CONTROL AND INFORMATION SYSTEM FOR BARC-TIFR SUPERCONDUCTING LINAC BOOSTER

Sudheer Kumar Singh, Pitamber Singh, IADD, BARC, Mumbai, India
J.N. Karande, Vandana Nanal,RG Pillay, TIFR, Mumbai, India

Abstract

Superconducting LINAC booster is modular machine which consists of 7 cryomodules each consisting four quarter wave resonators and one superbuncher module. The control system is a mixed distributed control system. Geometrical distributed system architecture has been followed for RF control. RF control has four local nodes(RF LCS) each nodes catering to two cryostat. Two additional nodes are made for beam line system and cryogenics distribution system, making it a systematic distribution system. The system is developed on Linux operating system but the software is portable on Linux and Microsoft windows. The software is developed in two layers namely scanner and operator interface. Scanners interacts with the interface hardware. All scanners are developed in JAVA , which is very challenging job looking towards the feature of JAVA. Various issues regarding this were closely investigated and solved to overcome the deficiency of JAVA .A micro-controller based board has been developed for cryogenics line distribution system. Different subsystems of the control system has been developed independently. A complete integration of the system will be completed before December 2012.

CONTROL SYSTEM ARCHITECTURE

LINAC is a booster to existing 14 MV Pelletron accelerator and built as moduler structure[1]. LINAC Booster's layout is given in fig 1.

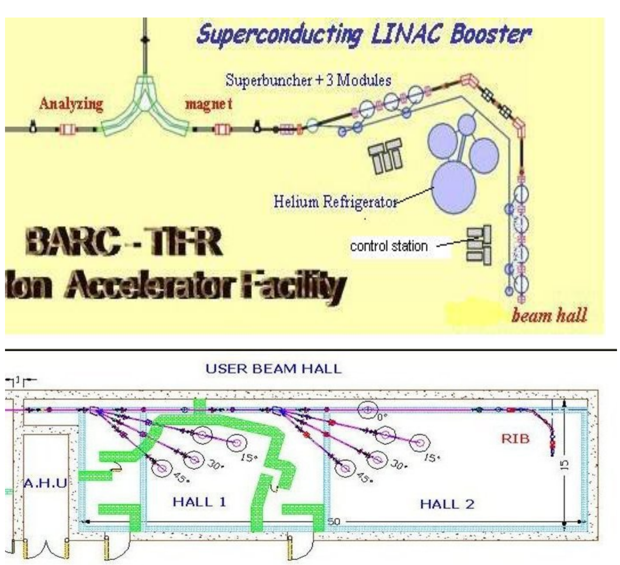

Figure 1: LINAC booster Layout.

LINAC can be divide in two half LIN1 and LIN2 . LIN1 consisting of three cryomodules for accelerating cavities , one cryomodule with single Superbuncher cavity and achromatic bending section. LIN2 consisting of four cryomodules with accelerating cavity.

LINAC control system follows the LINAC moduler structure and gemetric distributed control system has been selected for RF control with four nodes for RF control each node (RF LCS) is connected to each two nearby cryomodules. One node has been put for Beam line devices which include focussing magnets , bending magnets and Beam diagnostics devices . One node has been dedicated for Cryogenics distribution system. Each nodes are totally independent to each other which makes it possible to operate the system even when pelletron beam without further acceleration from LINAC have to be transported to beam hall. All nodes are interconnected to each other using Ethernet Link as filed bus. All control nodes LCS (Local Control stations) are located in accelerator hall. In main control room two PCs known as MCS (Main Control Station) are connected via Ethernet for interaction with the control system(fig 2) .

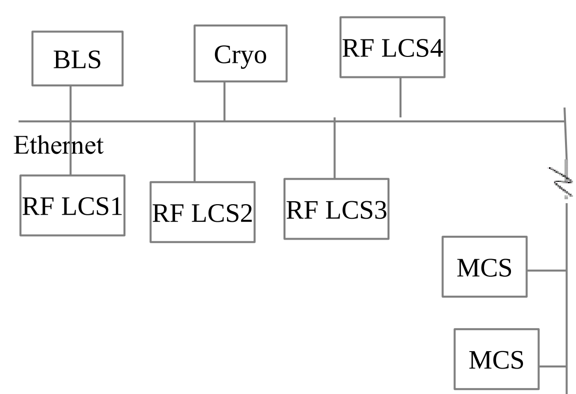

Figure 2: LINAC booster Layout.

A multilayer Hardware architecture has been followed each RF node consists of a CAMAC crate at Front Equipment Interface unit. CAMAC crates (fig3). CAMAC crates have an in house developed Ethernet based crate controller though the crates can be accessed from any PC connected in the network , its accesses has been limited to a single PC at Device interface unit . Device interface unit PC is connected. Communication between different LCSs and MCS is through Device Interface unit PC.

CAMAC crate is connected to RF Electronics bin using Digital Electronics modules (ADC, DAC , DI, DO, Pulser modules). Electronics bins consists of Signal Distribution module ,RF controllers[2] and RF amplifiers. Each RF LCS controls eight QWR Cavities, Except LCS1which controls only five QWR s (1 super buncher + 4 Accelerating cavities) LCS1 consists one two channel phase shifter one at the entry of LIN1 and other on eat the entry of LIN2. These phase shifter are helpful to tune the beam through the LINAC in case of slight energy variation from pelletron.

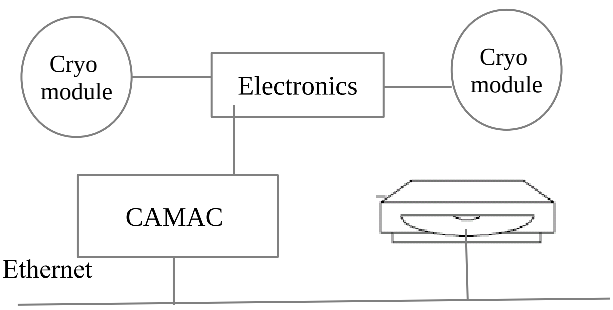

Figure 3: RF LCS Architecture.

Beam Line control node (BLS) [fig.4],consists of magnet power supplies , steerers , Faraday cups and Beam Profile monitors. Magnet power supplies are having RS232 serial interface. Farday cup control unit and BPM control units are developed on 8085 microcontroller boards based on Silabs microcontroller boards with rs232 serial interface for remote control and monitoring. Steerers are using power supplies procured from Delta with Rs232 remote interface units . In addition to these devices there are several hall probes connected to the system .All serial devices are connected to Serial to Ethernet converter switch unit from Moxa[3] .

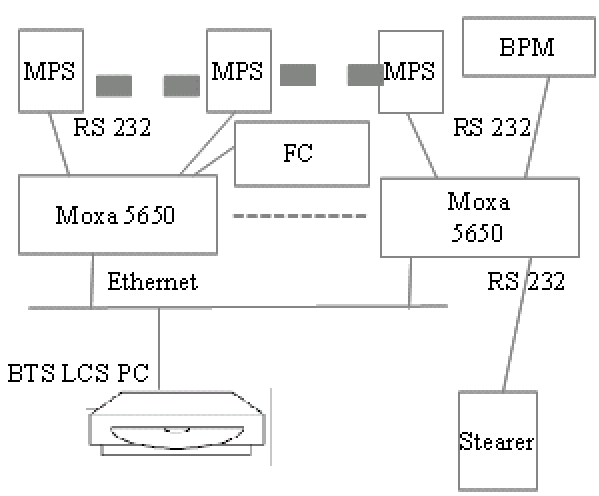

Figure 4: Beam Line LCS Architecture.

Each Moxa unit can be connected to 16 serial Device and can be operated in Rs232 mode or TCP/IP mode. TCP/IP server mode has been selected for LINAC control system.

Presently there are 30 MPS s , 2 Faraday cup controller units , 2 BPM controller units in the system. The system is extensible new system can be easily added on spare MOXA rs232 ports or by adding additional MOXA boards.

Cryo LCS is made up of Silabs based microicontroller board with associated electronics , two such boards have been made and are connected to MOXA serial to ethernet converter . A dedicated PC has been setup as Cryogenics Distribution system (CDS) node . Cryogenics Distribution system

CONTROL SYSTEM SOFTWARE

Control system software is developed as a portable system which can be ported on either MS windows and Linux. The control system software is written in JAVA except Cryogenics system which is implemented in Trolltech 's QT[4]. Software is written as client server architecture. Servers are running at LCS and client is running at Main control station PC. MCS software is a graphicle user interface. Its a multilayer software. Each node has GUI less software acting as TCP server and called as scanner . Scanner is responsible for interaction with hardware and message passing from graphicle user interface and in between different scanners. The system is configurable by using a database known as system configuration database. System configuration data base is stored at scanner. LCS architecture is given in fig 5. which has been used for all LCSs. It is a layered architecture . Device scan scans all device and system status periodically, scan time is passed as a commend line parameter. Communication Server interface listen for the new connection requests and open communication thread for each client.

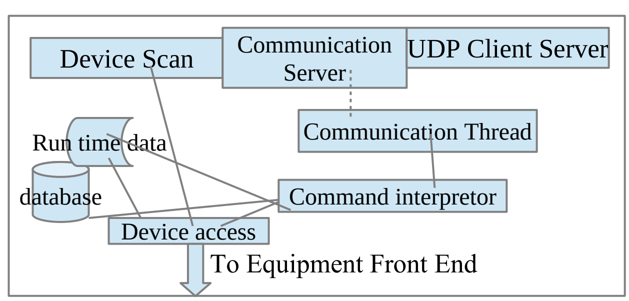

Figure 5: LCS Architecture.

MCS software connects to all LCS nodes and presents the overall system information to the operator. Different colour notations and audio alarm provides the important information to the operator. MCS screen is given in fig 6.

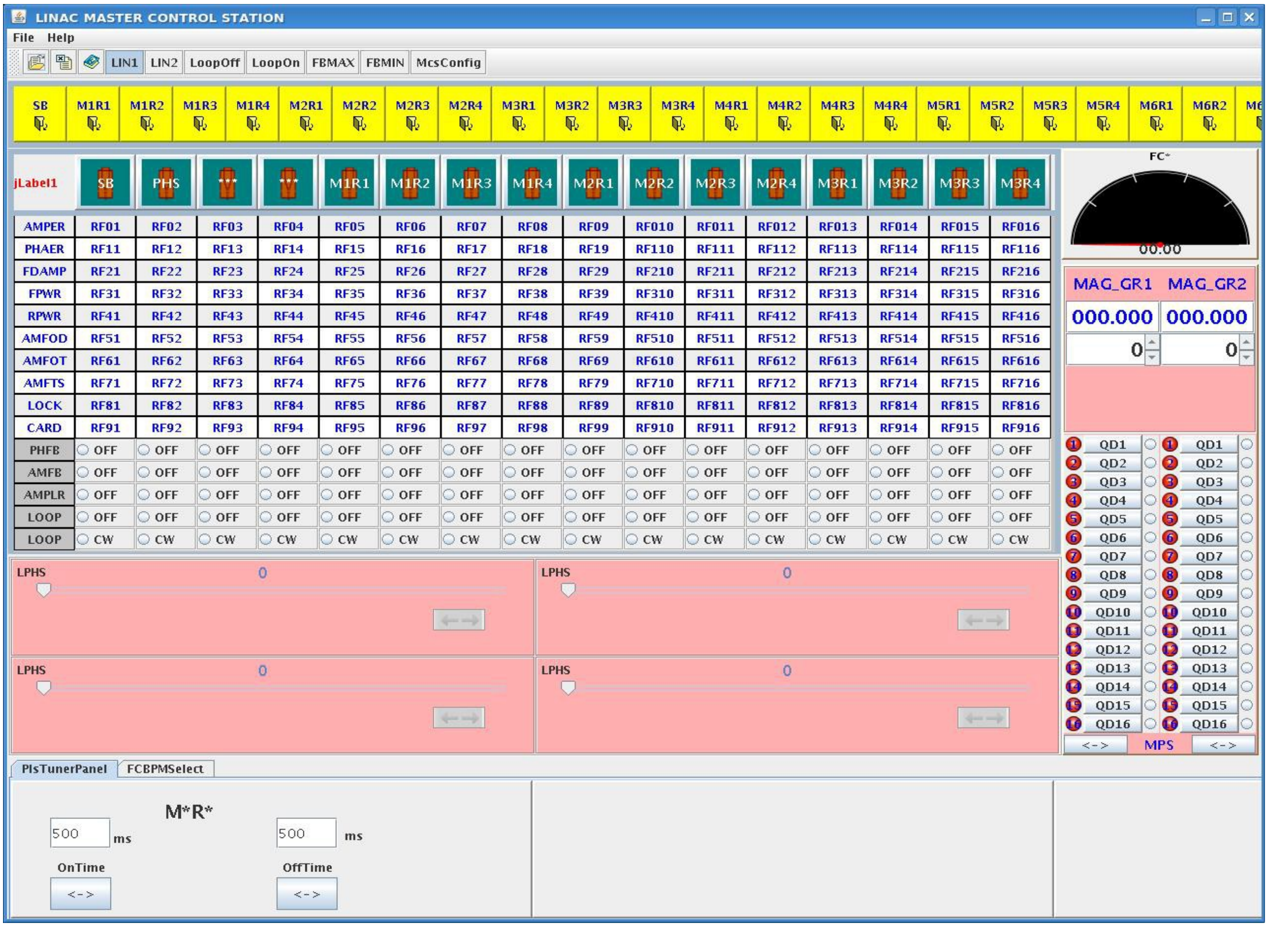

Figure 6: Main control Station (MCS) operator interface.

ACKNOWLEDGMENT

We would like to thank the pelletron LINAC facility members for there support in installation and Electronics division BARC for the excellent electronics hardware and devices.

REFERENCES

[1] Bsrinivasan, S K Singh et al.,"Superconducting LINAC Booster for Mumbai Pelletron" Pramana journel of physics, Indian Academy of Science Vol 57, No. 2 & 3 Aug -Sept 2001 p 651-658.

[2] Gopal Joshi et al. "RF Control Electronics for Linear Accelerator" DAE Sysmposium on Peaceful Atom 2009".

[3] MOXA 5650 Manuals www.moxa.com

[4] QT API qt.nokia.com/products