Modifications to Time Synchronisation on the EpiSensor Gateway products

Introduction

On the new NGR-30-3 hardware running Ubuntu 16 (OS version V02.00), it was observed that the OS time was resetting to February 11 2016 after power down. On previous versions of the hardware/OS the reset OS time was Jan 1 2000.
This led to a reworking and rethinking of the time handling and time synchronization methodology. [GW-1034, GW-1035, GW-1037]

Timedatectl versus Ntpd

On the new operating system timedatectl is available and will be used for setting the date and time as well as enabling and disabling NTP. In light of this the NTP daemon should NOT be installed on the new NGR-30-3 as it will conflict with the use of timedatectl.

Reboot and Power Down/Up

On reboot the NGR-30-3 does not lose it's time setting.
However on power down and then subsequent power up the time is lost and reset to February 11, 2016. On the older operating system the time reset to January 1, 2000. So it is important to detect the new reset time on the new system. (GW-1034)

Effect of NTP synchronization

When NTP synchronisation is enabled (using timedatectl), the gateway time does not reset to 2016 but in fact will hold the last time set on the gateway (which would be the time before shutdown). This leads to further complications because if there is no access to an NTP server after reboot the gateway will be out of synchronisation. As a result the gateway needs to check if NTP is enabled and if NTP is synchronized before trusting the gateway/s time settings. The output from timedatectl will indicate if NTP is synchronized or not :

```
jenny@jenny-Latitude-E6320:~/BITBUCKET/gateway$ timedatectl
Local time: Mon 2017-12-04 11:32:10 GMT
Universal time: Mon 2017-12-04 11:32:10 UTC
Timezone: Europe/London (GMT, +0000)
NTP enabled: yes
NTP synchronized: yes
RTC in local TZ: yes
DST active: no
```

Synchronisation between ZAP and Gateway

The ZAP will maintain its time even after power down for approximately 4 days. So the ZAP time can be used to set the time on the gateway.

Alternatively if the ZAP and the gateway lose their time, but NTP is enabled on the gateway, and the gateway has access to an NTP server, the gateway can send the time to the ZAP.

However some logic must be applied to make sure the correct time source is used (i.e. ZAP or gateway)

The gateway will send either a QTIM or a TIME to the ZAP in the following situations :

- On receipt of a NID
- On receipt of a FRMD
- Periodically as part of housekeeping
- Whenever the time is set via the user interface. (Settings -> Time)

The decision to send a TIME or a QTIM is based on the following logic :

IF the gateway time is < 2017
THEN send a QTIM as the gateway time is out of date
ELSE
      IF the NTP is enabled but not synchronized (e.g. could happen if no internet connection)
      THEN send a QTIM
      ELSE send a TIME
      ENDIF
      (Note if NTP disabled will send TIME and on legacy platforms send TIME)
ENDIF

When a TIME message is received from the ZAP :

IF the ZAP Time is <= 2000 (this means the ZAP has lost its time)
   IF the GW Time is >= 2017
   THEN
      IF NTP is disabled
      THEN Set the ZAP Time
      ELSE IF NTP is enabled and synchronized
      THEN Set the ZAP Time
      ELSE log an error for user interaction to set the time or provide access to NTP
      ENDIF

ELSE (GW Time < 2017) log an error for user interaction to set the time
ENDIF
ELSE (ZAP Time > 2000)
   IF the ZAP time is behind the gateway time
      IF the ZAP time is behind the gateway by > 5 minutes
      THEN
         IF (NTP enabled AND synchronized) or NTP disabled
               Set the ZAP time from the gateway
         ELSE log an error for user interaction to set the time or provide access to NTP
      ELSE differences < 5 minutes are ok
   ELSE (ZAP time not behind gateway time)
      IF gateway year < 2017
      THEN set the gateway time from the ZAP
      ELSE IF NTP enabled but not synchronized
      THEN set the gateway time from the ZAP

In all above if setting the gateway time and NTP is enabled, disable it momentarily.

Test Scenarios
NTP Disabled
>   No Internet Connection
>>   Soft Reboot   Send the gateway time to the ZAP.
>>   Power down/up Query the time from the ZAP and set the gateway time from this.
>>   Power down/up with ZAP losing the time. Query the time from the ZAP and then log a FATAL error because time not set on ZAP or gateway.

>   Active Internet Connection
>>   Soft Reboot   Send the gateway time to the ZAP.
>>   Power down/up Query the time from the ZAP and set the gateway time from this.
>>   Power down/up with ZAP losing the time. Query the time from the ZAP and then log a FATAL error because time not set on ZAP or gateway.

NTP Enabled
>   No Internet Connection
>>   Soft Reboot   Query the time from the ZAP and set the gateway time from this of ahead.
>>   Power down/up Query the time from the ZAP and set the gateway time from this.
>>   Power down/up with ZAP losing the time. Query the time from the ZAP and then log a FATAL error because time not set on ZAP or gateway.

>   Active Internet Connection
>>   Soft Reboot Send the gateway time to the ZAP.
>>   Power down/up Send the gateway time to the ZAP.
>>   Power down/up with ZAP losing the time. Send the gateway time to the ZAP.

NGR-30-5 (GW3000) Platform
On the GW3000 the ZAP will never hold the time after a reboot. So the ZAP can never be used to set the time of the gateway. However the GW3000 has a battery backed clock, so it will not lose it's time after a power down. For the GW3000, we will always send the TIME to the ZAP (unless the gateway time is < 2017).

Legacy NGR-30-3 Platform
On the NGR-30-3 the ZAP will never hold the time after a reboot. Even if NTP is enabled, after power down and up, the time is reset to 2000. Also synchronisation does not take place very soon after start-up so even if NTP enabled the gateway will still end up getting the time from the ZAP. So there are not as many different scenarios to test as on the new NGR-30-3.

The scenarios to test are:

- Power Down/Up Gateway will send QTIM to ZAP and the gateway time will be then set from the ZAP
- Soft Reboot Gateway will send TIME to ZAP
- Power Down/Up and ZAP loses time. Gateway will send QTIM to ZAP but the gateway time won't be set from the ZAP time because the ZAP time has not been set either.