MultiBeam Antenna Solutions

Identifying the disruptions/disruptors

- No. of Flat Panel Antenna manufacturers: 23
- No. of ESA FPA manufacturers: 6 to 8?
- No. of ESA+Multi-beam FPA manufacturers: 4 or 5?
- How many have strong focus on Aviation/Aeronautical: 3 or 4?
- **Who deliver both Ka & Ku, Ka+ku solutions?**
- Who are they? What ESA+Multi-beam features they have?
- Which stage they are in the development? Prototype or Product?
- What roadmap they have?

2 Sections

1. Disruptions Scanning
2. Airbus Focus areas

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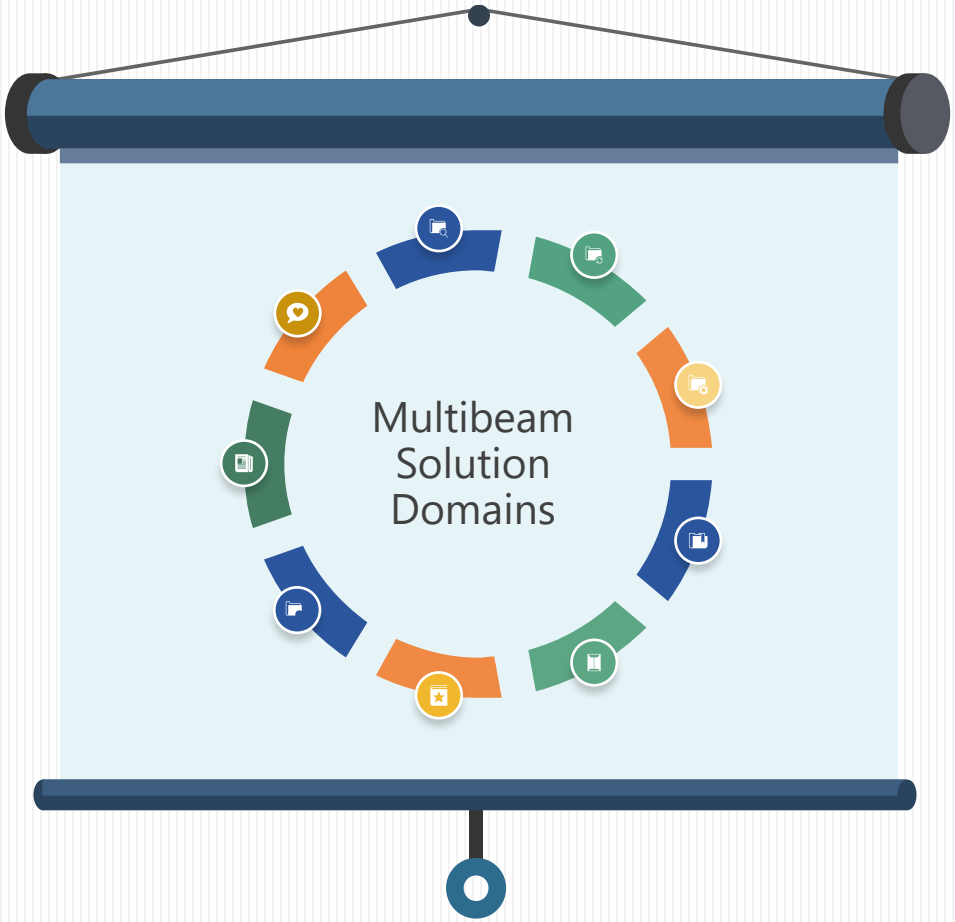
SECTION-1 DISRUPTIONS SCANNING

Multi-beam Solution domains

Disruptors/Antenna Manufacturers



Antenna Systems – 01
SFB & MFB, Beam-hopping, Lens, Reflector, Phased array

02 Phased Array/Flat panel Antenna
LEO, MEO, GEO

Lens Antenna 03
LEO, MEO, GEO

04 Reflectors Antenna
LEO, MEO, GEO/Panel reflectors, Membrane reflectors and Mesh Unfurlable

Multi-Beam Forming Network – 05
Topology, Overlapping scheme, No. of Feed/beam

06 Gateway Antenna & Ground stations

Manufacturing Process & Materials 07

08 Cooling system –
For transmitting antennas

Coverage area - 09
Near-time worldwide Availability Regional or Continental

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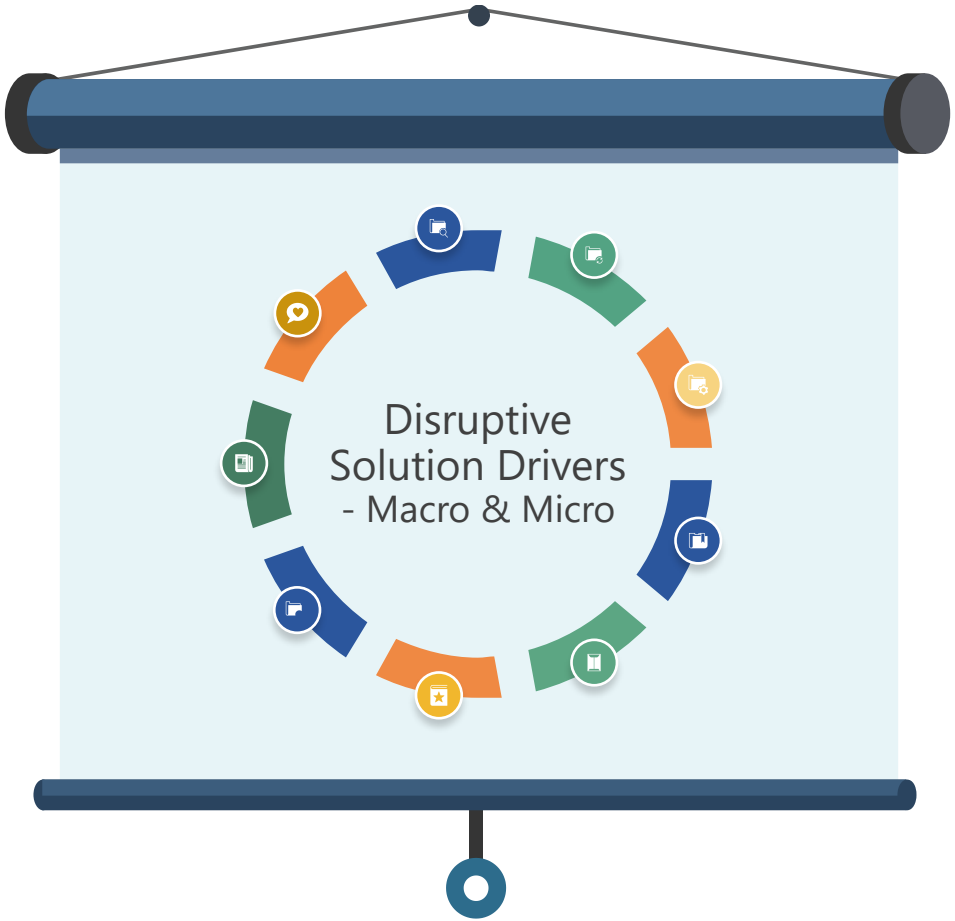

01 High-Throughput Broadband –
Increase no. of beams, reduce beamwidth, larger Reflectors

02 Reducing Cost –
Increase Spectrum Reuse, reduce no. of Gateways/Reflectors/Payload Mass

03 Add Flexibility & Optimize bandwidth usage –
Beam-hopping Active/Passive antenna to handle large coverage

04 Multi-frequency feeds –
Support for Q/V and W band in addition to Ka band

05 Multi-modal excitation–
Different beam sizes, Improves Feed design, controls the radiation pattern

06 Dualband Circular Polarized SFB –
Support for Tx & Rx| Userlink & Feeder link| Only 2 reflectors

07 Antenna Steering/Pointing Systems–
Loop with Ground stations, target of ±0.025° antenna pointing accuracy

08 Manufacturing & Assembly Aspects –
Reflector surface accuracy & stability| Additive Manufacturing

09 Non-Regular Coverage–
Different Beam sizes for different Geographies|Different capacity/sqm

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SECTION-2 AIRBUS FOCUS

Multi-beam key Features

Antenna Vendor assessment

Vendors launch/Product Roadmap

ANTENNA VENDORS & USP

Analysis Focus

	USP	Multi-beam Tech Markets	Antenna Tech	Freq. Bands supported?	Aero-Product status?
ThinkKom	1) Multi-beam MSA/ESA steered 'Ku3030' VICTS phased-array technology 2) 2x to 8x better than other phased arrays| Supports Ka-to-ku conversion 3) ka2517 - No interference with 5G|Exclusive focus on Aero market	Aero/Space, business/enterprise, government, consumers	Phased-Array Array-of-Arrays	Ku & Ka-band	Ka- commercialized Ku- commercialized
Gilat	1) Mobile satellite Antennas with open platform approach - Ultra slim antenna 2) Aero Transceivers support Satellite-on-the-move connectivity	Aero/Train/Maritime/ UAV	ESA/PAA Flat panel	Ku & Ka	Ka- commercialized Ku- commercialized
Isotropic Systems	1) allows end-users to arbitrage that capacity into one fully integrated terminal 2) patented optical beamforming technology, low power, one fully integrated terminal 3) Lens modules which is better than existing Flat panel tech	Aero/Land/Maritime	ESA/PAA Flat panel + Lens	Ka & Ku	Ka- Field trial done Ku – Prototype demo done
Phasor	1) Contellation agnostic: LEO & GEO| common modular technology core 2) ESA - software-defined antenna| wideband active-scanning phased array	Aero/Land/Maritime	ESA Phased-Array	Ku	Ku – commercialized Ka – Under development
SatixFy	1) 1) Installation simplicity| digital Electronically Steerable Multi-Beam Antenna Array (ESMA) | Ku & Ka support| GEO/MEO/LEO| Digital Beam-Forming ASIC| instant in-between satellite switching 2) True time delay (TTD), SDR support, lower SWAP (Size, Weight and Power) 3) fully electronic, with no moving parts| from chip to product company	Connected Car, IoT, Broadband, Aviation, maritime	ESMA phased-Array	Ku & Ka-band	Ka- commercialized Ku- commercialized
Cobham-Intellian-Viasat	1) Intelligent mediator that ensures the antenna can automatically switch between bands and satellite orbit 2) data transmission rates over satellite of more than 1 Gbps 3) antenna can track new satellite constellations automatically as they come online| 4) Software upgrade capabilities from C/Ku systems to full tri-band	Maritime/Military	Parabolic VSAT	Ku/Ka/C	No Aero products (Multi-beam)
Kymeta	1) Low profile, light weight, low maintenance, no mechanical components 2) Software controlled pointing/steering 3) Auto-commissioning and auto-provisioning	Land/Maritime/Military	Flat Panel	Ku	No Aero products (Multi-beam)

ANTENNA VENDORS CORE FEATURES - COMPARISON

	Software-defined SDR Support? *Yes – 20 No – 0*	**Electronic Beam steering support** *Yes – 20 No - 0*	**"Simultaneous" Multiple beams switching?** *Yes – 20 No - 0*	**"Automatic" Multiple beams switching?** *Yes – 30 No - 0*	**"make before break" Seamless handover?** *Yes – 30 No - 0*	**GEO/MEO beam switching Support** Ku & Ka - both? *Yes – 20 No – 0*	**LEO beam switching Support** Ku & Ka - both? *Yes – 30 No - 0*	**LEO-to-LEO switching Support** Ku & Ka - both? *Yes – 30 No - 0*	**GEO/MEO-to-LEO switching support** Ku & Ka - both? *Yes – 30 No - 0*
ThinkKom	20	20	20	30	30	20	30	30	30
SatixFy (ARTES)	20	20	20	**0**	30	20	30	30	30
Gilat	**0**	20	**0**	30	30	10	15	**0**	15
Isotropic Systems	20	20	20	**0**	30	20	30	**0**	30

	Thinkom	SatixFy	Isotropic Systems	Gilat
Score	230	200	170	130

ANTENNA VENDORS NICHE FEATURES - COMPARISON

	Time-delay Beam-forming? *Yes – 20 No - 0*	**Frequency Re-Use Beam-hopping** *Yes – 20 No - 0*	**Installation simplicity** *High – 30 Low - 0*	**Throughput in Gbps?** *Yes – 30 No - 0*	**GSO Interference avoidance** *Good – 20 Ok - 10*	**Power Amplifier Utilization** *Yes – 30 Ok - 10*	**Non-regular Coverage + more capacity?** *Yes – 30 No - 0*	**Full satellite value chain** (chip to products) *Good – 30 Ok – 10, No – 0*	**Score**
ThinkKom	20	0	30	0	20	10	0	0	80
SatixFy	20	20	30	30 (5 Gbps max)	10	30	30	30	200
Gilat	0	20	30	0	10	30	0	0	90
Isotropic Systems	20	0	30	No info	10	10	0	10	80

Launch or Roadmap plans for next 2 – 3 years

	Technologies Products/Services	Market Segments Applications
Gilat	1) Multi beams, seamless satellites transition, wide carriers and mobility 2) Promotion of AeroEdge 6000, a flat panel, dual band, KuKa aero antenna	1) Satellite communications for mobility and cellular backhaul | 2) Focus on Non-GEO constellations | 3) Focus on commercial aviation & business jets
Thinkom	1) Promotion of "multi-antenna array" which is better than ESA 2) The software solution can support multiple-beams/links dynamically	1) market low-cost enterprise and consumer user terminals 2) small lightweight antennas, to be available in Ka- and Ku-band versions, will deliver higher throughput rates and lower bandwidth costs
Isotropic	Plug-and-play functionality along with low skill install is offered as the terminal integrates the BUC, LNB, antenna controller, power supply,	1) all-electronic Ka-band terminals for Land and Maritime 2) Lens modules as core building block for a series of products
Phasor	Promotion of Phasor as a broadband (wideband) active-scanning phased array technology, employing a unique ASIC-based beamforming technology	1) Focus is on enterprise mobility markets today – aeronautical, maritime and land-mobile 2) Develop interoperable solutions for GEO & Non-GEO

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Thank you!

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