Time Series Data Format for ALERT2

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To: NHWC ALERT2 Technical Working Group

This proposal is for adding a Time Series Data (TSD) format to the ALERT2 Self-Reporting Sensor Protocol. Heretofore, the ALERT/Flood Warning community has utilized event based reporting with occasional heartbeat reports successfully. As more and more technological advances are made in real-time flood forecasting, modeling, and inundation mapping, the need for and value of time series data increases.

A format such as herein proposed has the potential of being used in various ways to fulfill multiple purposes, yet remain common in format. First, we will present the proposed format followed by some ideas for implementation.

Several options for how best to format the TSD within the existing protocol were considered. After receiving some comments on the original draft proposed it has been concluded that creating a new Report Type (# 5) within the Self-Reporting Protocol is the best option. That new report format would be as shown and described below.

Field	T	L	S	I	FL	V(2-i*11)	V(2-i*10)	V(2-i*9)	etc. (x8)	V(2)
Decimal	5	51	7	69	52	9.94	10.02	10.15	…	11.52
Hex	05	33	07	45	34	411F0A3D	412051EB	41226666	…	413851EB
Ctl Byte	Time Stamp	Rpt Type	Rpt Length	Sensor ID	Interval	Format Length	Data(1)	Data(2)	Data(3)	Data(...)	Data(12)

Time Series Data Elements (12 sets in this example)
4-Byte Floating Point
The interval of time between each data element (5 minutes in this example)
Sensor ID for which the TSD belongs (in this case Sensor ID 7 for Stage)
Report Length equals the total number of bytes in the packet after this 'position'.
Self-Reporting Sensor Protocol Report Type designator (TSD = 5)
A two byte field carrying the number of elapsed seconds since the last "12:00" (AM or PM).
A bit-wise byte of values and flags about the packet.

Working left to right in the proposed format above, beginning with the 3rd field, Rpt Type, this field holds a value of "5" identifying a format defined for Time Series Data will follow.

The 4th field, Rpt Length, contains the number of bytes in the message from this point forward, non-inclusive.

In most TSD messages the 5th field contains the sensor ID for which the subsequent data elements are about. For the sake of consistency, the same sensor ID numbering requirements and

limitations as in place for a Type 1, GSR, message will be employed for Type 5 messages. This includes the use of reserved sensor ID 255 for embedding a 4-byte POSIX timestamp. When such a timestamp is needed/used, then fields would be inserted between field 4 and 5 in the example above to carry the timestamp. Regardless of which timestamp is used (the 2-byte field right after the "Ctl Byte" or the sensor 255 POSIX time) that time will refer to the time of the MOST CURRENT data element carried in the message.

Field 6 is a single byte defined with the two high-order bits representing seconds (00), minutes (01), hours (10), or days (11) and the 6 remaining low order bits providing the actual interval (1 – 63, assuming "0" as invalid). With this structure it would be possible to send ranges from 1-63 seconds, minutes, hours, or days. Understandably, some possible intervals probably would never be used (e.g. 61-63 seconds or minutes, etc.). A bit view of the example (5 minute intervals; 0x45) in the table above would be "01000101". If the desired interval was to be 30 seconds the byte would be 0x5E, 94, and 01011110. For an hourly time series interval the byte would be 0x81, 129, and 10000001.

The 7th field contains the Format and Length (same requirements as Format and Length in Type 1 GSR message) of the following data [4-byte floating point in this example]

Subsequent fields, V(2-i*11) through V(2), contain values for suceeding evenly spaced intervals (as specified by field 6) of time. The oldest data are presented first with the most current data being last in the string. This last field is the one for which the timestamp carried applies to. In the example used, the TSD packet is carrying one hour of 5-minute data (12 elements).

All of this can be sent in the minimum 500 mSecond slot assuming typical default values are utilized for related timing configurations of the radio. To have sent this data as individual GSR packets every five minutes would have required 3.72 seconds of actual airtime with six full seconds of airtime having to be allocated.

A justifiable use for such a format would be when the information isn't required in real-time but is needed at intervals more frequent that one can visit the site to retrieve logged data. By taking advantage of the full transmission window slot and overall less data bytes being sent, there is also a reduction in the power consumption by the system compared to individual GSR reports every 5 minutes.

Continuing on the example of one hour of 5-minute data, there are circumstances where missed data reports (holes in the time series record) are undesirable or even unacceptable. In those cases, this same TSD report could be transmitted every 30 minutes (rather than hourly), resulting in six "new" data elements and six "redundant" (in previous report as "new") data elements. In really extreme cases the TSD could be transmitted more frequently with fewer "new" data elements and more "redundant" elements. Care must be taken such that there isn't a diminishing return on the gains being made by using the TSD.

Another case where one might want to use or need TSD would be to get hourly data elements once every "X" hours; either for initial postings or as redundant data to fill potential gaps in the data set previously gathered. Care must be taken that slot overruns don't occur with these TSD reports. Given

the nature of the majority of data elements reported by ALERT2, it would be of significant benefit if the ALERT2 protocol allowed for a robust 2-byte floating point value that matched the common values being transmitted via ALERT2.

The impacts of more data in single packets on the TDMA configuration of a system can be huge. It is beyond the scope of this Proposal to address all those ramifications. Let it suffice to say that ensuring adequate slot times for sites (and repeaters) that will be expected to send larger datasets will be paramount to operating a successful network. Seeking out the assistance of experienced TDMA professionals and software applications that help manage TDMA networks will be well worth the time and expense of doing it.

And while ALERT2 doesn't have a two-way module yet, it is believed that this same TSD format (or at least significant portions of it) could be utilized for polled/interrogated networks for providing time series and/or historical data; thereby reducing the burden on software developers to create something entirely new or different.

Respectfully Submitted,

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