1756HP-TIME

# REDUNDANT CONTROLLER IMPLEMENTATION

V1.00.02

Section	Page
INTRODUCTION	2
WALLCLOCK DISCIPLINE	3
SET SYSTEM VALUE (SSV)	3
O RSLOGIX V16	3
O RSLOGIX V19	3
PRECISION TIME PROTOCOL (PTP)	4
O RSLOGIX V19	4
SEQUENCE OF EVENTS (SOE)	7
CST / UTC	7
O RSLOGIX V16	7
O RSLOGIX V19	9
PRECISION TIME PROTOCOL (PTP)	9
O RSLOGIX V19	9

## **INTRODUCTION**

This document serves to describe the implementation of time synchronization (using the 1756HP-TIME module) in a redundant Allen-Bradley ControlLogix system. Currently the user can either use RSLogix v16 or RSLogix v19 when implementing the redundant control system (where v19 supports the Precision Time Protocol or PTP). An explanation will be given on synchronizing controllers as well as doing sequence of events (SOE) solutions.

If the user has any questions or queries please email: tech@hiprom.com



# WALLCLOCK DISCIPLINE

### Set System Value (SSV)

The following redundant PLC architecture will be used as an example:



#### RSLogix v16

1

The user can set the wallclock by writing the current UTC value to it. Because the CPU is not in the same rack as the 1756HP-TIME module the UTC offset cannot be used to discipline the clock because the CST of the local and remote racks are different.

The PPS bit can be used to discipline the clock every second as shown below:



Thus at the beginning of every second the SSV instruction will discipline the clock by using the UTC value received from the 1756HP-TIME module.

NOTE: The wallclock time will only be as accurate as the RPI of the remote rack + the RPI of the 1756HP-TIME module. For example if the remote rack RPI is 20ms and the 1756HP-TIME module's RPI is 10ms the max wallclock time error will be 30ms.

#### **RSLogix v19**

If the user is not using CIPSync (Precision Time Protocol – PTP) then the RSLogix v16 method will also apply to RSLogix v19.



3

### **Precision Time Protocol (PTP)**



The following redundant PLC architecture will be used as an example:

#### **RSLogix v19**

When using CIPSync the user must enable 3 options. This will allow the 1756HP-TIME module to synchronize the Controllers without any ladder needed (note that the time accuracy is much better when PTP is being used):

		00111	ig innuge ob i e	, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
⊡-CNBR_Remote:2:C	{}	{		HT:1756HI
	1		Decimal	INT
<u> <u> </u> -CNBR_Remote:2:C.Control </u>	2#0000 0000 0010 0000		Binary	INT
CNBR_Remote:2:C.PTPOutputEnable	1		Decimal	BOOL
	0		Decimal	BOOL
-CNBR_Remote:2:C.IRIGBOutputEnable	0		Decimal	BOOL
-CNBR_Remote:2:C.IRIGBLockLostTx	0		Decimal	BOOL
-CNBR_Remote:2:C.PreV16Support	0		Decimal	BOOL
	0		Decimal	BOOL
CNBR_Remote:2:C.NTPUpdateInterval	3600		Decimal	DINT
⊡-CNBR_Remote:2:C.ExternalSourceAddress	{}	{	Decimal	INT[4]
CNBR_Remote:2:C.Priority1	128		Decimal	INT
	128		Decimal	INT
	64		Decimal	INT
	4		Decimal	SINT
CNBR_Remote:2:C.AdvancedConfig	0		Decimal	DINT
	0		Decimal	DINT
	0		Decimal	DINT
	0		Decimal	DINT

1. Set the 1756HP-TIME module to output PTP in either the config image UDT or AOP:



#### NOTE: If the user is using major firmware revision 2 of the 1756HP-TIME module all parameters can be set from the Add-on Profile (AOP) and no UDTs are required as the images are structured.

2.

General Conne	ction Time Sync Module Info Interne	et Protocol   Port Configuration   Netwo	ork RSNetWorx
Type: Vendor: Parent: Name: Description:	1756-EN2TR 1756 10/100 Mbps Etherr Allen-Bradley Local EN2TR_Master	et Bridge, 2-Port, Twisted-Pair Media Ethernet Address © Private Network:	Change Type ←
- Module Defini	ltion Change	Host Name:	
Hevision: Electronic Kej Connection: Time Sync Co	3.6 Compatible Module None Innection: Time Sync and Motion		

# 3. Set the Logix Controller to enable Time Synchronization:

Controller Properties - RedCont	rolPTPTest	>
Advanced SFC Execution	File Redundancy Nonvolatile Memory	Memory
General Serial Port System Pro	tocol User Protocol Major Faults Minor Faults	Date/Time
The Date and Time displayed her Use these fields to configure Time	e is Controller local time, not workstation local time. e attributes of the Controller.	
Set Date, Time an	d Zone from Workstation	
Date and Time: 2011/02/02 04:12:	42 PM Change Date and Time ፍ	
Time Zone: (GMT+00:00) Gree	nwich Mean Time : Di	
Adjust for Daylig	ht Saving (+01:00) ፍ	
Time Synchronize		
Enable Time Synchronization	DANGER. If time synchronization is disabled online, active axes in any costellaris when the series are series that	
◯ Is the sustern time master	synchronized device, may experience	
Is a synchronized time slave	unexpected motion. Safety controllers may fault if no other time master exists in the	
O Duplicate CST master detected	local chassis.	
CST Mastership disabled		
O No CST master	Advanced	
	OK Cancel Apply	Help
Rockwell		



The Ethernet Bridge will serve as a boundary clock (PTP slave on Ethernet and PTP master on ControlBus). Thus the Logix Controller will synchronize to the Ethernet Bridge which in turn will synchronize to the 1756HP-TIME module.

Once the Logix Controller has synchronized to the TIME module the user can confirm the time accuracy by selecting the *Advanced* button in the Date/Time tab of the Controller AOP:

Controller Properties -	Advanced Time Sync			×
CIP Sync Time Synchron UTC System Time:	nization: Enabled 2011/02/02 04:13:38 PM			
Grandmaster Clock		Local Clock		
Description:		Synchronization Status:	Synchronized	
User Name:	GM01	Offset from Master:	-520	ns
User Location: Protocol Address: Physical Address: Clock Type:	Local C0.A8.01.67 00-60-35-0A-D8-DE Ordinary	Backplane State:	Slave	(Port 1)
Identity:	006035FFFE0AD8DE	Identity:	FFFF00010059	38B23
Class:	6	Class:	248	
Accuracy:	34	Accuracy:	254	
Variance:	65535	Variance:	65535	
Source:	GPS	Source:	Oscillator	
Priority 1:	128	Priority 1:	128 🗦	(Master Override)
Priority 2:	128	Priority 2:	128 📫	(Tie Breaker)
		OK Cancel	Apply	Help



# **SEQUENCE OF EVENTS (SOE)**

### CST / UTC

The following redundant PLC architecture will be used as an example:



#### **RSLogix v16**

When doing sequence of events (SOE) in a redundant system the user will need to add a 1756HP-TIME module per rack as to provide the CST and UTC pairs to each SOE module. This will allow the SOE module to timestamp events in UTC time. Thus the user will need to enable the CST Mastership on the 1756HP-TIME module and copy the UTC and CST pairs to each SOE module output assembly. The CST Mastership can be enabled either via the Config image UDT or AOP:

⊡-CNBR_Remote:2:C	{}	{		HT:1756HI
	1		Decimal	INT
	2#0000_0000_0010_0000		Binary	INT
-CNBR_Remote:2:C.PTPOutputEnable	0		Decimal	BOOL
	0		Decimal	BOOL
-CNBR_Remote:2:C.IRIGBOutputEnable	0		Decimal	BOOL
-CNBR_Remote:2:C.IRIGBLockLostTx	0		Decimal	BOOL
-CNBR_Remote:2:C.PreV16Support	0		Decimal	BOOL
	1	1	Decimal	BOOL
+-CNBR_Remote:2:C.NTPUpdateInterval	3600	·	Decimal	DINT
	{}	{	Decimal	INT[4]
CNBR_Remote:2:C.Priority1	128		Decimal	INT
	128		Decimal	INT
	64		Decimal	INT
ECNBR_Remote:2:C.PTPSyncInterval	4		Decimal	SINT
ECNBR_Remote: 2:C.AdvancedConfig	0		Decimal	DINT
	0		Decimal	DINT
	0		Decimal	DINT
	0		Decimal	DINT
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#### NOTE: If the user is using major firmware revision 2 of the 1756HP-TIME module all setting can be done from the Add-on Profile (AOP) and no UDTs are required as the images are structured.

The user can copy the CST and UTC pairs as shown below:

1	Copy File Source CNBR_Remote:2:I.UTC[0] Dest CNBR_Remote:4:O.UCTTime[0] Length 2
2	Copy File Source CNBR_Remote:2:I.CST[0] Dest CNBR_Remote:4:O.CSTTime[0] Length 2

-CNBR_Remote:4:0	{}	{		AB:1756
	0		Decimal	DINT
➡-CNBR_Remote:4:0.NewDataAck	2#0000_0000_0000_0000_0000_0000_0000		Binary	DINT
	0		Decimal	INT
-CNBR_Remote:4:0.ResetEvents	0		Decimal	BOOL
-CNBR_Remote:4:0.RetrieveByPoint	0		Decimal	BOOL
-CNBB_Bemote:4:0 LICTTime	()	ξ.,	Decimal	DINT[2]
E-CNBR_Remote:4:0.UCTTime[0]	656828160		Decimal	DINT
	301915		Decimal	DINT
CNBR_Remete: 4:0.CCTTime	()	ξ.	Decimal	DINT[2]
	279410533		Decimal	DINT
	544		Decimal	DINT

Once this is done the SOE module will indicate that it is reporting back UTC timestamps:

-CNBR_Remote:4:1	()	$\{\ldots$		AB:175
	2#0000_0000_0000_0000_0000_0000_0000		Binary	DINT
	2#0000_0000_0000_0000_0000_0000_0000		Binary	DINT
E-CNBR_Remote:4:I.NewData	2#0000_0000_0000_0000_0000_0000_0000		Binary	DINT
<u> <u> </u>-CNBR_Remote:4:I.Event0verflow </u>	2#0000 0000 0000 0000 0000 0000 0000 00		Binary	DINT
CNBR_Remote:4:1.ReturningUCTTime	1		Decimal	BOOL
-CNBR_Remote:4:I.EventNumber	0		Decimal	DINT

When an event occurs on the SOE module will timestamp the UTC value.



8

-CNBR_Remote:4:I	{}	{		AB:1756
	2#0000_0000_0000_0000_0000_0000_0000		Binary	DINT
	2#0000_0000_0000_0000_0000_0000_0000		Binary	DINT
	2#0000_0000_0000_0000_0000_0000_0000		Binary	DINT
← CNBR_Remote:4:I.Event0verflow	2#0000_0000_0000_0000_0000_0000_0000		Binary	DINT
-CNBR_Remote:4:I.ReturningUCTTime	1		Decimal	BOOL
	2		Decimal	DINT
-CNBR_Remote:4:1.Timestamp	()	{		AB:1756
-CNBR_Remote: 4:1. Timestamp[0]	{}	{		AB:1756
	()	ζ.,	Decimal	DINT[2]
E-CNBR_Remote:4:I.Timestamp[0].0	1655458586		Decimal	DINT
E-CNBR_Remote:4:1.Timestamp[0].0	301915		Decimal	DINT
E-CNBR_Remote:4:1. Limestamp[U].UnUff	{}	<u></u> {	Decimal	DINT[2]
-CNBR_Remote:4:1.Timestamp[0].0	1657324453		Decimal	DINT
E-CNBR_Remote:4:1.Timestamp[0].0	301915		Decimal	DINT

This can be copied into a variable of type *LINT* and viewed in *Date/Time* format to see the Gregorian Date.

EventTime DT#2011-02-03-09:05:06.630426(GMT+02:00) Date/Time LI	#2011-02-03-09:05:06.630426(GMT+02:00) Date/Time LINT
---	---

#### RSLogix v19

If the user is not using CIPSync (Precision Time Protocol – PTP) then the RSLogix v16 method will also apply to RSLogix v19.

#### **Precision Time Protocol (PTP)**

The following redundant PLC architecture will be used as an example:





#### **RSLogix v19**

When using CIPSync (PTP) the user must enable 3 options. This will allow the 1756HP-TIME module to synchronize the SOE modules without any ladder needed:



# NOTE: Only major revision 2 of the 1756-IB16ISOE module will support CIPSync (PTP).

-CNBR_Remote:2:C	{}	{		HT:1756HI
	1		Decimal	INT
<u> <u> </u> -CNBR_Remote:2:C.Control </u>	2#0000 0000 0010 0000		Binary	INT
CNBR_Remote:2:C.PTPOutputEnable	1		Decimal	BOOL
	0		Decimal	BOOL
CNBR_Remote:2:C.IRIGBOutputEnable	0		Decimal	BOOL
-CNBR_Remote:2:C.IRIGBLockLostTx	0		Decimal	BOOL
-CNBR_Remote:2:C.PreV16Support	0		Decimal	BOOL
	0		Decimal	BOOL
CNBR_Remote:2:C.NTPUpdateInterval	3600		Decimal	DINT
ECNBR_Remote:2:C.ExternalSourceAddress	{}	{	Decimal	INT[4]
CNBR_Remote:2:C.Priority1	128		Decimal	INT
CNBR_Remote: 2:C.Priority2	128		Decimal	INT
	64		Decimal	INT
	4		Decimal	SINT
-CNBR_Remote: 2:C.AdvancedConfig	0		Decimal	DINT
	0		Decimal	DINT
	0		Decimal	DINT
	0		Decimal	DINT

1. Set the 1756HP-TIME module to output PTP in either the config image UDT or AOP:



#### If the user is using major firmware revision 2 of the 1756HP-TIME module all setting can be done from the Add-on Profile (AOP) and no UDTs are required as the images are structured.

2. Set the Ethernet bridge module (EN2T, EN2TR etc.) to support CIPSync:



Module Prope	erties: Local:2 (1756-EN2TR 3.6)	
General Conne	ection   Time Sync   Module Info   Internet Protocol   Port Configuration   Network   RSNetWorx	
Type: Vendor: Parent: Name: Description:	1756-EN2TR 1756 10/100 Mbps Ethernet Bridge, 2-Port, Twisted-Pair Media       Change Type         Allen-Bradley         Local         EN2TR_Master         IP.Address:	
Module Defir Revision: Electronic Ke Connection: Time Sync C	nition 3.6 eying: Compatible Module None Connection: Time Sync and Motion	
tatus: Running	OK Cancel Apply Help	

3. Set the SOE module to timestamp using CIPSync (PTP):

🔤 Module Prope	rties: CNBR_Remote:3 (1756-IB16ISOE/A 2.7)	×			
General* Conn	ection Module Info Configuration Backplane				
Type: 1756-IB16ISOE/A 16 Channel Isolated 24V Input Sequence of Events					
Vendor:	Allen-Bradley				
Parent:	CNBR_Remote				
Name:	SOE_v2 Slot: 3 *				
Description:	× *				
Comm Format:	CIP Sync Per Point				
Revision:	2 7 📑 Electronic Keying: Compatible Keying 💌				
Status: Offline	OK Cancel Apply Help				



renera	r connection	Module mio	coningulation	Граскр		
Point	Enable CST Capture		nable CST Capture Chatter Detectic Off -> On On -> Off		Off -> On On -> Off	
	🔽 Off -> On	🔽 On -> Off	No. of Events	Time		
0	•	•	0			
1	•	•	0			
2	•	•	0		Module Configuration Bits	
3	•	•	0			
4	•	2	0		Latch CST	
5		<b>V</b>	0		☑ Timestamp in CIP Sunc	
6	V	V	0		P Threstamp in cir Sync	
7		V	0			
8		V	0	-		
•						

The Ethernet Bridge will serve as a boundary clock (PTP slave on Ethernet and PTP master on ControlBus) for each rack. Thus the SOE module will synchronize to the Ethernet Bridge which in turn will synchronize to the 1756HP-TIME module.

Once the SOE module has synchronized to the TIME module it will indicate that the timestamps will provide the UTC from the TIME module via CIPSync:

	2#0000_0000_0000_0000_0000_0000_0000_00		Binary	DINT
-CNBR_Remote:3:I.ReturningUCTTime	0		Decimal	BOOL
CNBR_Remote:3:1.ReturningCIPSyncTime	1	٦	Decimal	BOOL
CNBR_Remote:3:I.CIPSyncValid	1		Decimal	BOOL
UNBR_Remote: 3:1. CIPSync1 imeout	U		Decimal	BOOL
	10		Decimal	DINT
	()	{.	Decimal	DINT[2]
⊡-CNBR_Remote:3:1.0ffsettimestamp	()	{.	Decimal	DINT[2]
-CNBR_Remote: 3:1. Timestamp	()	{.		AB:1756
-CNBR_Remote:3:1.Timestamp[0]	()	{.		AB:1756
-CNBR_Remote: 3:1. Timestamp[0]. OffOn	()	{.	Decimal	DINT[2]
E-CNBR_Remote:3:1.Timestamp[0].Off0n[0]	921144119		Decimal	DINT
E-CNBR_Remote:3:I.Timestamp[0].Off0n[1]	301903		Decimal	DINT
-CNBR_Remote: 3:1. Timestamp[0]. OnOff	()	{.	Decimal	DINT[2]
-CNBR_Remote: 3:1. Timestamp[0]. OnOff[0]	921144144		Decimal	DINT
	301903		Decimal	DINT

When an event occurs the SOE module will timestamp the UTC value.



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÷-(	CNBR_Remote:3:I.EventOverflow	2#0000_0000_0000_0000_0000_0000_0000		Binary	DINT
		0		Decimal	BOOL
		1		Decimal	BOOL
		1		Decimal	BOOL
	CNBR_Remote:3:1.CIPSyncTimeout	0		Decimal	BOOL
<u>+</u> -(	NBR_Remote:3:1.EventNumber	10		Decimal	DINT
		{}	{.	Decimal	DINT[2]
-CNBR_Remote: 3:1.0ffsettimestamp		{}	{.	Decimal	DINT[2]
-CNBR_Remote:3:1.Timestamp		{}	{.		AB:1756
-CNBR_Remote: 3:1. Timestamp[0]		{}	{.		AB:1756
-CNBR_Remote:3:I.Timestamp[0].OffOn		{}	{.	Decimal	DINT[2]
- [	E-CNBR_Remote:3:1.Timestamp[0].OffOn[0]	921144119		Decimal	DINT
	±-CNBR_Remote:3:1.Timestamp[0].OffOn[1]	301903		Decimal	DINT
CNBR_Remote: 3:1. Timestamp[0]. OnOff		{}	{.	Decimal	DINT[2]
	-CNBR_Remote: 3:1. Timestamp[0]. OnOff[0]	921144144		Decimal	DINT
	E-CNBR_Remote: 3:1. Timestamp[0]. OnOff[1]	301903		Decimal	DINT

This can be copied into a variable of type *LINT* and view in *Date/Time* format to see the Gregorian Date.

EventTime DT#2011-02-02-18:33:52.708407(GMT+02:00) Date/Time LINT				
	EventTime	DT#2011-02-02-18:33:52.708407(GMT+02:00)	Date/Time	LINT





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