EOS Establishes Space Communications Business

Canberra, 30 September 2019

Electro Optic Systems (ASX: EOS) will today establish a new business segment to be named EOS Communication Systems. This business segment will be the third discrete business element in EOS, joining EOS Defence Systems and EOS Space Systems.

The launch of the new business was triggered by EOS completing several technology breakthroughs required for next-generation space communications. EOS has invested around $250 million over 9 years, including around $50 million of contributions from government partners in the USA and Australia, towards achieving this outcome.

All of EOS' investments in research and development towards the establishment of this business have been fully expensed. All of the intellectual property developed with the project funds belongs to EOS.

The final technology breakthrough clearing the path for the establishment of the communications segment was the achievement of new technology allowing specific laser effects in space to be achieved with typically 0.1% of the power previously required.

The industrial and commercial applications of this technology are vast because the laser power density required for many space applications can now be achieved with much smaller lasers. In some cases including next generation space communications, this is an enabling step.

EOS will apply the technology immediately towards an estimated $120 billion of space communication infrastructure requirements. Of the $400 billion of space communication infrastructure which will be replaced over the next 20 years, at least 30% ($120 billion) must accommodate new communications technology incorporating these EOS developments or comparable technology.

The EOS technical approach uses a special, laser (called a guide star laser, see image below) to measure the distortion caused by the atmosphere. An equal and *opposite* distortion is injected into the operational laser beam (e.g. a communication laser) at its source. Consequently the atmosphere acts as a correcting lens to restore the laser beam to near-perfect quality as it moves through the atmosphere and into space.

Using this technology laser beams emitted from the ground can now be manipulated in space *as if the atmosphere was not present*. The previously unavoidable loss of laser intensity can be largely overcome and the negative impact of atmosphere on the laser can be ignored for many applications.

A guide star laser in operation removing atmospheric distortion from star images. The EOS process works in reverse to remove atmospheric distortion from beams transmitted up from the ground.

In practical terms, laser intensities achieved in space can now be 1,000 times higher, using the same laser. For many space applications, the laser power required in the absence of this technology would be prohibitive.

A precursor of this technique, called adaptive optics, has been used by astronomers for decades to correct stellar observations for the distortion of the atmosphere. Astronomers have used guide star lasers to measure the atmospheric distortion applying to observations of stars and applied corrections to the incoming stellar images.

However there were significant technological hurdles to achieve beam correction in the reverse direction, with the atmosphere very close to a light source which is transmitting into space from earth. EOS has invested significant resources over 10 years to overcome these hurdles.

A key application is in optical communications to, from and among satellites in space.

Laser-based optical communications systems on earth can achieve bandwidths exceeding 10 THz [TerraHertz] communicating through fibre optics. This is 20 times the ***maximum*** bandwidth achievable with microwave technology. Consequently optical communications routed through fibres dominate all trunk communications on the earth's surface.

The higher bandwidths offered by laser optical communications on earth are also required for space communications, but it has proven impossible to increase the transmitting power of the ultra-wideband communication lasers used for terrestrial communications to the levels required to achieve communications to and from space.

This power increase will now not be necessary, or be significantly reduced, because a laser communication channel to space can now be established using 0.1% of the laser power previously required.

This major leap forward in controlling laser beam intensity in space cannot itself enable operational communications to and from space because other significant practical barriers exist. In parallel programs funded by EOS over 9 years, the company has systematically completed all the necessary developments to remove those barriers to allow commercial exploitation:

A. **Beam Delivery**. The breakthrough removes the detrimental impact of the atmosphere to produce very intense beams at very high altitudes. But the optical beams are (by definition) now much smaller and more concentrated. This requires the laser communication beam to be directed to a moving satellite with a very high precision and very high stability - in each case 10 times better than previously ever achieved. EOS has spent the past decade developing and operationally qualifying laser beam directors which now routinely provide this 10-times improvement in precision and tracking stability for satellites.

B. **Acquisition and Tracking**. New communication satellites will usually be lighter and cheaper, and have lower and less stable orbits than current satellites. They require more rapid acquisition and more accurate tracking. EOS has developed and operationally deployed its own advanced space tracking equipment, astrodynamic algorithms and orbital analysis capabilities to allow satellites to be rapidly and accurately acquired by the laser beam in space.

C. **Asset Protection**. Space assets are vulnerable to space collisions with debris and other forms of interference. EOS has developed and operationally proven comprehensive debris collision analysis tools, supported by responsive, dedicated tracking sensors to almost entirely remove physical risk.

D. **Weather Immunity**. EOS has established two widely dispersed optical sites in Australia for space operations, and has surveyed others in preparation for further deployments. Heavy cloud can degrade or deny optical communication with space, however EOS expects to achieve immunity to bad weather with its deployed infrastructure.

E. **Industrial Capability**. The most difficult aspect of any new technology is usually its conversion to commercial production. To achieve a resilient and reliable industrial capability for implementing optical communications, EOS has established internal capability for any items not available through multiple commercial sources.

F. **Testing**. EOS has collaborated with the Japanese space Agency (JAXA) to stablish the world record for the longest optical communication link (5.7 million km) ever achieved. EOS uniquely operates its own test satellite, EOSCOM for space optical communication research and development. EOSCOM supports all the communication wavelengths (frequencies) EOS intends to deploy in space.

G. **Skilling**. Through its $20M funding of the CRC for Space Environment Management (SERC) and its partnerships with key universities, EOS has developed a substantial cadre of skilled professionals in Australian industry to support this new space activity. Investment in skilling will continue.

All of this development effort has been funded principally by EOS, and fully expensed by it.

In the past decade EOS has not detected any entity or group of entities which has systematically addressed all the key technology and commercialisation issues which EOS considers necessary to achieve commercial exploitation of space optical communications. Through strategic investment EOS has achieved of all the technical and supporting developments required to widen the communication highway through space to any point on the earth's surface, or above it. This achievement may be unique.

EOS will immediately establish a new business segment, **EOS Communication Systems**, to exploit this leap forward. This new business will be operational from early in Q4 2019 and will be cash flow positive from its initiation.

Speaking on the establishment of EOS Communication Systems, Dr Ben Greene, the Group CEO of EOS said:

> "The breakthrough EOS has achieved in space communications is not a scientific experiment or a specific technical phenomenon. It is a complete suite of interactive and deployable solutions for the next generation of space communication."
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> "EOS recognized early the wide range of developments required for achieving the next leap forward in satellite communications, so we executed almost a decade of research and development across several disciplines to overcome the barriers to efficient optical communication. This program included technology development, refinement and operational testing as well as supply chain development."
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> "We have identified at least $120 billion of satellite communications infrastructure investment over the next 20 years which must be aligned with, and ultimately adapt to, the wave of optical communications capabilities emerging globally. We will enter this market immediately."
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> "EOS will exploit this technology through a new business segment, EOS Communication Systems, which has been positioned to address this major market. We will imminently announce the staffing, structure and initial customers of this new segment."
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> "EOS does not intend to raise new funds to establish its new Communication Systems segment, which we expect will be profitable from its initiation by addressing a key niche in this market. Later expansion to ultimately address most of the identified market is planned."

The suite of technologies EOS is now deploying to space communications will also have significant impact in other valuable markets and applications, including space situation awareness [SSA], space debris management and mitigation, space traffic management and space propulsion. EOS is also moving to exploit these significant opportunities.

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ABOUT ELECTRO OPTIC SYSTEMS (ASX: EOS; OTC: EOPSY)

EOS operates in two sectors: Defence Systems and Space Systems.

- EOS Defence Systems specialises in technology for weapon systems optimisation and integration, as well as ISR (Intelligence, Surveillance and Reconnaissance) for land warfare. Its key products are next-generation vehicle turrets and remote weapons systems.
- EOS Space Systems specialises in applying EOS-developed optical sensors to detect, track, classify and characterise objects in space. This information has both military and commercial applications, including managing space assets to avoid collisions with space debris, missile defence and space control.