High Power mm-wave Transmitter System for Radar or Telecommunications S. L. Stride\textsuperscript{1}, R.L. McMaster\textsuperscript{1} and Dr.R.J.Pogorzelski, \textsuperscript{1}Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena CA 91109, Robert.L.McMaster@jpl.nasa.gov, Scot.L.Stride@jpl.nasa.gov, Ronald.J.Pogorzelski@jpl.nasa.gov

Introduction: Future NASA deep space missions able to provide tens of kilo-watts of spacecraft DC power, make it feasible to employ high power RF telecommunications systems. Traditional flight systems (e.g., Cassini), constrained by limited DC power, used a single high-gain 4m Cassegrain reflector fed by a single lower power (20W) transmitter. Increased available DC power means that high power (1000 W) transmitters can be used. Rather than continue building traditional single-transmitter systems it now becomes feasible to engineer and build multi-element active arrays that can illuminate a dish. Illuminating a 2m dish with a spherical wavefront from an offset 1kW active array can provide sufficient ERP (Effective Radiated Power) when compared to a larger Cassegrain dish. Such a system has the advantage of lower mass, lower volume, improved reliability, less stringent pointing requirements, lower cost and risk. We propose to design and build a prototype Ka-band transmit antenna with an active sub-array using 125W TWTAs. The system could be applied to a telecommunications downlink or radar transmitter used for missions such as JIMO.

Principle approach: Using multiple 120 TWTs would mean only one transmitter would be required, because there would be graceful degradation over time. TWTAs today have an estimated life time of over 100,000 hours and with graceful degradation the transmitter would last for over 20 to 30 years. Also with multiple TWTAs the output power could be selected by turning off some of the tubes. Using multiple tubes solves the thermal management problem by not concentrating the heat in one place and using thermal radiation instead of conducted emission as the way of managing the heat. The collector of TWTs can be allowed to heat up to 250°C or higher allowing the heat to be radiated into space. Using 9 to 12 120 watt TWTAs instead of many solid state elements, 500 to 600, would minimize the distribution and mechanical structure requirements.

Such a system can be used for pulsed radar and/or CW telecommunications.

References: None