

Constellation Size	20	40	150	150
Altitude	500 km	100 km	500 km	2000 km
Sensor Offset	0 Deg	15 Deg	15 Deg	30 Deg
Satellite Class	Microsat	Microsat	Microsat	Microsat

Table 3 – Comparison of the Different Peaks for Coverage/Cost

	Peak 1	Peak 2	Peak 3	Peak 4	Peak 5
Sensor	Sensor 4	Sensor 5	Sensor 5	Sensor 2	Sensor 5
Constellation Size	20	20	20	20	20
Altitude	500 km	500 km	500 km	500 km	500 km
Sensor Offset	0 Deg	0 Deg	15 Deg	30 Deg	30 Deg
Satellite Class	CubeSat	CubeSat	CubeSat	Microsat	CubeSat

Looking at these results from Tables 2 and 3, it shows that to minimize gap periods, the microsats with sensor 2 (15 Deg FOV) provides the best performance overall from the 500km orbit. There are also a few cases where the higher number of satellites provides a high overall value as well. For coverage, the wider field of view sensors generally provide the most value while the 500 km orbit seems to be the best basing location. Also of note: the higher constellation sizes did not provide as much value. The added performance of more sensors does not offset the costs associated with the larger constellation. These are just some of the analysis observations as there are numerous ways to interpret the data.

CONCLUSION

This analysis was meant as a starting point to understand the factors and trends in space-based GEO SSA constellations with a focus on timely observations to detect maneuvers and propagate following those maneuvers. The results do show that a space-based system can provide significant benefits and timely observations that will augment the ground based SDA systems. Further analysis is required at greater depths to truly optimize a GEO based constellation. In addition, slew and scan patterns should be added along with modeling of the jitter and drift effects of the platform to provide a realistic assessment of the performance. Also, additional parameters such as a mixed constellation above and below GEO as well as velocity and anti-velocity vector pointing will help maximize the constellation performance. This analysis should be incorporated into a system of systems analysis that includes ground based, space based, and multi-phenomenology sensors and basing locations. This would drive the requirements for a space-based architecture and potential future acquisitions.

REFERENCES

- [1] Erwin, Sandra. “As It Plans LEO Constellations, DoD Must Prepare to Deal with Congestion.” *SpaceNews*, 17 June 2019, spacenews.com/on-national-security-as-it-plans-leo-constellations-dod-must-prepare-to-deal-with-congestion/.
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