Beam Sync Clocks

Used to provide critical beam related timing
- Injection/extraction Kickers, Beam Abort, TEL, etc.

Synchronized to the beam in a given machine via its LLRF system

Base frequency is rf/7 (approximately 7.5 MHz)
- rf source is LLRF

Carry a turn marker ($AA)
- triggered by LLRF

Most events are associated with beam transfers
- often qualified against downstream permit status

Events are encoded immediately after $AA marker on clock

Presently only 16 possible events per system (hardware limitation)

Hardware located at MI-60
- cannot be modified while machine running

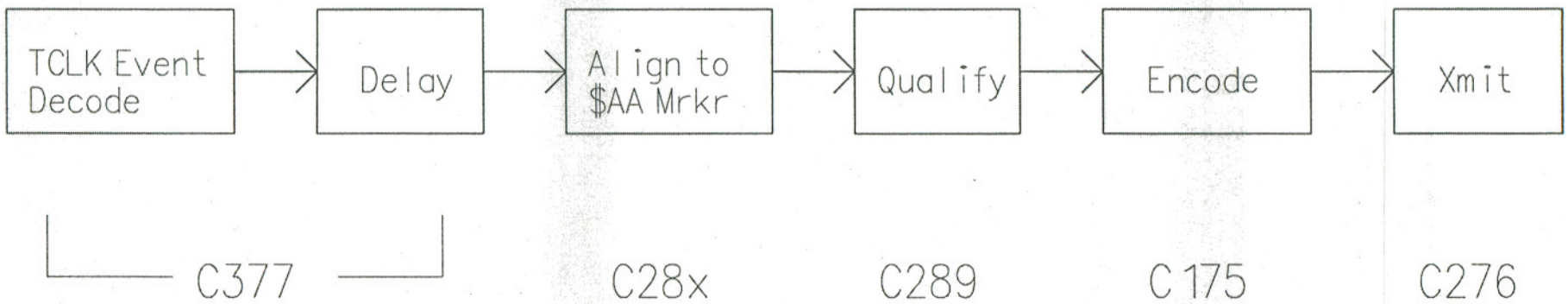
Information can be found on Timing & Links Group web page
- http://www-bd.fnal.gov/controls/hardware_vogel/index.html

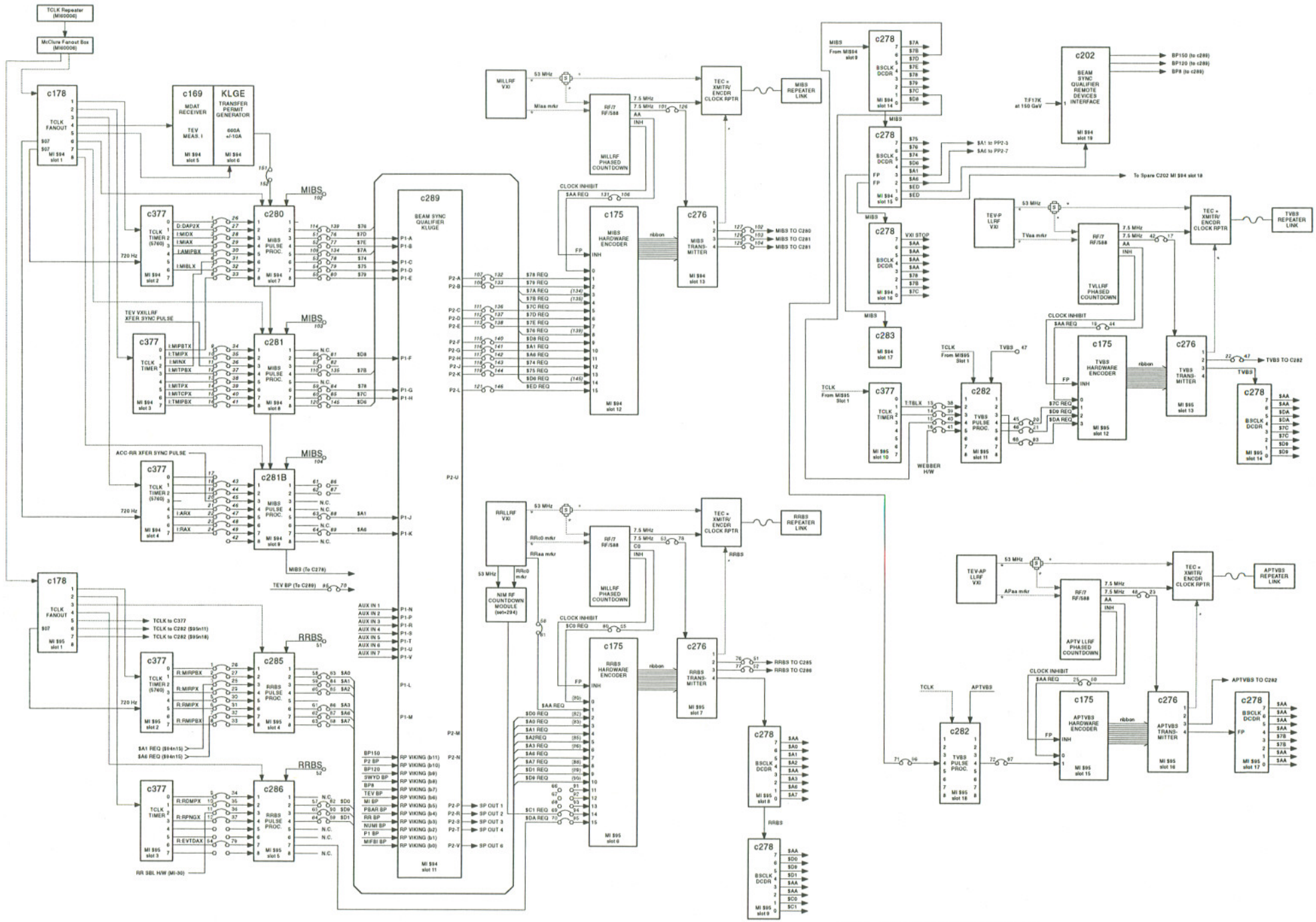
Beam Synch overview

G. Vogel 4-24-05

BS Event	System	Reflected TCLK Event	Typical TCLK Reference	(suggested) Delay Name	new/ modify/ redefine/ deassign/ unassign	description
$A1	MIBS	$98	$E1	I:ARX		8 GeV pbar transfer from Acc. to RR
$A6	MIBS	$97	$96	I:RAX		8 GeV proton transfer from RR to Acc.
$74	MIBS	$A9	$A5	I:MINX		120 GeV proton extraction from MI to NUMI
$75	MIBS	$39	$30	I:MIBLX		120 GeV proton extraction from MI to SWYD
$76	MIBS	none	$82	D:DAP2X		8 GeV extraction from Deb. to AP2 beamline
$77	***MIBS***	***none***	***hrdwr***	***xxx***	***NEW***	***8 GeV proton transfer from Booster to MI***
$78	MIBS	$58	$4D	I:MITPX		150 GeV proton transfer from MI to TeV for fixed target
$79	MIBS	$81	$80	I:MIPBTX		120 GeV proton extraction from MI to pbar target (was generated by $8C)
$7A	MIBS	$94	$2A	I:AMIPBX		8 GeV pbar transfer from Acc to MI
$7B	MIBS	$5B	$40	I:MITPBX		150 GeV pbar transfer from MI to TEV
$7C	MIBS	$5C	$4D	I:MITCPX		150 GeV proton transfer from MI to TEV for collider
$7D	MIBS	$86	$85	I:MIDX		8 GeV transfer from MI to Deb. ("forward protons")
$7E	MIBS	$99	$93	I:MIAX		8 GeV proton transfer from MI to Acc.
$DA	***MIBS***	***none***	***user defined***	***I:DATRG***	***NEW***	***Data Acquisition Event***
$D8	MIBS	$55	$5D	I:TMIPX		150 GeV proton transfer from TEV to MI
$ED	MIBS	$FA	none			MIBS event request denied
$AA	MIBS	none	MI LLRF	xxx		RF/7; zero azimuth marker; occurs on every revolution
$7C	TVBS	none	hrdwr	xxx		150 GeV proton transfer from MI to TEV (reflected MIBS $7C)
$D9	TVBS	$D9	hrdwr	xxx		sudden Tevatron beam loss
$DA	TVBS	none	user defined	C:EVTDAX		Data Acquisition Event
$AA	TVBS	none	TEV LLRF	xxx		RF/7; zero azimuth marker; occurs on every revolution
$AA	APTVBS	none	TEV LLRF	xxx		RF/7; zero azimuth marker; occurs on every revolution
$A0	RRBS	$F0	$E0	R:MIRPBX		8 GeV pbar transfer from MI to RR
$A1	RRBS	$9B	$E1	R:ARX		8 GeV pbar transfer from Acc. to RR
$A2	RRBS	$F2	$E2	R:MIRPX		8 GeV proton transfer from MI to RR
$A3	RRBS	$F3	$E3	R:RMIPX		8 GeV proton transfer from RR to MI
$A6	RRBS	$F6	$96	R:RAX		8 GeV proton transfer from RR to Acc.
$A7	RRBS	$F7	$E4	R:RMIPBX		8 GeV pbar transfer from RR to MI
$D0	RRBS	$F5	$E7	R:RDMPX		event to fire RR dump kicker; placed on clock fixed wrt $AA
$D1	RRBS	none	$E5	R:RPNGX		event to fire RR pingers; placed on clock fixed wrt $AA
$D9	RRBS	$F9	hrdwr	xxx		generated on sudden beam loss in RR; placement on clock not clear
$DA	RRBS	none	user defined	R:DATRG		Data Acquisition event
$AA	RRBS	none	RR LLRF	xxx		RF/7; zero azimuth marker; occurs on every revolution
$C0	RRBS	none	RR LLRF	xxx		marker for injected beam; occurs on every revolution

Typical Beam Sync Event Process

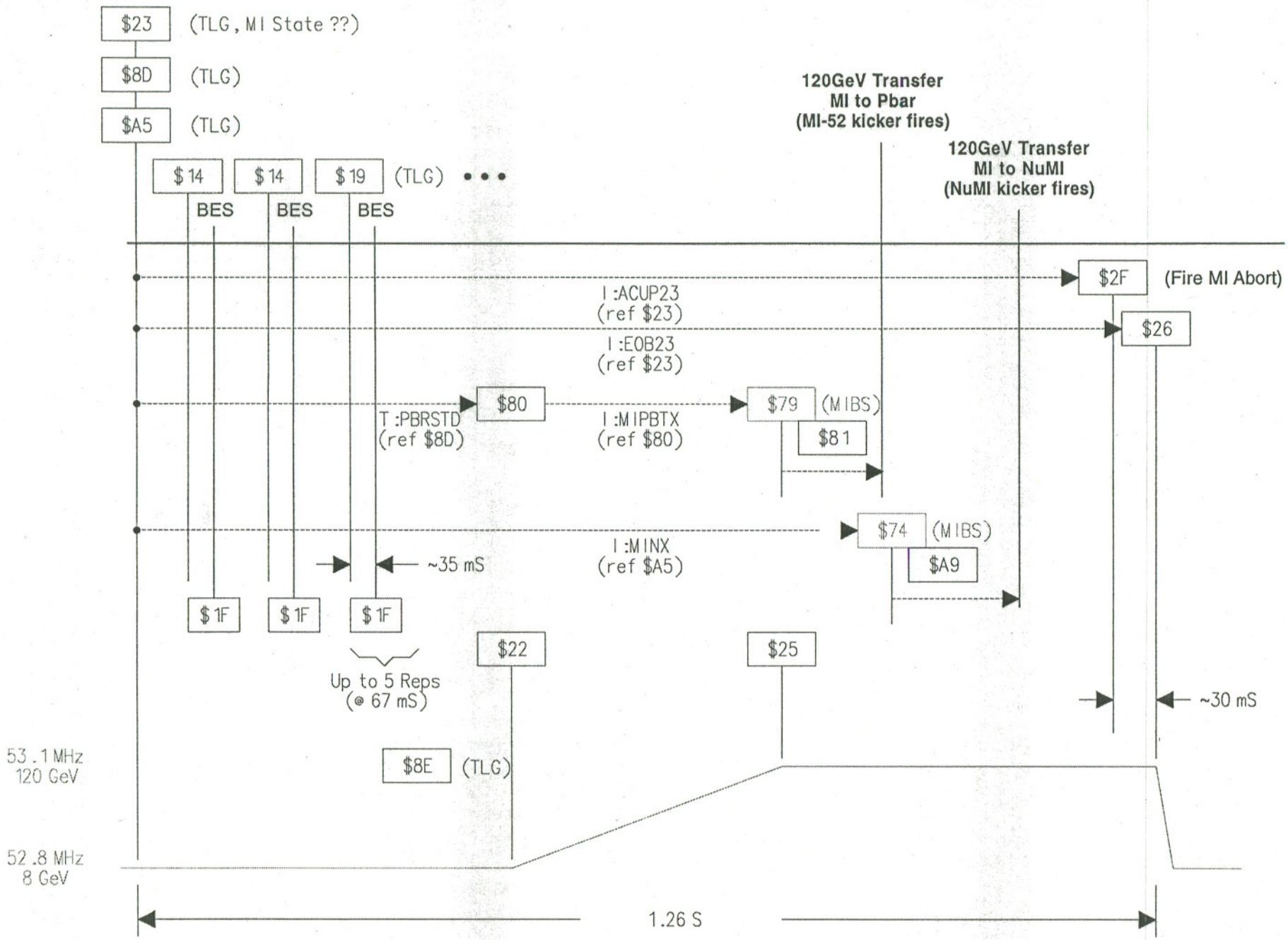




NOTES: *NN Black italic lettering indicates PP-1 assignments*
XX Blue block lettering indicates PP-2 assignments
* Green signal paths indicate phase matched cables
Red signal paths indicate TCLK

ACCELERATOR CONTROLS
BEAM SYNC CLOCK SYSTEM BLOCK DIAGRAM

DRAFT Timeline for Mixed Mode NuMI Cycles



G. Vogel 5/05