

## **Exploring Cognition using Software Defined Radios for NASA Missions**

NASA missions typically operate using a communication infrastructure that requires significant schedule planning with limited flexibility when the needs of the mission change. Parameters such as modulation, coding scheme, frequency, and data rate are fixed for the life of the mission. This is due to antiquated hardware and software for both the space and ground assets and a very complex set of mission profiles. Automated techniques in place by commercial telecommunication companies are being explored by NASA to determine their usability by NASA to reduce cost and increase science return. Adding cognition – the ability to learn from past decisions and adjust behavior – is also being investigated.

Software Defined Radios are an ideal way to implement cognitive concepts. Cognition can be considered in many different aspects of the communication system. Radio functions, such as frequency, modulation, data rate, coding and filters can be adjusted based on measurements of signal degradation. Data delivery mechanisms and route changes based on past successes and failures can be made to more efficiently deliver the data to the end user. Automated antenna pointing can be added to improve gain, coverage, or adjust the target. Scheduling improvements and automation to reduce the dependence on humans provide more flexible capabilities.

The Cognitive Communications project, funded by the Space Communication and Navigation Program, is exploring these concepts and using the SCan Testbed on board the International Space Station to implement them as they evolve. The SCan Testbed contains three Software Defined Radios and a flight computer. These four computing platforms, along with a tracking antenna system and the supporting ground infrastructure, will be used to implement various concepts in a system similar to those used by missions. Multiple universities and SBIR companies are supporting this investigation.

This paper will describe the cognitive system ideas under consideration and the plan for implementing them on platforms, including the SCan Testbed. Discussions in the paper will include how these concepts might be used to reduce cost and improve the science return for NASA missions.