Mini-stamp as a micro-display for at-a-glance subsystem information for DSN links

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Operators of the Deep Space Network (DSN) attend to numerous tasks with the overall goal of providing continuous support for the world's deep space missions. This high-stakes operations environment requires operators to understand the state of the Deep Space Network and predict what will happen next. Under the Follow-the-Sun initiative which requires remote operations of the highly complex telecommunications equipment, operators will need to remain aware of the state of the entire network rather than just their own facility, and transitioning fluidly between periods of low activity and periods of high demand.

I designed a micro-display for operators to see, at a glance, the state of a Deep Space Network support including its subsystems. Using in-depth user-centered and participatory design techniques to identify information requirements, I designed what I called a Postage Stamp (NTR-49720) for individual operators to be able to maintain awareness of their own assigned supports. However, under Follow the Sun, operators must remain aware of *all* supports. The area occupied by the Postage Stamp must shrink to allow operators to see the state of the entire system, e.g., via a Big Board posted prominently in the operations room.

Micro-displays are tools for mental model re-alignment, helping operators to keep their mental models of how the system works and behaves aligned with the changing state of the complex system. Data-driven micro-displays such as the Postage Stamp and Mini-Stamp display information about the system in a consistent way. Like a traffic light, the format of the micro-display never changes: the operator always knows where to look to find a specific piece of information. The Mini-Stamp always looks like the Mini-Stamp, and all of its data fields always lie in the same place on the micro-display. Real-time data flows through the Mini-Stamp to provide information to the operator.

Antenna

The main portion of the Mini-Stamp micro-display shows the antenna number and its status. This antenna-centric view of a DSN support reflects staffing and scheduling practices at the sites around the globe. The antenna number corresponds to the unique antenna identifier, and its status is antenna action (stowed, slewing, tracking, stowing, stopped/brakes).

Uplink

The uplink portion of the Mini-Stamp shows whether the transmitter is enabled, and whether there are errors, warnings, and/or alerts for the uplink of the support.

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This research was carried out at JPL, Caltech, under a contract with NASA

Downlink

The downlink portion of the Mini-Stamp shows whether the receiver shows a lock on the spacecraft signal, and whether there are errors, warnings, and/or alerts for the downlink of the support.

Symbols

The symbols portion of the Mini-Stamp is intended to show whether data is being received, and whether there are errors, warnings, and/or alerts for the data/symbols portion of the support.

Status bits

The Mini-Stamp includes a single status indicator for ranging (up and down) and command mod. These are consistent with the status bits on the Postage Stamp.

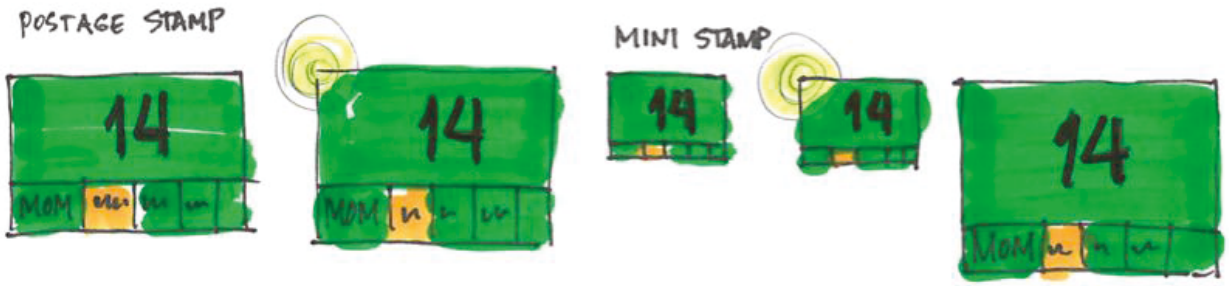

Figure 1. Using a hotspot to minimize the Postage Stamp into a Mini-Stamp and then re-expand the Mini-Stamp into a Postage Stamp

Antenna 35 is stowed and idle

Antenna 15 is on point and in track, supporting uplink, downlink, and ranging

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Antenna 25 is in track, radiating but with a lost lock on downlink and symbols; error states in ranging or commanding

Antenna 65 is pre-calibrating before the start of the track

Antenna 43 is in post-calibration after the end of a support

Antenna 34 is in track, with a multiple spacecraft per aperture (MSPA) configuration; the main support has an uplink and the secondary has downlink.

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