mapped into a CMC task running on the emulation PC. The logic of I/O cards runs in the IDxx module. Data exchange between the process simulator and the Melody Controller Emulation is done using the PrimoOPC server. For each PM875 controller a CCU task is handling the communication to the HSI and to the Composer software (measurements and simulations within Composer). With the emulator debugging tool and the PrimoS console direct access to the database is possible.

Composer Integration Package
This package is an add-on for the emulator system.

The package consists of software components installed on the emulator and in the Composer machine. The running package will automatically load the emulator if control logic has been loaded within the Composer software. That way the emulator can be loaded without any special knowledge of the emulator software.

The package is not necessary for the basic emulator to work. Loading is possible using the manual procedure. But especially if the emulator is loaded frequently this package will drastically reduce errors and the time needed to load new control logic into the emulator.

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