



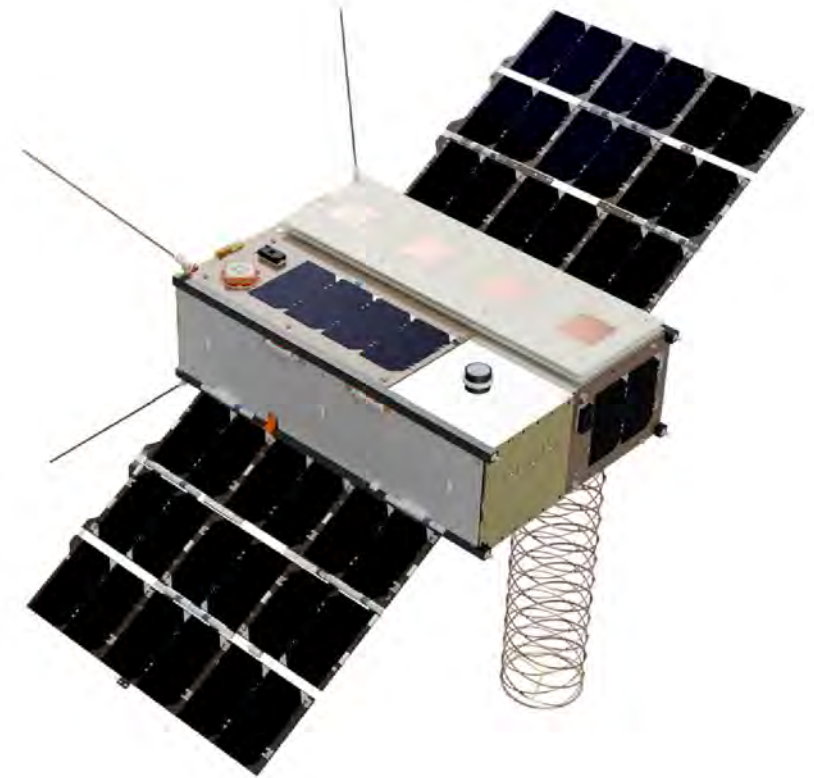
INSPACE
MISSIONS

Babel CEOI PD4

NCEO & CEOI Science Virtual Conference
24th June

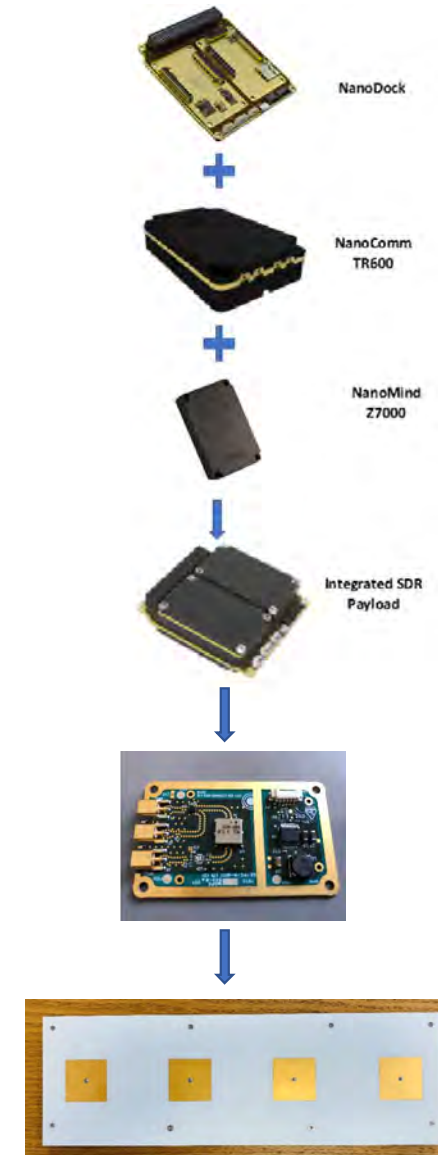
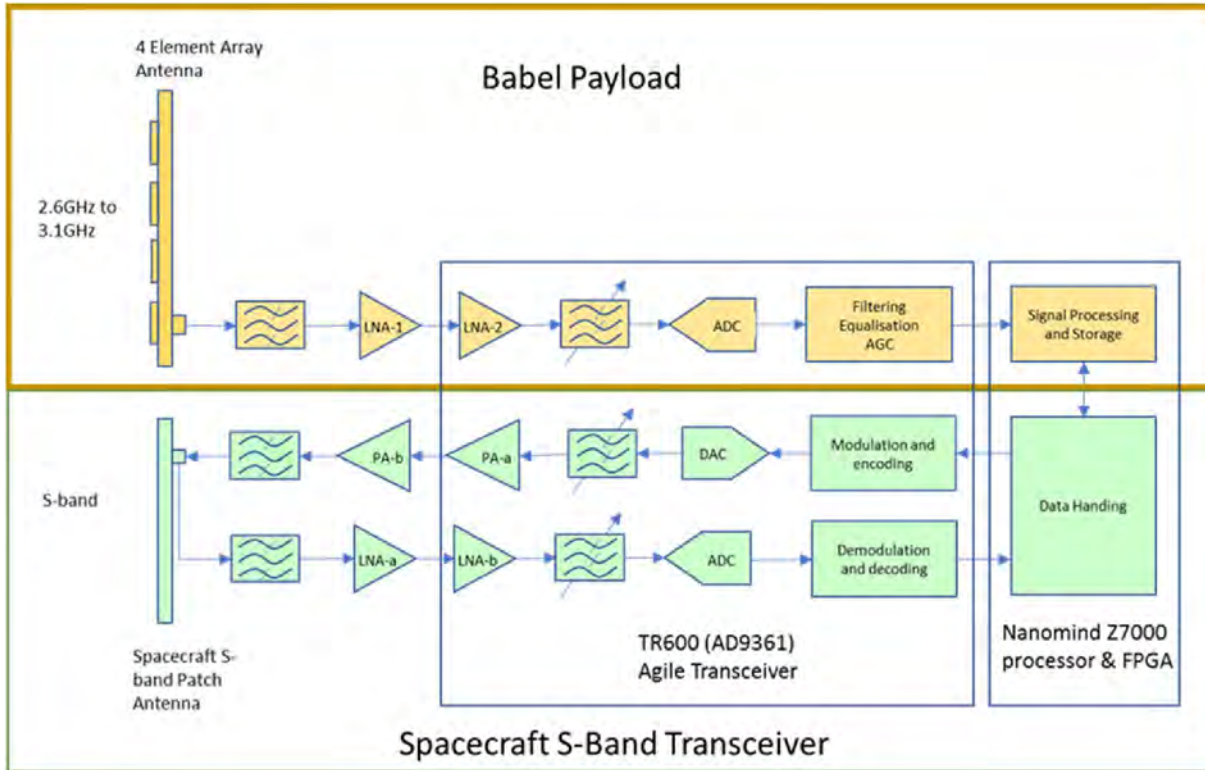
Babel – An In-Space Payload on Faraday-1

- Software defined radio
- 4-element linear patch antenna and LNA
- Frequency band 2.6GHz to 3.1GHz
- Specific interest
 - 4G spectrum (2.6 to 2.7GHz GHz)
 - Ship radar (3.0-3.1GHz)
- Software allows raw capture, FFT or averaging FFT
- Up to 3 software applications and associated FPGA bit streams can be uploaded and stored on board
 - Single application and FPGA bit stream loaded for launch with the three functions above
- The SDR can be booted with any three of these
- Fail safe image in case of boot issues
- Attitude scanning modes for experimental geolocation



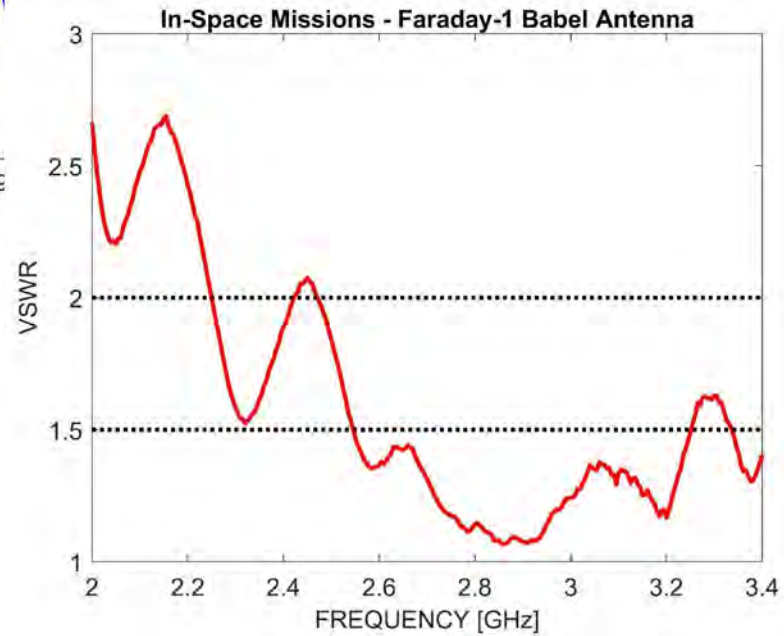
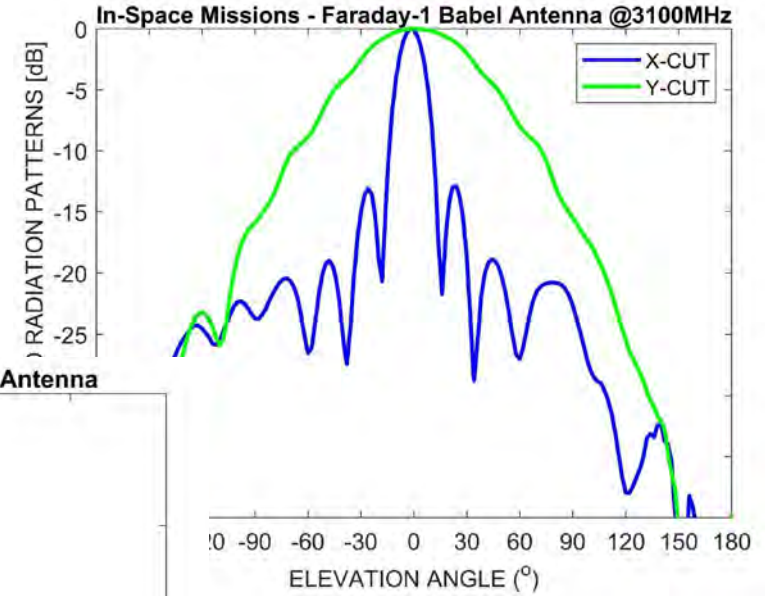
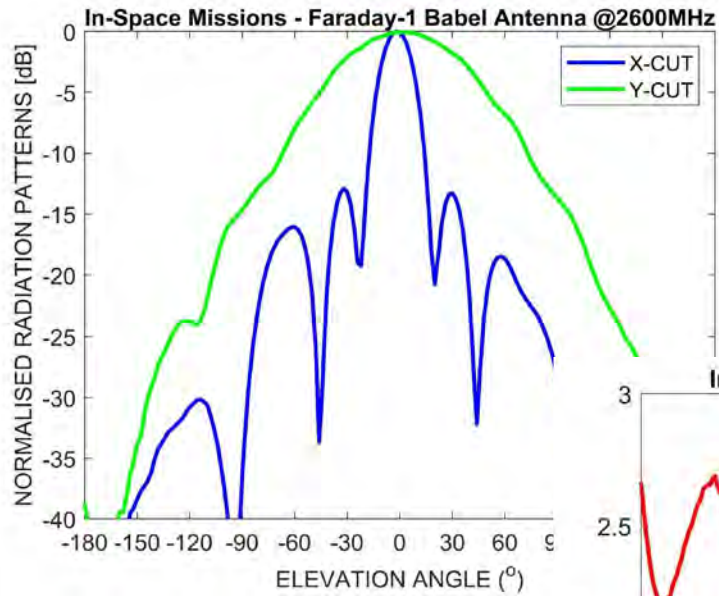


Payload Overview





Antenna: Measured Pattern & VSWR





Link Budget: Radar and 4G Base Station

Calculated based on 5 degree elevation angle

Will certainly detect radar

Could detect a 4G base station depending on real antenna pattern and Tx power

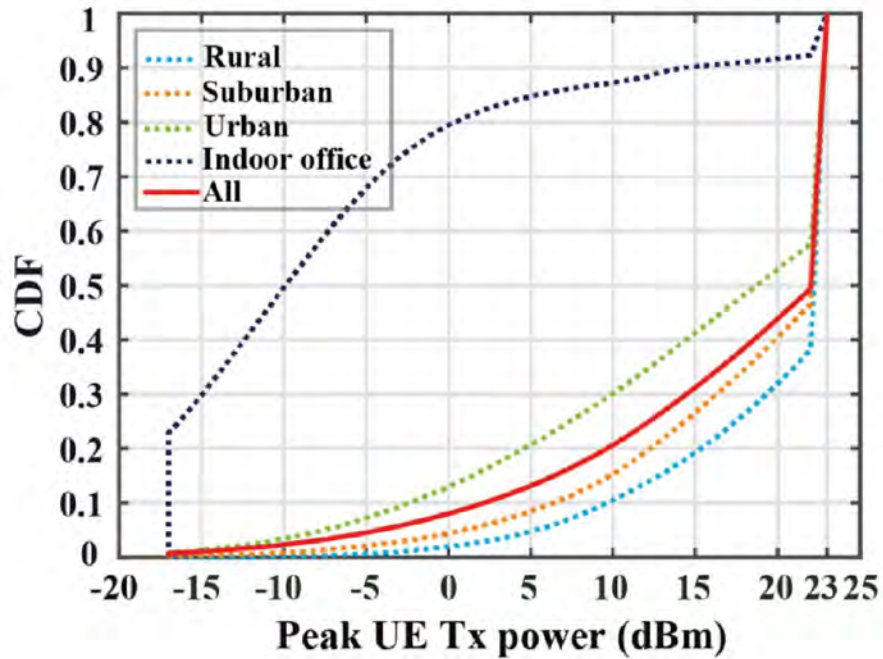
Radar			
Mid band frequency	3.05E+09	Hz	
Wavelength	9.84E-02	m	
Signal bandwidth	1.00E+06	Hz	
Signal power	2.00E+02	W	
Signal EIRP	23.0	dBW	
Free space loss at LEO	-168.48	dB	
Spreading loss for Max PFD only	-137.34	dB	
Max PFD at S/C	-114.33	dBW/m2	
Max PFD per Hz	-174.33	dBW/m2/Hz	
Max PFD per 4kHz	-174.33	dBW/m2/4kHz	
Clear	Y		
Atmospheric losses	-4.38	dB	
Pointing loss	0.0	dB	
Power received at antenna	-149.8	dBW	
Spacecraft antenna gain	15.5	dB	
Linear to CP loss	3.0	dB	
Feed loss	0.1	dB	
Connector loss	0.1	dB	
Power at input to the AD9361	-137.4	dBW	
	-107.4	dBmW	
10*Log(kTB*1000)	-113.98		
Main Rx NF	7	dB	
Main Rx noise factor	5.01	factor	
Sensitivity	-106.98		
LNA NF	0.5	dB	
LNA noise factor	1.1	Factor	
LNA Gain	14	dB	
Gain factor	25.11886432	Factor	
F total	1.3	Factor	
NF total	1.1	dB	
Sensitivity	-112.90		

4G Base Station			
Mid band frequency	2.69E+09	Hz	
Wavelength	1.12E-01	m	
Signal bandwidth	3.60E+05	Hz	
Signal power	4.00E+01	W	
Signal EIRP	16.0	dBW	
	46.0	dBmW	
Free space loss at LEO	-168.48	dB	
Spreading loss for Max PFD only	-137.34	dB	
Max PFD at S/C	-121.34	dBW/m2	
Max PFD per Hz	-181.34	dBW/m2/Hz	
Max PFD per 4kHz	-176.91	dBW/m2/4kHz	
Clear	Y		
Atmospheric losses	-4.38	dB	
Pointing loss	0.0	dB	
Power received at antenna	-156.9	dBW	
Spacecraft antenna gain	13.9	dB	
Linear to CP loss	3.0	dB	
Feed loss	0.1	dB	
Connector loss	0.1	dB	
Power at input to the AD9361	-146.1	dBW	
	-116.1	dBmW	
10*Log(kTB*1000)	-118.42		
Main Rx NF	6.2	dB	
Main Rx noise factor	4.17	factor	
Sensitivity	-112.22		Receiver noise floor
LNA NF	0.5	dB	
LNA noise factor	1.1	Factor	
LNA Gain	20	dB	
Gain factor	100	Factor	
F total	1.2	Factor	
NF total	0.6	dB	
Sensitivity	-117.80		



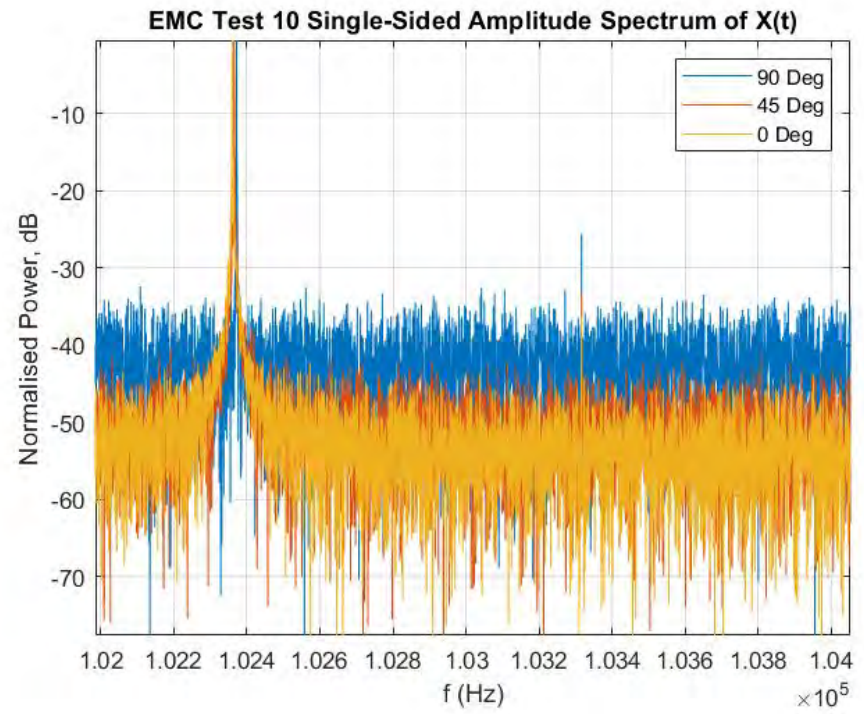
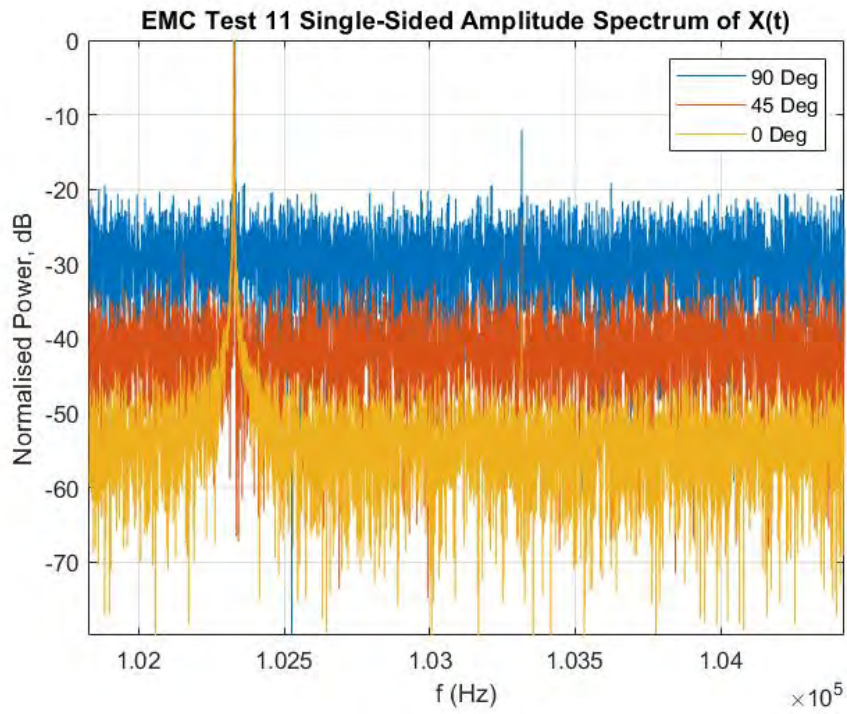
Link Budget: 4G Handset

Link budget for overhead
 50% UE at about 23dBm
 Will not detect single UE
 May detect aggregated signals
 May provide some heat map type data



4G Handset		
Mid band frequency	2.69E+09	Hz
Wavelength	1.12E-01	m
Signal bandwidth	3.60E+05	Hz
Signal power	2.00E-01	W
Signal EIRP	-7.0	dBW
	23.0	dBmW
Free space loss at LEO	-156.11	dB
Spreading loss for Max PFD only	-124.97	dB
Max PFD at S/C	-131.96	dBW/m2
Max PFD per Hz	-191.96	dBW/m2/Hz
Max PFD per 4kHz	-187.53	dBW/m2/4kHz
Clear	N	
Atmospheric losses	-0.41	dB
Pointing loss	0.0	dB
Power received at antenna	-163.5	dBW
Spacecraft antenna gain	14.5	dB
Linear to CP loss	3.0	dB
Feed loss	0.2	dB
Connector loss	0.2	dB
Power at input to the AD9361	-152.2	dBW
	-122.2	dBmW
10*Log(kTB*1000)	-118.42	
Main Rx NF	7	dB
Main Rx noise factor	5.01	factor
Sensitivity No LNA	-111.42	Receiver noise floor
LNA NF	0.5	dB
LNA noise factor	1.1	Factor
LNA Gain	20	dB
Gain factor	100	Factor
F total	1.2	Factor
NF total	0.7	dB
Sensitivity	-117.76	

EMC Tests



Array Deployment Test and in Flight Prep

