

1 OVERVIEW

This application note describes how to properly encode Time of Day information using EIA-608-B Extended Data Services (XDS) packets. In the United States, the Public Broadcasting System (PBS) Television network and its affiliates have been providing this information to the viewing public since the mid 1990s. The application note is written in a tutorial format in order to give Engineering and Operations personnel an understanding of time, time zones and daylight saving time concepts, as well as how this information is encoded into the XDS packets. The application note also provides step by step procedures for setting up the Evertz 8084 and 8084AD Caption/XDS encoders (referred to generically as 8084AD throughout this document) and the Evertz MetaCast 2 software to accomplish this.

2 WHAT IS THE CORRECT TIME ANYWAY?

2.1 UTC AND TIMEZONES

Prior to the late nineteenth century, time keeping was a purely local phenomenon. However, once railroads began to operate and move people rapidly across great distances, time became much more critical. In the early years of the railroads, the schedules were very confusing because each stop was based on a different local time. The standardization of time was essential to efficient operation of railroads.

In 1878, Canadian Sir Sanford Fleming proposed the system of worldwide time zones that we use today. He recommended that the world be divided into twenty-four time zones, each spaced 15 degrees of longitude apart. Since the earth rotates once every 24 hours and there are 360 degrees of longitude, each hour the earth rotates one-twenty-fourth of a circle or 15° of longitude. Sir Fleming's time zones were heralded as a brilliant solution to a chaotic problem worldwide.

In 1884 an International Prime Meridian Conference was held in Washington D.C. to standardize time and select the Prime Meridian. The conference selected the longitude of Greenwich, England as zero degrees longitude and established the 24 time zones based on the Prime Meridian. Though most U.S. states began to adhere to the Pacific, Mountain, Central, and Eastern time zones by 1895, the U.S. Congress made the use of these time zones mandatory by the Standard Time Act of 1918.

There are six time zones in the fifty United States as shown in Table 1. The local time of day in a specific time zone is calculated with respect to Universal Time, Co-ordinated (UTC) sometimes also referred to as Greenwich Mean Time or (GMT). UTC is the world's time standard and is essentially the standard time at the Prime Meridian that runs through Greenwich, England. All other time zones have an offset with respect to UTC, which represents the number of hours (and sometimes minutes) that they are ahead or behind the UTC time.

Offset		Time Zone	Where Observed
Code	Hours		
05	UTC-05:00	Eastern	New York
06	UTC-06:00	Central	Chicago
07	UTC-07:00	Mountain	Denver
08	UTC-08:00	Pacific	Los Angeles
09	UTC-09:00	Alaska	Alaska
10	UTC-10:00	Hawaii-Aleutian	Hawaii

Table 1: Time Zones in the United States

2.2 DAYLIGHT SAVING TIME

Daylight Saving Time (DST) was instituted to take advantage of the later hours of daylight between April and October. In 1966, the U.S. Congress passed the Uniform Time Act that standardized the length of Daylight Saving Time. For those parts of the United States that observe Daylight Saving Time, it begins at 2 a.m. local time on the first Sunday of April. Time reverts to standard time at 2 a.m. local time on the last Sunday of October. In the spring clocks *spring* forward by 1 hour to 3 a.m.; in the fall clocks *fall* back by 1 hour to 1 a.m. Arizona, Hawaii and most of Indiana have chosen not to observe Daylight Saving Time.

People often consider daylight saving time to be an “event” that happens twice a year, setting their clocks ahead or back by one hour. In reality, DST is *in effect* (ON) for six months of the year and *not in effect* (OFF) for the other six months, in regions that observe DST.

2.3 CALCULATING THE LOCAL TIME

Local time can be calculated from UTC if we know the time zone we are in and whether daylight saving time is effect or not. (This is how VCRs are designed to arrive at local time.) Similarly we can calculate UTC if we know the local time, the time zone and whether daylight saving time is in effect or not. The following formula can be used to calculate Local time or UTC.

TZ is the Time zone offset according to the code in Table 1.

DST has a value of 0 hours when Daylight Saving time is not in effect and the value of 1 hour when it is in effect.

$$\text{Local Time} = \text{UTC} - \text{TZ} + \text{DST}$$

$$\text{UTC} = \text{Local Time} + \text{TZ} - \text{DST}$$

See section 4.1 for information on how to set up the 8084AD correctly for either local time or UTC as the LTC input. The 8084AD always transmits UTC in its time of day packets (see section 3).

3 HOW XDS TIME OF DAY WORKS

XDS stands for eXtended Data Service. This data is encoded on Line 21 of field 2, using the same format as closed caption information. It is intended to supply program related and other information to the viewer. This may include the name of the program, content rating, name of the network, current time of day, etc. EIA-608-B specifies that when there is caption or XDS information in field 2, then there must be at least a null caption signal present in field 1 as well. The 8084AD automatically inserts a null caption signal if there is no other caption signal present in field 1.

There are two XDS packets defined by EIA-608-B for encoding time and date information. The *Time of Day* packet (0701) encodes the **UTC time** and contains a flag bit (**DST Flag**) that is to be set when Daylight Saving Time is *in effect* (i.e. between the first Sunday of April and the Last Sunday of October). The *Time of Day* packet must be inserted locally at each affiliate station so that the correct time is encoded when programs are aired at different times across the network.

The *Time Zone* packet (0704) encodes the **time zone offset** from UTC time and contains a flag bit (**DSO Flag**) that is to be set when the entire area served by the signal observes Daylight Saving Time. When the DSO Flag bit is set to Off, it means that the DST Flag bit in the *Time Of Day* packet will be ignored by the VCR. The *Time Zone* packet must be inserted locally at each affiliate in order to encode the correct time zone offset for the region.



In areas where the TV signal will be received in more than one time zone or in a region where one part observes Daylight Saving Time and another does not, the *Time Zone* packet must not be transmitted. In regions where the *Time Zone* packet is not transmitted, viewers will have to manually program their VCRs with the correct time zone, and whether Daylight Saving Time is observed. Older VCRs may require the user to also set the local time.

4 SETTING THE TIME AND DATE IN THE 8084AD

The 8084AD maintains an internal clock that is used to encode the time and date information into the XDS packets. The preferred way to set the clock in the 8084AD Caption Encoder is to connect Linear Time Code (LTC) with the date and time zone information encoded into the user bits (8084 LTC option required). This signal is connected to the 3-pin XLR connector on the rear panel marked *LTC In*. It can be derived from a network feed off the satellite, or from a local time code generator such as the Evertz Model 5010-GPS that is locked to an accurate time reference (e.g. GPS). Section 4.1 gives information on how to configure the LTC input correctly.

In order for the 8084AD to accurately calculate UTC and Local Time, the user must set the Time zone offset and Daylight Saving information also. If the date information is encoded in the LTC user bits then the 8084AD can read this information. Otherwise, the preferred method of setting the date and time zone information is by using the MetaCast 2 software running on a computer connected to one of the 8084AD's serial ports.

4.1 CONFIGURING THE 8084AD LTC INPUT

The 8084AD can accept Linear Time Code with either UTC or local time. With either UTC or local time as the input, the 8084AD's daylight saving time setting will have to be changed twice a year by MetaCast 2, (see section 4.2.6) but the transition is smoother if UTC is used. In addition the 8084 can read date and time zone information that has been encoded in the Leitch CSD5300 encoding format. The *LTC RDR CONFIG* item on the Engineering Setup Menu is used to configure the LTC reader in the 8084AD. (Press *SHIFT+SETUP* and then use the \downarrow key to go to the *>LTC RDR CONFIG* menu item. Then press the \leftarrow or \rightarrow keys to view the options available for that menu item. The currently selected setting will be flashing. Section 3.1 of the 8084AD manual gives more information about using the Engineering Setup Menu.) The front panel time display on the 8084AD displays the Local time. In order for the 8084AD to display the correct local time you must also set the time zone and DST Flag in the 8084AD. Section 4.2 gives information on how to set the time zone and Daylight Saving Flag in the 8084AD using the MetaCast 2 software.

When you have properly configured the LTC reader, the time zone and DST Flag, and apply a valid time code signal and input video, the 8084AD will show a letter **T** at the right side of the front panel display when the time is being displayed. The time display will have a period (.) between the hours and minutes if DST is in effect, otherwise a colon (:) will be displayed. When the 8084AD arrives from the factory its daylight saving time and time zone settings may be different from yours, so the MetaCast 2 software must be used for the initial setup and also at each daylight saving time change. When the 8084AD is confident that the extracted time is stable it will update its internal clock and display the message **TIME UPDATED** on the front panel display. This should take approximately 8 to 10 seconds after time code is first applied.

Sections 4.1.1 and 4.1.2 give the settings for the 8084AD for both UTC and Local Time LTC sources.

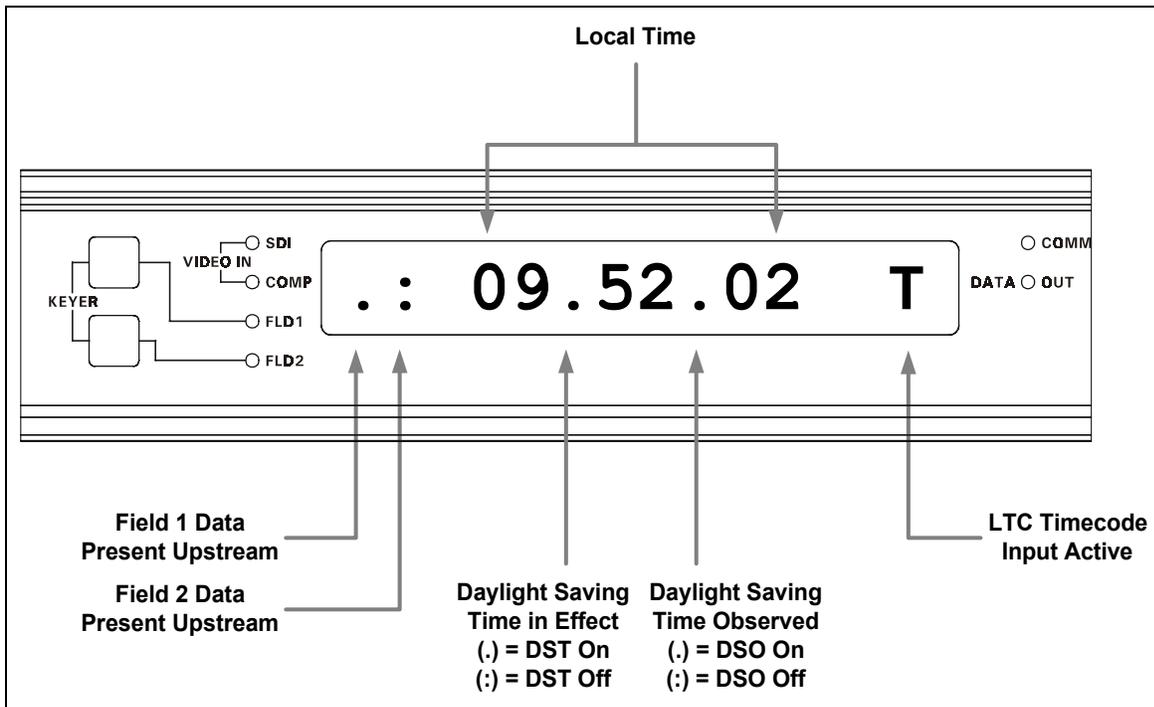


Figure 1: 8084AD Front Panel Time Indicators

4.1.1 Using LTC that contains UTC

If your time code source has UTC time with date information in the user bits select the *UTC Time + Date* menu choice in the LTC RDR CONFIG menu item. If your time code source has only UTC time with no encoded date information select the *UTC Time* menu choice. Make sure you press the *SELECT* key after you have selected the menu choice. (The selected menu choice will be flashing if it is active)

4.1.2 Using LTC that contains Local Time

If your time code source has Local time with date information in the user bits select the *Local Time + Date* menu choice in the LTC RDR CONFIG menu item. If your time code source has only Local time with no encoded date information select the *Local Time* menu choice. Make sure you press the *SELECT* key after you have selected the menu choice. (The selected menu choice will be flashing if it is active)

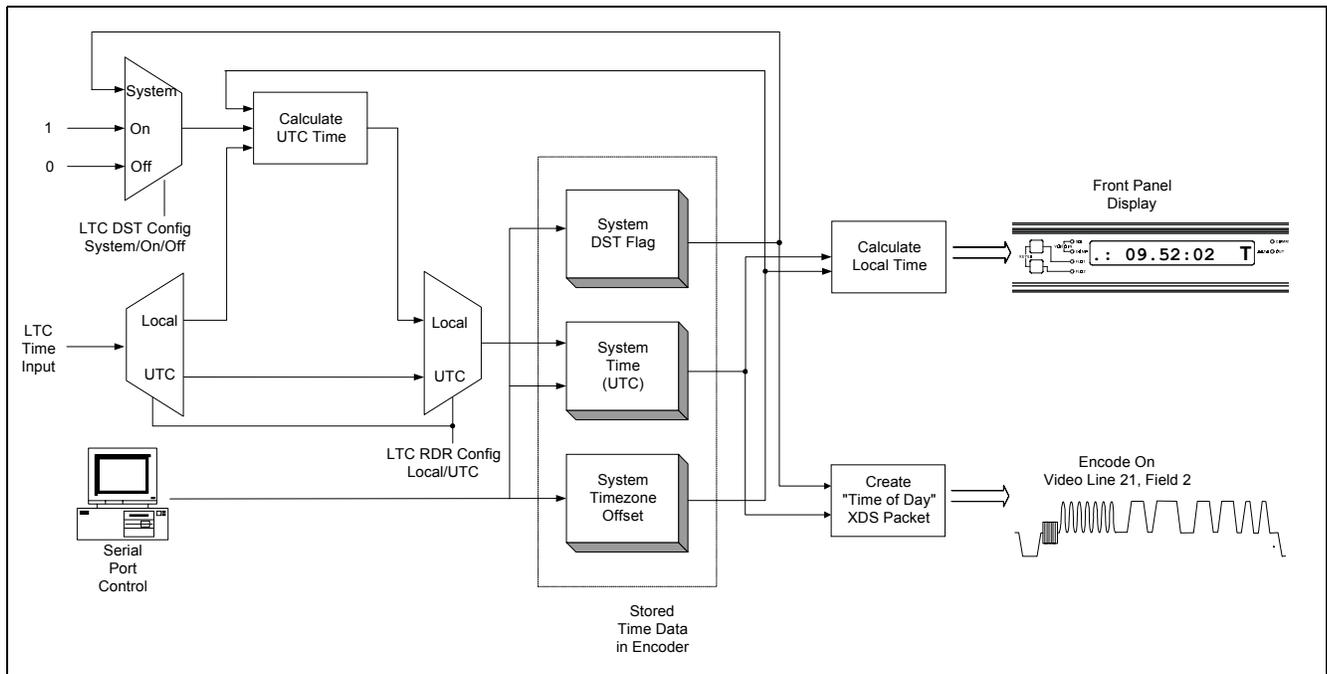


Figure 2: 8084AD Time of Day Processing

4.2 USING METACAST 2 WITH THE 8084AD

MetaCast 2 is a Windows software application that schedules the XDS packets sent by the 8084AD Encoders according to the program schedule currently being aired. It allows the station operator to program XDS packets such as show name, duration, V-chip rating for each program segment. In order to accomplish this in sync with the programs being aired, MetaCast 2 needs to have a stable time reference. The preferred method is to have MetaCast 2 read the time from the 8084AD (which is in turn reading the time from the house time code reference). MetaCast 2 will maintain this time internally as the *Broadcast Time* and use it to control the scheduling of packets.

MetaCast 2 also provides tools to monitor and set the time, date and time zone offset of the encoder, to manage changes to and from Daylight Saving Time and to enable and disable the transmission of XDS *Time of Day* and *Time Zone* packets. These tools are available by opening the *Clocks* windows from MetaCast 2's tool bar.

4.2.1 Connecting MetaCast 2 to your 8084AD

You can connect one of the serial ports on your PC to any port on an 8084AD using an ordinary NULL modem cable that should have been supplied with the 8084AD encoder. The next step is to ensure that both devices are using the same communication settings. For the 8084AD Encoder, these can be selected from the front panel engineering menu. Check your encoder manual on how to change the port settings. It is recommended that the 8084AD be set at 9600 baud, 8 data bits and no parity.

The next step is to configure MetaCast 2 to the same settings. The encoder communication settings can be found under Comm Settings in the Encoder menu. On the dialog form, select the PC port to which the 8084AD is connected and choose the same settings in the designated combo boxes. For handshaking, it is recommended that 'Hardware' be selected but this requires all pins to be connected in the serial cable.

If the response window is not visible on the right side of the screen, click Responses from the View menu. Select Connect from the Encoder menu and watch the All or Encoder tab for indication of a successful connection. Also, if the status bar is visible on the bottom of the screen, the left most panel should say 'Online' and turn green.

4.2.2 Overview of the Clocks Page

The first box on this page displays a full version of the current Broadcast Time; this time is also available in 24-hour format on the MetaCast 2 Status bar, located at the bottom of the screen. The format is composed of Windows' Long Date and Time format as defined under Regional Settings in the Windows Control Panel. The next control allows you to select the source of the broadcast clock. The Time Zone field is not directly editable but may be modified by clicking 'Set Clock' button on the toolbar. The time zone presented generally indicates whether Daylight Saving Time is active by including the word 'Daylight' or when inactive by using the word 'Standard'. The Daylight Saving Time in Effect checkbox allows you to set whether Daylight Saving Time is currently active or not. If this field is disabled, MetaCast 2 has been set to automatically adjust for Daylight Saving Time. A check in the box means that Daylight Saving Time is active (and the DST Flag will be set in the Time of Day XDS Packet). The comments 'Not observed in this time zone' mean that the selected time zone will ignore the DST flag when calculating local time (and the DSO Flag will be set in the Time Zone XDS packet). The bottom two buttons allow you to toggle whether Time/Date and Time Zone packets are being encoded. If the buttons are pressed then the associated packet is being encoded and should appear on the Encoder Status page.

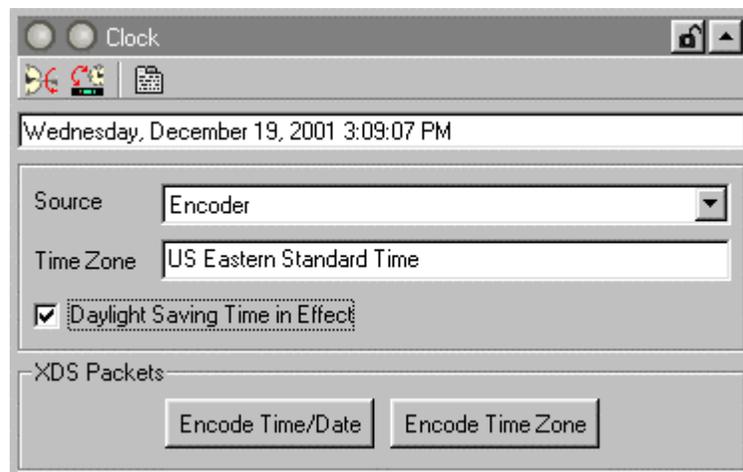
Lights

The left light indicates the status of the Time/Date packet and right light indicates the status of the Time Zone packet respectively.

 (gray)	 (green)	 (red)	 (yellow)
The packet is not in the Encoder's memory according to MetaCast 2. This is the default situation when offline.	The packet is being encoded as expected.	The packet is not being encoded as expected. There is an error of some sort.	Transition between states.

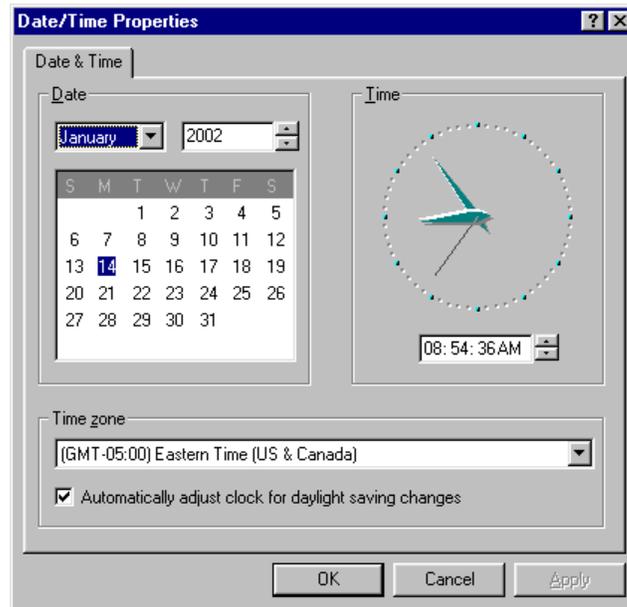
Toolbar

Icon	Name	Description
	Set Clock	Open up the Date/Time Properties window so that you can edit the Date, Time and Time Zone. If your clock source is the PC, this button will open the standard dialog used to set the PC clock.
	Sync MetaCast and Encoder	If you are connected to a Caption Encoder, this button will ensure that MetaCast 2 is synchronized with the 8084AD Encoder. If your clock source is the Encoder, MetaCast 2 will update its own clock; otherwise MetaCast 2 will update the clock in the Encoder.
	Options	Shortcut to the General Options page when you can set various clock parameters.



4.2.3 Setting the 8084AD Date from MetaCast 2

If your LTC input to the 8084AD contains date information you can go straight to section 4.2.4, otherwise you will have to set the date in the 8084AD from MetaCast 2. To do this you will need to temporarily set the Time Source to *PC Clock*. Check the PC Clock's settings by clicking the 'Set Time' button on the Clock page toolbar. The *Date/Time Properties* screen will appear.



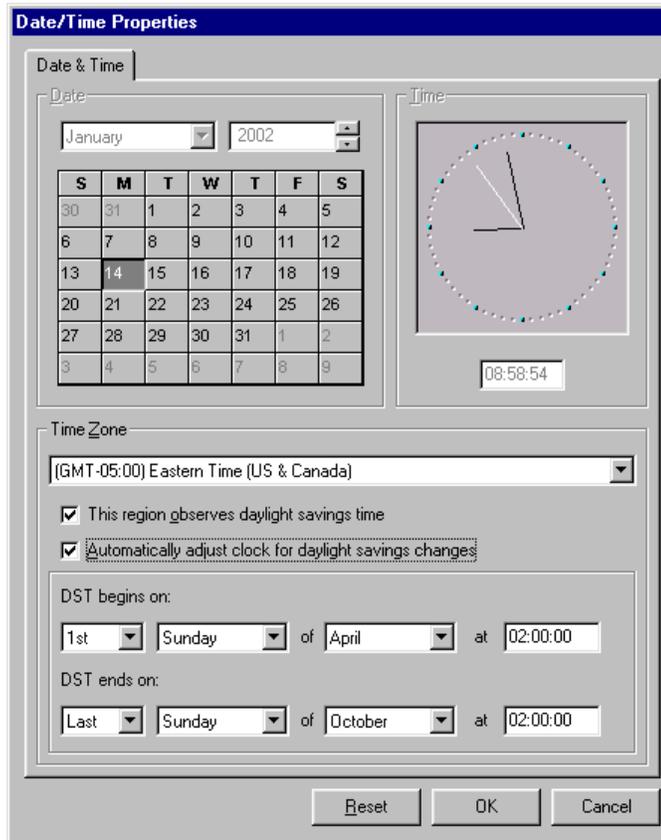
After making any changes press the Okay button to update the PC clock. After exiting the *Date/Time Properties* screen you will need to click the 'Sync MetaCast 2 and Encoder' button on the Clocks Toolbar to apply those new settings to MetaCast 2. Note that this will set the time, date and time zone into the 8084AD, however the time will be overwritten by the LTC connected to the 8084AD. Proceed to the next section to configure MetaCast 2 to update its time clock now from the 8084AD.

4.2.4 Configuring MetaCast 2 to Read the Time from the 8084AD

Set the Time Source on the Clocks page to *Encoder* to have MetaCast 2 synchronize its clock from the 8084AD (which is reading your house time code). Normally this will only synchronize MetaCast 2's *Broadcast Time*, but you can also have MetaCast 2 to set the PC Clock by checking the option on the General Options page. If you do this, additional instances of MetaCast 2 not connected to the 8084AD, but running on the same PC, can also be synchronized by selecting PC Clock as their time source.

4.2.5 Setting the Time Zone

Next you will need to set the time zone so that the 8084AD and MetaCast 2 can properly convert between UTC and local time. Click the 'Set Clock' button on the Clock page toolbar to open the *Set Time* page. To select a time zone, click the down arrow on the combobox and select your region from the dropdown list. The Date and Time options on this page are not available since this information will be taken from the Encoder; however, the Daylight Saving settings will need to be configured to match your house time source. See section 4.2.6 for more information on setting the Daylight Saving Time options.



4.2.6 Configuring Daylight Saving Time

Two independent check boxes control Daylight Saving Time (DST) in MetaCast 2. The first check box is used to set the DST Flag in the 8084AD and is checked when Daylight Saving Time is currently being observed. It is located on the Clocks page and in most cases it should be updated by MetaCast 2's automatic DST adjustment controls. The second check box is used to set the DSO Flag in the 8084AD and needs to be checked if the current region you are broadcasting to observes Daylight Saving Time. MetaCast 2, and any televisions or VCRs receiving XDS *Time of Day* packets, use the DSO Flag to determine if they should adjust their time when the DST Flag is set.



Even in regions that do not observe Daylight Saving Time, you must still turn on the DST flag in accordance with surrounding regions so that they can properly calculate their local time.

The status of both check boxes can be monitored on the Clocks page. When Daylight Saving Time is active, the box next to the text 'Daylight Saving Time in Effect' will become checked. For regions that do not observe Daylight Saving Time, the comment '(Not observed in this region)' will be added to the checkbox caption.

You can choose how MetaCast 2 adjusts for DST on the Date/Time Properties page. Check the box immediately below the time zone list if DST is observed in your region. This value is updated from the Windows' Time Zone database whenever you select a new time zone.

The check box immediately below that lets you choose whether MetaCast 2 should automatically adjust for DST or not. Normally you should check this box, even if your region does not observe DST. When the box is checked, the DST time controls below become available, allowing you to configure when MetaCast 2 will automatically adjust for DST. By default, the dates are taken from Windows' Time Zone database but you can adjust them to any time you wish.



If you are feeding Local Time to the 8084AD's LTC reader, it is important that both MetaCast 2 and your house clock are configured to switch to DST at the same time, otherwise inaccuracies could occur.

The *Daylight Saving Time in Effect* check box on the Clock page will now be updated automatically based on the rules you have chosen. If you do not observe DST in your region then the comment '(Not observed in this region)' will be added.



If you do not check the *Automatic DST Adjustment* box then you will have to will manually determine when DST is in effect or not. If you do not set the *DST in Effect* check box correctly incorrect time settings may result on Televisions and VCR's that are receiving the XDS packets.

4.2.7 Synchronizing Clocks

Once your clocks have been set, the final task is to ensure that everything remains synchronized. You can resync MetaCast 2 to your Encoder by clicking 'Resync MetaCast and Encoder' button on the Clock toolbar. MetaCast 2 will also automatically resynchronize to the Encoder time periodically according to your settings on the General Options page. The 'Set PC clock' check box on this screen instructs MetaCast 2 to set the PC clock in addition to its internal BroadCast time. This allows additional instances of MetaCast 2 running on the PC to be synced to one 8084AD Encoder with an LTC reader.

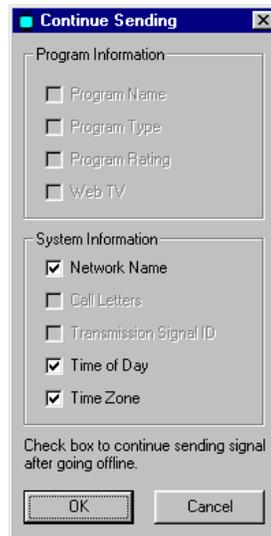
4.2.8 Configuring the 8084AD to Encode Time of Day and Time Zone XDS Packets

The bottom two buttons on the Clocks page allow you to control whether *Time of Day/Date* and *Time Zone* packets are being encoded. If the buttons are pressed then the associated packet is being encoded and should appear on the Encoder Status page. Normally both buttons should be depressed. However, if you are in a region that broadcasts to two different time zones you should not transmit the *Time Zone* packets. Also, if part of your broadcast region observes Daylight Saving Time and part of it does not then you should not transmit *Time Zone* packets. Viewers in your area will have to set their own VCRs and television sets for the correct time zone, and whether they observe Daylight Saving Time or not. **Note:** if you transmit *Time Zone* packets in either of these cases viewers' VCRs will not be set correctly.

When you exit MetaCast 2, you will be presented with the choice to continue encoding XDS packets or to remove them from the 8084AD packet stream. To continue sending the *Time of Day* and *Time Zone* packets after you exit MetaCast 2 you will need to check the appropriate boxes; otherwise they will be removed.



Note that XDS packets are NOT retained after a power loss to the 8084AD even though the internal clock is battery backed up. In order to guarantee that the packets will be sent continually you must either provide uninterruptable power to the 8084AD or re-enable the packets using MetaCast 2 after a power failure.



4.2.9 Monitoring the Time of Day and Time Zone Packets in MetaCast 2

The current time and date being read from the encoder is shown on the top text box of the Clocks page. The Current time is also shown on the Status window at the bottom of the screen.

The encoder Status window shows the XDS packets that are currently being transmitted by the 8084AD. You should see an entry for the *Time of Day*

Category	Translation	Source
Time of Day	System Time	System
Time Zone	05	System
Network Name	PBS	System
Call Letters	WPBS	System
TSID	1	System

5 Issues With Consumer Electronics

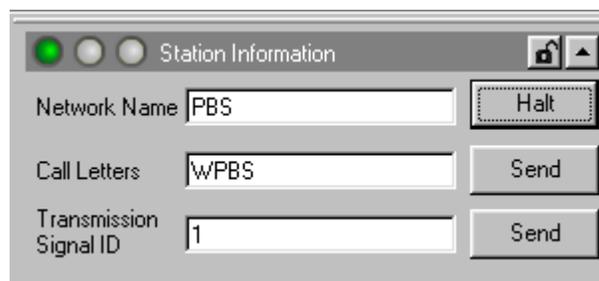
5.1 Line 21 Field 1 Signal Must be Present when Encoding XDS

EIA-608 Specifies that Line 21 Field 1 caption signal must also be present when XDS packets are being inserted. Some XDS decoders will not function if the caption signal is not present in both fields. When encoding XDS packets, the 8084AD will automatically insert a Line 21 Field 1 caption signal if there is not one present already.

5.2 Issues with Panasonic and Quasar VCRs

The Matsushita chipset (used in Panasonic and Quasar VCRs) has some anomalies in the way they handle *Time of Day* and *Time Zone* XDS packets

- The Network Name XDS packet MUST be present, and its contents MUST be "PBS".



- The Station Call Letters and Time Zone packets MUST also be present for the AUTO CLOCK feature in these VCRs to work. This is bad, since some stations will not encode Time Zone packets, in accordance with EIA-608-B rules.
- These VCRs ignore the state of the DST bit. They figure out whether DST is in effect based on the current date & time, using the typical rules for changing the clock. This means that these VCRs may not work properly in regions of the country that do not observe daylight saving time.
- If XDS is encoded at more than one location (e.g. Network and affiliate) it is possible for some locally inserted packets to be interrupted to allow upstream XDS packets to pass through. The locally inserted packet will then be resumed when the upstream packet is completed. These VCRs will ignore *Time of Day* packets that are paused and resumed. They only acknowledge uninterrupted XDS packets. To avoid this all XDS encoding should be done locally at the point of final transmission, and the 8084AD should block upstream XDS packets, if at all possible.

5.3 Miscellaneous Issues

- Some VCRs will only update their clocks once per hour
- Some VCRs will only update their clocks accurate to the minute
- Some VCRs only update their clocks one time after power up.