iv. Network and Links

The local area network and the timing and data links which connect the various locations will share a common distribution system via fiber-optic cable. Wherever possible, preference will be given to passive splitting of signals over active means, to reduce the number of potential points of failure.

Network Architecture

The network backbone is implemented with FDDI, a 100 Mbit/sec timed token ring network standard that has gained wide acceptance as a high performance alternative to Ethernet Backbones. As designed for RHIC, a dual ring interconnects two FDDI top level Concentrators, one in Bldg. 911 and the other in the Collider Center. The two top level concentrators provide the only path to the FDDI ring and are key network management points. Computers with FDDI capability and Router/Bridges are connected directly to the top level or nested Concentrators as single attachment stations. Router/Bridges in all locations will bridge or route FDDI traffic to Ethernet segments for local use. Excepting a Concentrator itself, a failure of an FDDI connected device will not affect the FDDI backbone. In all cases FECs are connected to Ethernet in radial fashion through intelligent Hubs. Management features of the Hub will be used to improve network reliability by controlling Ethernet connections.

Network Implementation

Both top-level Concentrators will use multimode fiber to connect computers and Router/Bridges locally. FDDI Concentrator M ports will be connected to the six service buildings around the ring by single mode fiber. Each service building will have an FDDI Router/Bridge that terminates the single mode fiber carrying FDDI from the Collider Center. The Router/Bridge will bridge or route 4 independent Ethernet segments from the FDDI backbone, providing a through put of 4 Ethernet band width equivalents. Ethernet is extended to each of the 3 adjacent alcoves.

FDDI Concentrators, Router/Bridges, Ethernet Hubs, and FECs will have resident Simple Network Management (SNMP) agents that respond to queries and commands from a workstation dedicated to network management. Features will include:

- Display of network traffic on the FDDI backbone and all Ethernet segments.
- Capability to disconnect malfunctioning devices.
- Display and logging of network errors at point.
- Control of the access to the Controls network from other networks.

Links

Synchronization of the operation of the widely distributed RHIC equipment will be provided by five types of data links. They will each be implemented via a modified Manchester encoded signal distributed via fiber optics, with local fanout and distribution via wire.

Clock/Event (Timeline) Link. A master clock signal (10 MHz) and serially encoded events are distributed from a central location (4 o'clock service building). Events are generated by: (1) direct pulsed input from external sources; (2) command from a console program; or (3) sequence or delay generators. At service buildings and alcoves, events are decoded on specially designed modules having direct input provisions for the Timeline (e.g. waveform generator), or by general purpose timing modules. A Decoder/Delay Module provides pulsed outputs after programmable delays that can be triggered by either events from the RHIC timing system, external events or other delay channels.

Beam Synchronous Link. For each ring of the collider there will be a link which provides a clock signal which is derived from the approximately 8.9 MHz beam bucket frequency. A revolution fiducial event will be encoded on this link, which will be used in the beam instrumentation system and for the synchronization of the firing of the extraction kickers. A few additional events may be encoded at lower priority than the fiducial event. These events will be used for beam instrumentation triggers and for any other use requiring beam synchronicity.

Real Time Data Link. Machine parameters such as main magnet current are distributed in real time to all locations at a 720 Hz rate by a separate data link called RTDL. The data are time-division multiplexed on a single serial data link in the form of data frames containing a code identifying the parameter type followed by a field containing data. Initial provision will be made for 30 different frames, with expansion possible. Input of data will be either by FEC software command or via a serial data input.

Beam Permit Link. The permit system is essentially a serial link running through all locations around the collider ring. The presence of a carrier frequency from the previous (upstream) location indicates beam permit is interpreted as a "TRUE" value. At each location, fail-safe inputs for the various systems are provided. All local systems must be in the ready state to pass on the beam permit carrier to the next (downstream) location. After the beam permit carrier passes through all locations, it returns to the source module which maintains the carrier. Upon detection of a fault condition requiring beam abort, any system may interrupt the carrier by pulling its input to the beam permit link "FALSE" value. Upon detection of a missing carrier, an abort event is generated

synchronous with the revolution event of the beam and broadcast to all locations via the Timeline. To assist in "postmortem" analysis of beam aborts, FIFOs located in each beam-abort module store the order in which events occurred along with time stamp information.

Remote Computer Reset Link. The remote computer reset link is used to cause resetting and restarting of any specified FEC and utilizes serial codes implemented as for the event system.