Towards a "concurrent design facility (CDF)" for nanosatellites: a back-of-the-envelope calculation of the overall energy budget of OUFTI-1

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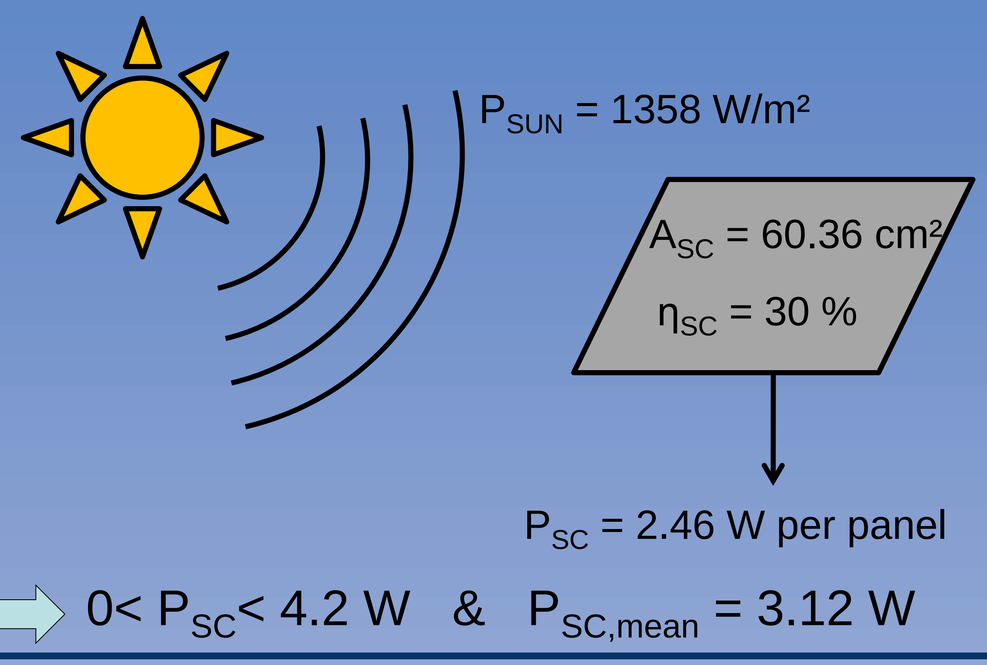
Introduction

We give a very compact account of the overall energy budget of the OUFTI-1 nano satellite, thereby providing a useful guide for future designs, as well as an explanation of why a nanosatellite can, energeticaly, survive and do useful tasks in space.

Energy provider



$0 < P_{SC} < 4.2$ W & $P_{SC,mean} = 3.12$ W

Energy budget

Check that EPS is correctly designed to support D-STAR communications

$E_{ORB,\,prov} = E_{B,init} + P_{SC}\,T_{SUN}$

$E_{ORB,\,cons} = E_{B,final} + P_{FIX}\,T_{ORB} + P_{VAR}\,T_{COM}$

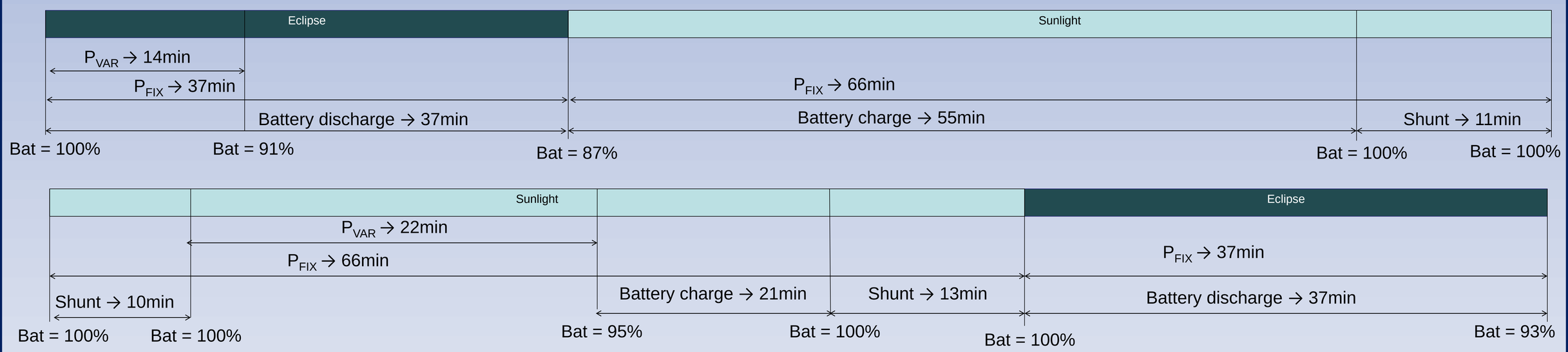
$T_{ORB} = T_{SUN} + T_{ECL}$

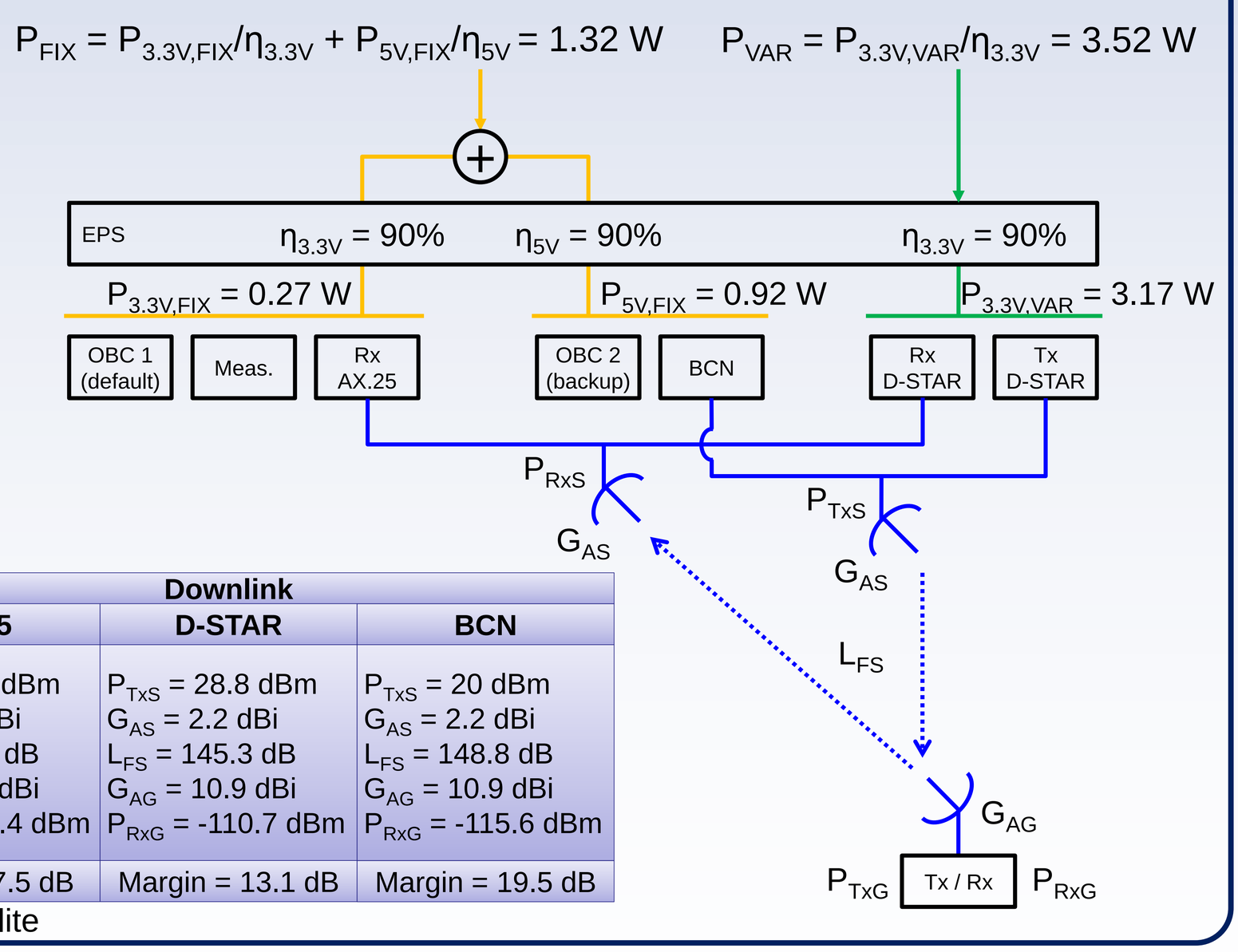
Worst-case orbit:

T_{ORB} = 103 min

T_{SUN} = 66 min

T_{ECL} = 37 min





EPS = Electrical Power Supply
OBC = On-Board Computer
BCN = Beacon
Meas. = Measurements
Rx = Reception
Tx = Transmission

Uplink		Downlink		
AX.25	**D-STAR**	**AX.25**	**D-STAR**	**BCN**
P_{TxG} = 50 dBm G_{AG} = 12.8 dBi L_{FS} = 153.4 dB G_{AS} = 2.2 dBi P_{RxS} = -100 dBm	P_{TxG} = 44 dBm G_{AG} = 12.5 dBi L_{FS} = 154.8 dB G_{AS} = 2.2 dBi P_{RxS} = -104.4 dBm	P_{TxS} = 28.1 dBm G_{AS} = 2.2 dBi L_{FS} = 143.9 dB G_{AG} = 18.5 dBi P_{RxG} = -105.4 dBm	P_{TxS} = 28.8 dBm G_{AS} = 2.2 dBi L_{FS} = 145.3 dB G_{AG} = 10.9 dBi P_{RxG} = -110.7 dBm	P_{TxS} = 20 dBm G_{AS} = 2.2 dBi L_{FS} = 148.8 dB G_{AG} = 10.9 dBi P_{RxG} = -115.6 dBm
Margin = 16.9 dB	Margin = 21.9 dB	Margin = 7.5 dB	Margin = 13.1 dB	Margin = 19.5 dB

G = Ground, S = Satellite