Proposed P1J/K Coordination towards the Definition of CCSDS Recommendations about On-board Time

European Space Agency
guillermo.ortega@esa.int

- **P1J presentation on response to P1K proposal drafted on MoM with Ref. ESD-DM-047 (Damien MAEUSLI, ESA/ESTEC)**
- **During its June-2000 meeting, the CCSDS Technical Steering Group instructed the CCSDS P1K SOIF sub-panel 'to cooperate with P1J sub-panel on the issue of on-board timing aspects (Action TSG-99-14)**
- **This presentation will NOT address solutions but intends to bring a forum of discussion on the subject**

- **P1J and P1K shall not conflict but rather complement each other**
  - **P1K sub-panel tries to set up a basic and minimum network infrastructure in order to support the distribution of both data and 'tick' information**
- **P1J sub-panel may be the "client" using the services provided by P1K (e.g. SOIF)**
- **In particular P1J may be asked to establish a standard on the use of navigation data for SOIF systems (see next slides)**

- **Define a “Navigation” format to exchange navigation data between space agencies**
- **Define which data will be transferred**
- **Define the pseudo-format of the transferred data**
- **Three cases: Ground-to-flight, Flight-to-ground and Flight-to-flight**

- **The development of the present three satellite-based global navigation systems (the U.S.'s NAVSTAR, the former U.S.S.R.'s GLONASS and the European GalileoSAT) represent a huge change in the technology of navigation and positioning**
- **Although initially planned for military purposes, the civil sector (non military) has quickly recognized the potential value of these positioning systems in the areas of civil aviation, marine and ground navigation, spacecraft navigation, and surveying and geodesy**
- **The development of products and services has open a new market with rapid growth**

- **Aircraft operators represent one of the main markets for satellite navigation systems, which have the potential to transform air traffic management in many areas. With the services provided by satellites, it will be possible to improve not only navigation accuracy but also enhance communication and surveillance capabilities, thus increasing safety, gaining time and reducing fuel consumption and costs.**

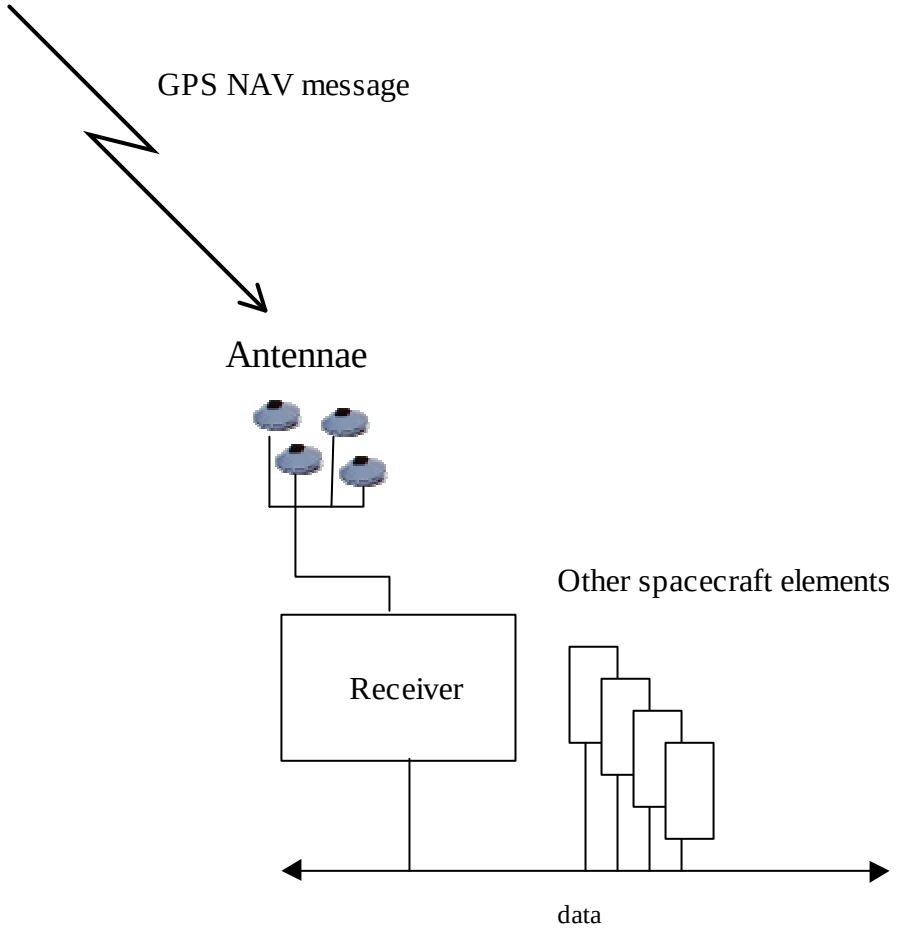
- **But not only airlines will benefit from navigation satellite systems. Companies operating transport services by road, sea or rail need to know where their vehicles are at all times. So do police, ambulance and taxi services. Some European car manufactures are already featuring satellite navigation systems in their top-of-the-range vehicles and cheap hand-held receivers are becoming widely used by recreational sailors, climbers and hikers.**

- **As well as improving safety, a European contribution to a global navigation satellite system will greatly contribute to improve economic prosperity, industrial returns, employment and quality of life in Europe.**

- **The USA GPS system NAVSTAR is managed by the U.S. Air Force (USAF) for the Government of the United States. The NAVSTAR satellite constellation is composed of 27 satellites deployed in near-elliptical orbits around the Earth. The satellites are located in 4 orbital planes where each orbital plane contains 6 satellites**
- **The Russian GPS system GLONASS is similar to the American NAVSTAR. Presently, GLONASS is operated by the air command of the Russian military forces. GLONASS is formed also of 24 satellites having 3 orbital planes, with 8 satellites per plane. Unlike GPS, GLONASS uses the Frequency Division Multiple Access (FDMA) technique to broadcast the data**
- **In Spring 1999, the Council of the European Space Agency has approved the space mission GalileoSAT. The definition of the Galileo system will be completed by the end of the year 2000. Galileo shall be fully operational by the year 2008. It will be inter-operable with the NAVSTAR system. The GalileoSAT constellation will consist of medium Earth orbit satellite constellation and a number of geostationary satellites plus some other local complements.**

- **Technical Note issued by ESTEC on "The use of Global Positioning System Time for Spacecraft Navigation". Topics: Use of GPS time on-board, navigation timing accuracy, time distribution, and GPS time code.**
- **Presentation by ESTEC on "Interface with commercial near-Earth navigation systems" NAVSTAR, GLONASS, and future GalileoSAT.**

- **What happens when GPS NAV message reaches a spacecraft platform?**
  - **1) acquire nav. message**
  - **2) Extract time**
  - **3) Broadcast time on bus**
- **3) is the concern of P1K**
- **1) is the concern of the marketplace**
- **2) MAY BE THE CONCERN OF P1J**



- **Damien MAEUSLI on the memo "...In view of the number of GPS applications, the P1J demand / GPS case is a perfect candidate to verify the suitability of the basic 'tick' service definition and its capability to support efficiently more advanced timing services. Furthermore, as far as P1K knows, no standard solution to distribute GPS information across the platform is currently specified…"**
- **Generation of a time format to be used in all platform and payload elements**

- **P1J involvement:**
  - **Study the necessity for the standardization of the generation of a specific time format from ANY GPS navigation message system (possible action on G. Ortega to draft a technical note).**
  - **Study the standardization of a common time format generated directly from S/C sensors (possible action on G. Ortega to draft a technical note). I recommend to contact Kate (GSFC on this issue)**
  - **Study the implications of a possible time format with the space-to-ground and ground-to-space interfaces**
  - **Study the use of SOIF for the broadcasting of this possible format**

- **Take actions to draft technical notes to gather state of the art, requirements, and necessities for such standard**
- **Meet extraordinarily mid 2001 to quick check progress on the issue**
- **Extend P1J membership with more flight-to-flight experts, specially from industry (S. Gomez NASA/JSC, D. Berry and K. Hartman NASA/GSFC, J. Benedicto and R.Lucas ESA, K. Yamanaka NASDA, …)**