1 INTRODUCTION

The accelerator test facility (ATF) in KEK was started in 1988 to develop the linear-collider technologies. First, it had a 0.3 GeV S-band linac at the TRISTAN Nikko experimental hall [1]. In 1991, ATF was upgraded at the TRISTAN assembly hall and it was designed to have a 1.54 GeV S-band linac and a dumping ring. Beam tuning of the linac has been started since November 1995. The damping ring is under construction and its operation will be started in January 1997.

The control system was built by using a commercial database application with our developed device-driver software. This database application is based on the mechanism of the distributing databases across the networks and graphical user interfaces on the X-window system. We succeeded in creating the control system in a limited time and staff with the help of this database system.

2 SYSTEM CONFIGURATIONS

2.1 CAMAC system

We decided to adopt a serial CAMAC system as the interface standard. We can use many CAMAC modules developed to control TRISTAN devices after the termination of the TRISTAN project. CAMAC crates located near the power supplies are connected with optical networks based on the enhanced serial highway driver (2160-Z1F) developed by Kinetic Co., Ltd. This highway depends on the Q-bus system and has a capacity of 5 Mbytes per sec data transmission rate.

We have two CAMAC links. One is for the linac and the beam transport line to the ring. It includes 11 sets of klystrons and modulators, 120 magnets and 70 monitors. Another link is for the damping ring and the extraction line for beam diagnostics. It includes 370 magnets and 130 monitors. The reason to separate the CAMAC link is the difference of the access load between the linac and the damping ring. Further, we have an additional CAMAC link for a device developing and as a spare of the control networks.

2.2 Computers

CAMAC networks are controlled by the DEC-VMS-mixed-cluster system as shown in Figure 1. We have three VAX servers for each CAMAC network, six VAX stations for operator consoles and a software development, and an Alpha server for master control computer. These machines are connected through the ethernet 10-base-5 network. We use two communication protocols, i.e., DECNET and TCP/IP running on the Open-VMS V2.6. Computer specifications of the ATF cluster are listed in Table 1. Since the Alpha server has the highest CPU performance, most of the control tasks are running on this server. We have two storage devices, a RAID disk (Storage Works) and a DAT drive.

<table>
<thead>
<tr>
<th>Machines</th>
<th>Relative Performance</th>
<th>RAM (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha server 2100/233</td>
<td>71.6</td>
<td>512</td>
</tr>
<tr>
<td>VAX server 4000/300</td>
<td>1.9</td>
<td>32</td>
</tr>
<tr>
<td>VAX server 4000/106A</td>
<td>17.0</td>
<td>64</td>
</tr>
<tr>
<td>VAX server 3500</td>
<td>1.0</td>
<td>16</td>
</tr>
<tr>
<td>VAX station 4000/90</td>
<td>12.1</td>
<td>32</td>
</tr>
</tbody>
</table>
2.3 CAMAC software

Old device libraries such as the RF drivers were written on the VAX server 4000/300 using the routines of the IEEE CAMAC standard. Alpha has a good performance but it has no direct access line to CAMAC. Our CAMAC system is based on the Q-bus system, but Alpha has a PCI-Bus system. We prepared the CAMAC network routines for Alpha software by using the VMS system service (mailboxes) and the TCP/IP socket library provided by DEC.

To keep the compatibility between Alpha and VAX servers, it has the same access format of the IEEE CAMAC standard. We could easily convert some programs into Alpha server. Further, we have an advantage on the overall performance, because we could minimize the tasks running on the slower VAX servers. Simple CAMAC tasks are running on the VAX server 4000/300, and other complicated tasks are running on the Alpha server.

Average time to execute a CAMAC single action from Alpha to VAX server 4000/300 is 5ms. For VAX server 4000/106A, it is only 1ms. In this situation, the performance of the CAMAC access is limited by the network overhead. Therefore, we prepare the function that executes many single actions in a network call.

3 PROGRAMS FOR OPERATION

3.1 Database System

The database system, VSYSTEM [2] developed by Vista-Control Systems, Inc., was used in the core part of the control system. It could easily include many device libraries written by ourselves. The data sharing between some processes, such as logging tasks, alarm monitors and data displays, are quite easy.

VSYSTEM handles many databases separately. Therefore, we do not need to stop the whole database system to modify the one of databases even if other databases are used. An element of the database is called “channel” and it supports various data types, integer, real, binary, strings and arrays for integer and real. Array channels are quite useful to keep the correlation between some data.

Further, VSYSTEM has useful components. VDRAW is the most convenient display tool based on the X-windows. It has graphical buttons, many graph types, moreover it could include the user written graphical symbols.

3.2 Device controls

Figure 3 shows an example for the linac control window. Each symbol shows the status of the magnets, screen profile monitors, gates valves and so on. They also act as switches to open the detail-control windows. Figure 4 also shows the table-mode magnet control windows. Monitored values are displayed with various colors associated with the device status.

There are two ways for executing the user written routines from VDRAW. One is the “user-link” and this
A direct command to the operating system. Another is the function calls named “handler”. It is directly connected to the channel access. If we access a channel defined with a handler, write or read action written in the handler routine starts automatically and updates the channel value.

3.3 Logging
Data logging is automatically done by VLOGGER. We only define which channels should be stored and what is the trigger of the logging. We can define multiple logging tasks individually.

3.4 Orbit corrections
To change the optics and to correct the closed-orbit, we use a computer program complex for accelerator design that is called SAD [3]. It has been developed in KEK since 1986. ATF was designed by using this code. SAD is running on the local cluster system in other KEK networks.

To communicate with SAD machines, we send and receive data files by FTP. The input-data file to SAD has a present hardware information such as K-values, beam positions and beam energy. The returned-data file from SAD has a new K-value data-set and predicted some values. They are displayed in the magnet status tables after converted into the current data; see the left column in Figure 4. The predicted beam position by SAD is also displayed in the BPM graphic windows.

**NEXT PLANS**

Development of the control system is done during the linac commissioning and the construction the damping ring in a limited time and staff. In this situation, quickly available device-control programs took first priority. After the damping ring starts its operation, we need to tune-up above programs for the future maintainability and to get the good overall performance. It will be done by using low-level functions such as AST in the VSYSTEM.

Access conflicts between more than two processes lead an unexpected situation. In the VSYSTEM handlers, it usually controls a device, there is no conflict because same handler cannot run in same time. The conflict will occur when the operator controls some devices while the background process is waiting to control them. Therefore, we need process-handling mechanisms based on the database that controls the device or the device-set occupations.

Further, we will plan to use the distributing database mechanism that is one of the advantages of VSYSTEM. This will improve the overall performance in our control network. At this time, VAX server 4000/300 for the linac control would be upgraded to faster one.

**ACKNOWLEDGMENTS**
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**REFERENCES**