EDISON Scale research report - Initiation

Mynaric

Technology

30 October 2017

Fibreless optical links in the skies

Mynaric has developed equipment for transmitting data via laser between moving airborne or space platforms at rates similar to conventional optical fibre, but with the light transmitted through free space rather than along a cable. This opens the possibility of equipping the airborne networks proposed by Facebook and Google, or the satellite networks supported by Elon Musk and Richard Branson with high speed optical data links rather than slower microwave connections. These proposed networks offer the opportunity of providing more data transmission in the developed world without needing to install more fibre-optic cable and extending internet access to the half of the world's population who are not connected.

Mynaric can transmit to a moving airborne platform

Free-space optical communications are well-suited for airborne or satellite networks as they provide data rates c 1,000 times faster than conventional microwave links between satellites. They are also more power efficient, which is important for a drone or satellite operating on solar power, less susceptible to hacking and do not require a permit for operation. Mynaric is unusual in having solved the problem of steering a narrow laser beam sufficiently accurately to keep it locked on a target only cms in diameter carried on a moving aerial platform several hundreds of kms away. This is an essential step in developing viable airborne optical networks.

Fundraising supports transition to commercial phase

Mynaric is still at a pre-commercial phase. In H117 it reported €681k revenues from development projects for customers and a loss before tax of €1,369k. Following the successful test of a 10Gbps air-to-ground link earlier in 2017, it has raised €27.3m gross through a placing at €54.0/share. Some 40% of the funds are intended for investment in assembly and test capability at its main site in Germany, so that it is ready to provide dozens of communications terminals for potential customers trialling product next year; c 30% is to accelerate completion of space qualified terminals; c 25% is to strengthen the group's presence in the US and Asia.

Valuation: Analysis of potential revenues

As Mynaric is still at a pre-commercial stage we show a scenario analysis looking at potential revenues derived from potential deployment of the technology in airborne and satellite communications networks of differing sizes. We calculate that a cluster of 250 airborne communications platforms could need €125m of Mynaric's equipment, a constellation of 100 small satellites - €100m.

Financial summary

Year end	Revenue (€'000s)	PBT (€'000s)	PAT (€'000s)	DPS (€)	P/E (x)	Yield (%)
12/13	113	(2,977)	(2,599)	0.0	N/A	N/A
12/14	1,295	(196)	(196)	0.0	N/A	N/A
12/15	1,856	(841)	(841)	0.0	N/A	N/A
12/16	471	(1,843)	(1,843)	0.0	N/A	N/A

Source: Mynaric

Price	**€54.00**
Market cap	**€146m**

Share details

Code	M0Y
Listing	Deutsche Börse Scale
Shares in issue	2.7m
Last reported net cash as at end June 2017 (prior to placing, which raised €27.3m gross)	€0.3m

Business description

Mynaric has developed free space laser communication equipment that uses light to transmit data in high capacity communication networks in the air and in space.

Bull

- Wireless laser technology gives faster data rates than conventional microwave transmission.
- Wireless laser technology potentially brings internet connectivity to regions too remote to connect by fibre.
- Mynaric has key technology for connecting between moving airborne communications platforms.

Bear

- Technology not proven in complete communications networks.
- Rate of commercial roll-out dependent on network operators securing funding.
- Limited number of potential network operators to sell equipment to.

Analysts

Anne Margaret Crow +44 (0) 203 077 5700

Katherine Thompson +44 (0) 203 077 5730

tech@edisongroup.com

Company description: Wireless laser communications

Mynaric was founded in 2009 by former employees of the German Aerospace Centre (DLR) to commercialise wireless laser communications technology for aerospace applications. Mynaric has demonstrated the viability of this technology through a series of tests culminating in a 10Gbps air-to-ground transmission from a moving aircraft earlier this year. We believe Mynaric is the only company so far to have achieved this. It has developed prototype transmitters and receivers suitable for sending data up to, down from, and between aerial platforms, at rates similar to that achieved through optical cables in terrestrial applications. The technology is being evaluated by companies intending to deploy it in aerial communications networks, enabling them to provide high speed internet access and associated services to regions where there are limited or no terrestrial networks. Mynaric is not profitable at present. In H117 it generated €681k revenues from development projects for customers and reported a loss before tax of €1,369k.

Mynaric listed on the Scale index of the Deutsche Börse on 30 October 2017. Immediately prior to listing it raised €27.3m (gross) at €54.0/share. The funds raised are being used to establish assembly and test capability sufficient to output up to 100 transmitter/receiver units a year, to accelerate development of space-qualified and higher data-rate terminals and to strengthen the group's presence in North America and Asia.

Mynaric is headquartered near Munich in Germany. It also has a subsidiary in Huntsville, Alabama, where there is a cluster of companies involved in the aerospace and space industries. It currently employs around 50 people, two-fifths of whom are qualified engineers. The company was originally called Vialight Communications and changed its name in September 2017.

Market background – bridging the digital divide

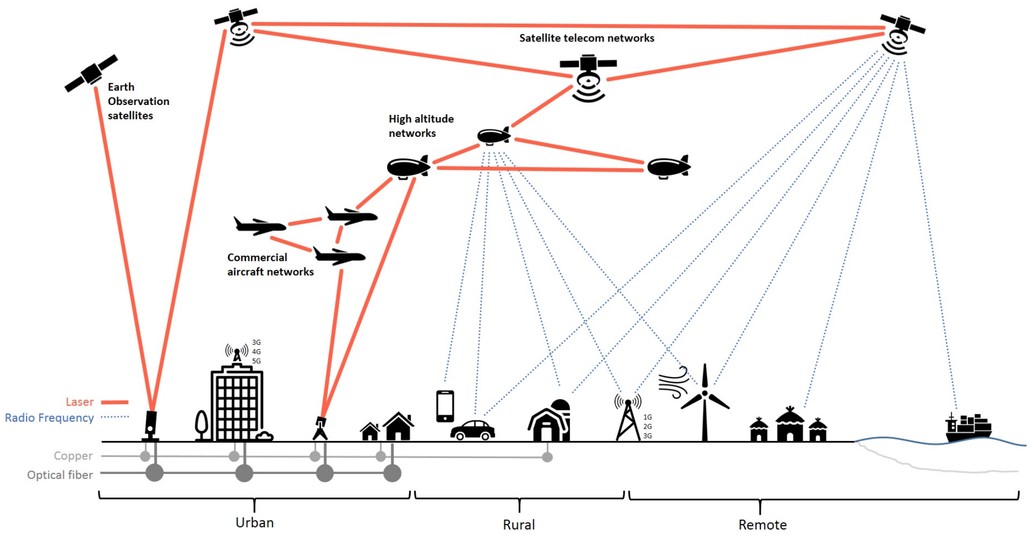
Demand for technology linked to demand for data

Demand for Mynaric's technology is being driven by consumers' and industry's seemingly insatiable demand for data. Existing networks in developed regions are becoming full. At the same time around half of the world's population do not yet have internet access, which precludes global giants such as Google, Facebook or Amazon from making money from them. The capacity of existing networks is also being strained by demand for data transmission from IoT (Internet of Things) applications and the Industry 4.0 smart factory methodology. In a white paper on visual networking (user applications that combine digital video and social networking) dated September 2017, CISCO noted that in 2016 annual global IP traffic was 1.2ZB (1ZB is 1,000 exabytes, an exabyte is one billion gigabytes). The paper forecast that by 2021, global IP traffic will reach 3.3ZB per year ie increasing nearly threefold over the five-year period, which is equivalent to 24% CAGR. This represents a 127-fold increase between 2005 and 2021.

Microwave links too slow

One solution for transmitting more data is to install more fibre optic backbone, but this takes time to roll out, is uneconomic for areas of low population density or only a few connected devices and may not be feasible if the terrain is inhospitable because of natural causes such as mountain ranges or unhelpful human activity ranging from warfare to simple pilfering of the optical cable. Relaying communications signals through a network of satellites overcomes the problems associated with laying optical fibre but currently the satellite communications links deploy microwave (radio frequency) technology, which is c 1,000 times slower than laser communication.

Exhibit 1: Connectivity in the future



Source: Mynaric

Wireless laser economically attractive

Creating a communications network from laser beams running from one point to another in free space rather than through optical fibre presents an economically attractive alternative (see Exhibit 1) provided that the technological difficulties in implementing such a network can be overcome. Mynaric estimates that it costs around €10m to install and commission a 100km section of suburban optical fibre and would cost up to €1m for a laser communication link between two flight platforms in the stratosphere, including the flight platforms. For a long-haul link of 1000km, subsea optical fibre deployment and commission would cost €100m while a laser communications link between two LEO (low earth orbit) satellites would cost up to €10m, including the cost of the satellites and their launch.

Technology

Mynaric's technology uses near infra-red light waves (200THz, 1THz = 1,000GHz) to transmit data from one point to another in free space ie without having to pass down optical fibre.

Faster, more secure and lower power than microwave

Mynaric is addressing applications where data is transmitted between aerial or space-borne platforms, providing an alternative to microwave links that gives substantially faster data rates (1,720Gbps via laser vs 36Gbps for advanced microwave technology). Since wireless laser beams do not spread out like microwave links they are much more difficult to intercept illegally and are thus much more secure. The narrowness of the laser beam also means that wireless laser links from one network are very much less likely to cause interference with wireless laser links in another network, meaning that it is not necessary to obtain an operating licence from the ITU (International Telecommunications Union) for a wireless laser network, although this is mandatory for most microwave networks. Additionally, laser links are significantly more power efficient than microwave links to transmit data over the same distance, which is an important advantage when transmitting from a solar powered satellite, UAV or balloon where power consumption must be kept to a minimum.

Lightweight, safe and temperature stable option

Since Mynaric's equipment has been developed for airborne operation it is designed to be lightweight (5-12kg), for example using carbon fibre enhanced composite materials for some applications rather than aluminium. This material also has a low coefficient of expansion so that the system performance does not change in response to changes in external temperature. As the equipment transmits at a relatively low power in the near infra-red part of the spectrum, the beams are not harmful to the human retina so there is no risk associated with airline pilots flying through them. Importantly, since the equipment transmits at 1,550 nanometers (nm), which is the same as conventional optical fibre, Mynaric is able to use widely available opto-electronic components, meaning that the cost of a complete network deploying Mynaric's equipment will potentially be less than a competitive system operating on a different wavelength. In contrast Tesat, a competitor, transmits at 1,064nm so its equipment is inherently more expensive because it cannot use "off-the-shelf" components.

Innovative precision beam steering for moving platforms

The key differentiator of Mynaric's technology is its ability to transmit narrow laser beams between two moving aerial platforms. It is difficult enough to align a laser beam so that it lines up with a target only centimetres in diameter, which is several hundreds of kilometres away. The problem is compounded when the target is moving because it is located on an aircraft, where it is subject to incessant vibration, or on a UAV (unmanned aerial vehicle), airship or air-balloon. Mynaric uses IP licensed from the DLR for its innovative pointing and tracking mechanism that solves this problem. This is licensed on an exclusive basis for aerial applications, and on a non-exclusive basis for space applications, which Tesat, for example, is also working on. Under the terms of the licence agreement, which extends until at least 2027, Mynaric will pay DLR 1-4% of commercial revenues. Since its founders left the DLR, Mynaric also has developed its own IP, which it alone has rights to. For example, it has developed techniques that ensure that the beam alignment system keeping the communication signal locked onto its target is not affected by changes in temperature. The IP is not protected by patents to avoid excessive disclosure and legal fees related to patent defence.

As laser beams are essentially concentrated light, links between the ground and an aerial platform or satellite may degraded by fog and air turbulence, or by another aircraft, bird or construction crane temporarily cutting the beam. Like other companies developing wireless laser technology, Mynaric addresses the fog problem by having multiple ground-to-air links, so that the probability of all of them ceasing transmission simultaneously is sufficiently unlikely. In addition, some customers such as AWN (Airborne Wireless Network) are developing hybrid wireless laser/microwave systems deploying Mynaric's laser technology so that lower data rate microwave links can be used in extreme circumstances. Mynaric addresses the issue of a temporary interruption of the beam up to 10msec in duration using FEC (forward error correction) signal coding techniques.

Competitive environment

Limited number of market participants

So far there are only a few companies working on wireless laser technology. The most advanced technically are Tesat-Spacecom and Thales. Tesat, an Airbus subsidiary with c 1,200 employees and over €300m annual revenues, deploys wireless laser technology developed together with the DLR, but different from Mynaric's. DLR's laser crosslink technology was used for tests linking two US and German military satellites in 2007. More recently, under licence by Tesat, the technology has been selected to be the backbone of the European EDRS programme providing LEO-GEO (geosynchronous orbit) data relay services of 1.8Gbps. It is currently in use on six EDRS associated satellites. Thales Alenia Space Switzerland (formed from the acquisition of RUAG's opto-electronics business in November 2016) delivered sub-systems for the EDRS project but is moving away from government sponsored programmes to more commercial activity. In May 2017 it announced it was going to deliver its first flight model of a small, lightweight laser communications terminal this year for a 2018 launch aboard an undisclosed earth observation satellite. Ball Aerospace (part of Ball Corporation, which had $9.1bn sales in 2016) has developed terminals suitable for deployment on GEO, LEO and airborne platforms. The airborne platform deploys its own Risley prism technology to provide the pointing and tracking function. Space Micro claims to offer a 100Gbps terminal for LEO constellation cross-links and GEO up/down links.

Exclusive rights to IP gives Mynaric the edge in airborne applications

Competitors typically are orientated towards providing expensive, one-off equipment for governments and research institutes for space programmes. Mynaric is unusual in that the CEO's background in industry has led the company to develop a product that is ultimately intended for volume production and for deployment in commercial applications. Importantly, Mynaric is more focused than its competitors on airborne applications. This is because it has exclusive rights to key IP developed by the DLR for transmitting wireless laser signals between and up to moving airborne platforms. It has added its own engineering IP, with the combination forming a key source of competitive advantage. Management notes that Mynaric is the first and so far the only company to have transmitted at 10Gbps from an airborne terminal to a ground terminal.

Proposed deployments

Several aerial networks are at early stages of development. The most well-known of these have been proposed by Facebook, Google and Elon Musk. Mynaric has not publicly stated that it is involved in any of these projects other than the one being developed by Airborne Wireless Network (AWN), but we note that in 2016 Mynaric conducted an air-to-air test in the stratosphere.

Airborne

Airborne Wireless Network (AWN)

AWN owns the patent to a broadband wireless communications system using commercial aircraft flying their normal routes to form a meshed network of airborne repeaters delivering broadband connectivity to subscribers on the ground along the flightpath as well as in-flight entertainment services to passengers on the aircraft. In the original patent, the aircraft would be equipped with microwave transmission equipment. AWN is opting instead for a hybrid microwave/wireless laser system. In April 2017 it signed a Memorandum of Understanding (MOU) with Mynaric, followed in August by a design and manufacturing services agreement under which Mynaric's communications equipment will be integrated into AWN's proposed network, the Infinitus Super Highway. The same month it announced that it had successfully completed a series of flight tests with two Boeing 767-300 jetliners over New Mexico using microwave links. AWN's next step is to explore the potential of laser-based communications within the meshed network using Mynaric's technology. The two companies aim to begin testing the laser technology before the end of 2017. AWN intends to test communications between a cluster of 20 jetliners in H218 and to roll-out its network during H119. It has signed an agreement with Air Lease Corp, which markets to more than 80 airlines worldwide, to promote the concept and has also been approached by other airlines interested in the opportunity of generating data transmission revenues from their existing assets. AWN notes that there are 25,000 commercial aircraft globally, at least 18,000 of which are airborne at any time, presenting potential for coverage of a material portion of the earth's surface where internet is not already available.

Facebook

In 2013 Facebook and other tech companies formed Internet.org, a global partnership to make the internet available to the large proportion of the world's population without access. In 2014 Mark Zuckerburg announced the formation of Facebook's Connectivity Lab which included the team acquired with Ascenta, who specialise in designing and building unmanned high-altitude long-endurance (HALE) aircraft as well as personnel from NASA. The team's approach was based on the premise that different sized communities need different solutions. Solar-powered HALE aircraft were proposed for suburban areas in limited geographical regions, LEO and GEO satellites for lower density areas. The team was tasked with looking at free-space optical communication as a way of dramatically boosting the speed of internet connections. In July 2016, Facebook conducted the first flight test of its Aquila HALE aircraft, which lasted for 96 minutes and ended in a crash landing as part of the wing snapped in flight. The second test flight, in June 2017 lasted for one hour and 46 minutes. The aircraft reached a height of 3,000 feet and landed without incident. When complete, a single Aquila drone will circle a region up to 60 miles in diameter, beaming down connectivity from an altitude of 60,000 feet, staying airborne for up to three months at a time and consuming only 5kW of power. There are significant challenges still to overcome including confirming that it is possible to collect enough solar energy to power the communications equipment and store it overnight in batteries that are sufficiently high energy density as well as ensuring that the complete system is cost competitive.

Google

Google's Project Loon involves the launch and maintenance of a fleet of high altitude communications balloons the size of tennis courts to provide internet coverage to people in rural and remote areas. It has flown over 19m km of test flights since the project began, with one balloon surviving 190 days aloft in the stratosphere. So far it has demonstrated data transmission at 155Mbps between balloons 100km apart in the stratosphere and back down to people on the ground with connection speeds of up to 10Mpbs, directly to their LTE phones. It is currently testing laser communication options. When installed, each balloon will have a coverage area of 5,000 square kilometres. The balloons were used in a real deployment earlier this year when Project Loon and Telefonica worked together to provide connectivity to areas in Peru affected by severe flooding. The balloons do not need to be propelled by a rocket or aircraft into position but are inflated and moved by the wind to the correct position. Balloons are retrieved at the end of each flight and the communications equipment recovered and reused.

Satellite

BridgeSat

According to SatMagazine, currently 27% of earth observation missions generate more data than they are able to downlink. BridgeSat, which is backed by UK-listed Allied Minds, is developing an optical communications network designed to enable operators of LEO observation satellites to transmit all of the data that they collect. It is offering small form factor laser communication terminals based on technology from two US organisations: The Aerospace Corporation, which is a federally funded research and development centre and Draper Laboratory, which is an independent, not-for-profit engineering research and development organisation. BridgeSat is establishing a worldwide network of earth-based optical ground stations for spacecraft operators to beam down to. It will offer access to this optical communication network on a price per delivered bit basis. It aims to have the network in place for satellites being launched in 2018.

EDRS (European Data Relay System)

EDRS is a system providing near-immediate access to images from surveillance satellites. Instead of waiting for the LEO observation satellite to arrive above a secure ground station and transmit data, the geospatial imagery is transmitted via laser to a GEO satellite that immediately transmits the data via microwaves to any point on the earth's surface within its line of sight, which is approximately one-third of the earth's surface.

OneWeb

Richard Branson is a director of Oneweb, a proposed network of 648 LEO satellites that is intended to give global broadband coverage. The company intends to launch an initial 10 production satellites for in-situ test during early 2018 with volume launches planned for H218 leading to commencement of broadband delivery in 2019. In June 2017, it received a licence from the FCC (Federal Communications Commission) to operate in the US and inaugurated the production line at the Airbus facility in Toulouse where the satellites will be built. Publically available information shows the satellites communicating using Ku and Ka band microwave links but, as discussed, the network would be able to transmit more data if optical communications links were substituted.

SpaceX

In 2016, SpaceX filed an application with the FCC for a 4,425 LEO satellite communications network to deliver global broadband internet access to the more than 34m Americans (and other global rural communities) without access to 25Mbps broadband. It intends to start commercial broadband service with 800 satellites transmitting in the Ku and Ka microwave bands and using optical laser links to connect satellites in the fleet. Operating lifetime is estimated at five to seven years per satellite. In 2017, SpaceX filed an application to begin ground testing the satellite communications system. In 2015, SpaceX's founder, Elon Musk, estimated that it would take about five years and $10bn to get the project off the ground.

Route to commercialisation

Successful sequence of trials

Mynaric has conducted a sequence of trials to demonstrate its wireless laser technology, culminating in 10Gbps transmission over an air-to-ground link earlier this year (see Exhibit 2).

Exhibit 2: Significant events

Date	Milestone
Pre-2009	Over 20 years development at German Aerospace Centre (DLR)
2009	Founders leave DLR to form Mynaric (formerly called Vialight) to commercialise wireless laser technology
2013	Air-to-ground demonstration in Germany with Airbus subsidiary Cassidian and the DLR 7km altitude, 60km distance, 1Gbps
2015	Ground-to-ground demonstration in Spain. 145km distance
2016	US subsidiary Mynaric Inc founded Air-to-air demonstration in US. 20km altitude, 80km distance, 1Gpbs
2017	Air-to-ground demonstration in US, 10Gpbs Design and manufacturing services agreement with Airborne Wireless Network Pre-series air-borne terminals available Listing on Scale index of German Stock Exchange
2018 target	Completion of in-house assembly and test capability for small-scale serial production
Late 2018/early 2019 target	Availability of space terminals.

Source: Mynaric

First commercial products available

To date, all of Mynaric's revenues have been from project work for customers, but the company has recently introduced its first commercial products. These are suitable for customer trials for platforms up to 20km from the earth's surface ie UAVs, balloons and aircraft. Mynaric will continue to refine these products to reduce the costs for volume deployment.

Mynaric is also working on space terminals suitable for connectivity between satellites. It expects these variants to be available by the end of 2018. These will be able to transmit over longer distances than the airborne variants. In order to keep the cost of the space variants as low as possible, Mynaric will use standard commercial off-the-shelf components similar to those used for airborne platforms. It will carry out its own qualification on these components to assess whether they are suitable for use in space where levels of radiation are high.

Exhibit 3: Product portfolio

	Air-to-air transmitter/receiver Cross-link terminal*	Air-to-ground transmitter/receiver Ground link terminal*	Ground-to-air transmitter/receiver Ground station*
Air	600km link distance, 10Gbps data rate, 5-12kg weight, 40W power consumption Available for production	50km link distance, 10Gbps data rate, 8-12kg weight, 80-140W power consumption Available for production	50km link distance, 10Gpbs data rate Available for production
Space	4,000km link distance, 10Gpbs data rate, 15kg weight, 40W power consumption In development, available by end 2018	1,400km link distance, 10Gpbs data rate, 10kg weight, 60W power consumption In development, available by end 2018	1,400km link distance, 10Gpbs data rate Available for production

Source: Company data. Note: *Typical system parameters.

Scaling up production to support extensive customer trials

Now that the first commercial products are available for airborne applications, Mynaric intends to establish in-house capability to support the manufacture of up to a hundred terminals each year for deployment in trial communications networks being launched by customers. Management intends to sub-contract manufacture of sub-systems and to perform final assembly and test in-house. Initially this will take place in its German technical facility. Longer term, management intends to provide similar capability in the US as this will make it easier to serve American customers.

Management has not disclosed any information regarding potential sales volumes. We understand that project revenues have been derived from almost a dozen customers and that it has around 200-300 sales contacts. We also note that Mynaric has a formal agreement in place with AWN. As discussed in the Sensitivities section, uptake of equipment for trials and ultimately for commercial deployments will be dependent on the progress that customers make towards commercial roll-out. In all cases, the length of sales cycle will be long as it takes a couple of years for a customer to move from discussions and preliminary studies to first airborne flights followed by initial network roll-out.

IPO

Mynaric listed on the Scale index of the Deutsche Börse on 30 October 2017. Immediately prior to listing it raised €27.3m (gross) at €54.0/share. The price was at the upper bound of the target range, and the placing was covered over four times. The funds raised are being used to establish assembly and test capability sufficient to output up to 100 transmitter/receiver units a year (c 40%), to accelerate development of space-qualified terminals and higher data-rate terminals (c 30%), to strengthen the group's presence in North America and Asia (c 25%) and for general company development (c 5%).

Management and shareholders

Supervisory board and management board

Dr Wolfram Peschko, chairman and CEO

Dr Peschko has been with the group since 2011 and is in charge of strategy, finance and general management. He has more than 30 years of experience in senior management, gained at various companies with sales of more than €50m and headcounts of up to 1,000 employees. He holds a doctorate in physics from TU Darmstadt and is a graduate of the INSEAD Advanced Management Programme.

Dr Markus Knapek, chief commercial officer

Dr Knapek is one of the co-founders of Mynaric and is responsible for group strategy and business development. From 2001 to 2003, he worked in technical sales for Siemens ICN in Moscow. From 2003 to 2011, he was employed at the DLR where he worked on the development of optical ground stations and atmospheric channel models in the field of laser communication. Dr Knapek holds an engineering doctorate from the Technical University of Munich and a master's degree from the City University of New York.

Joachim Horwath, chief technical officer

Mr Horwath is one of the co-founders of Mynaric and has led product development in the field of wireless laser communication since 2009. He is responsible for the technical direction of the group. In 2000 he started work in the photonics systems unit at Siemens. From 2002 to 2015 he worked for the Institute of Communications and Navigation of the German Aerospace Center (DLR). He investigated atmospheric effects on coherent and incoherent laser communication systems and was responsible for developing a variety of aircraft laser terminals and ground stations. Mr Horwath has a degree in electrical engineering from Graz University of Technology in Austria.

Shareholders

The shareholders prior to listing have not sold any shares as part of the IPO. The shareholder list post-IPO continues to be dominated by members of the management team and supervisory board.

Exhibit 4: Shareholders

Name	% holding*
Dr Markus Knapek	16.8
Joachim Horwath	14.7
Dr Harald Gerloff (member of supervisory board and CEO of NetMEDIA)	13.3
Infinitum	14.6
Dr Wolfram Peschko	7.7

Source: Company data. Note: *After placing.

Financials

Revenue levels dependent on customer demonstration activity

During FY14 and FY15 the majority of revenues were derived from two large-scale customer demonstrations of Mynaric's products. By 2016 these contracts were substantially completed, hence the year-on-year reduction in revenues. Another large-scale customer order was won at the end of FY16, which is why H117 revenues are substantially ahead of those for H116. Other income is attributable to government funded development projects, which has increased in each consecutive year from FY14 to FY16. Personnel expenses have increased steadily throughout the last three years as the company has grown. Other operating expenses include payments to third parties for technical assistance with customer projects and in-house development as well as normal operating and adminstrative costs. Annual losses after tax have risen steadily from FY14 to FY16, reflecting the rate of technical development necessary to create awareness of the technology and its possibilities and to achieve a position in the market from which customer sales can increase to reach the point where the company is profitable.

Exhibit 5: Financial summary*

	€'000s	2014	2015	2016	H116	H117
Year end 31 December		HGB	HGB	HGB	HGB	HGB
Income statement						
Revenue		**1,295**	**1,856**	**471**	**422**	**681**
Other income		95	313	649	283	295
Cost of materials		(437)	(415)	(370)	(126)	(74)
Personnel costs		(569)	(1,243)	(1,908)	(848	(1,356)
Other operating expenses		(367)	(867)	(762)	(361)	(914)
Profit Before Tax (as reported)		**(196)**	**(841)**	**(1,843)**	**(880)**	**(1,369)**
Net loss (as reported)		**(196)**	**(841)**	**(1,843)**	**(879)**	**(1,369)**
Balance sheet						
Total non-current assets		118	451	788	708	875
Total current assets		1,482	1,289	1,155	910	1,721
Total assets		**1,600**	**1,740**	**1,943**	**1,618**	**2,596**
Total liabilities		**(1,348)**	**(261)**	**(1,681)**	**(392)**	**(1,274)**
Net Assets		252	1,479	262	1,226	1,322
Net cash		333	713	227	551	348
Shareholder equity		**252**	**1,479**	**262**	**1,226**	**1,322**
Cash flow						
Net cash from operating activities		10	(1,419)	(1,643)	-	-
Net cash from investing activities		(27)	(438)	(552)	-	-
Net Cash from financing activities		252	2,237	1,708	-	-
Net Cash flow		**235**	**380**	**(486)**	**-**	**-**
Cash & cash equivalent end of year		**333**	**713**	**227**	**-**	**-**

Source: Company accounts. Note: *Data are for the operating subsidiary Mynaric Lasercom GmbH as Mynaric AG was formed in H117.

Fundraising at IPO strengthens balance sheet

Mynaric's balance sheet is debt free with €348k cash at end June 2017, ie prior to the €27.3m raised from the IPO. The cash consumed by operating losses and investment in assets has been provided through a mixture of revenues from projects and external finance. In FY16, expenditure on fixed assets totalled €492k, primarily on laboratory equipment and test and measurement apparatus. €626k was raised through the issue of equity, a further €1,000k through the issue of bonds. In FY15, €2,237k was raised through the issue of equity and €252k in FY14.

Valuation: Analysis of potential revenues

Exhibit 6: Analysis of potential revenues

Internet LEO system				
Cost of payload* (€m)	2			
% payload composed of Mynaric systems	50%			
Number of satellites in constellation	50	100	200	300
Revenues attributable to Mynaric (€m)	50	100	200	300
UAV, aircraft, balloon-based system				
Cost of payload (€m)	1			
% payload composed of Mynaric systems	50%			
Number of platforms in constellation/cluster	50	100	250	500
Revenues attributable to Mynaric (€m)	25	50	125	250

Source: Edison Investment Research. Note: *Payload is the part carrying out the communications or sensing function.

Mynaric is still at the pre-commercial phase and there are no consensus estimates available. Since a valuation based on historic EV/sales multiples for listed peers would not ascribe any value to the potential deployment of the technology in airborne or satellite systems, we present instead a scenario analysis showing potential revenues achievable if the technology is deployed in communication systems of different sizes. We split the analysis into two types of system. The first looks at communication networks based on smaller LEO satellites, which typically have more than

100 satellites each. The second looks at communication networks based on many more, less expensive platforms which may be either UAVs, aircraft or balloons. A communications satellite has space qualified terminals, which are more expensive than those on an airborne platform.

Sensitivities

Dependent on large internet projects being completed: While the proposals put forward by Facebook etc are exciting, there is no certainty that they will be technically or economically feasible and that finance will be forthcoming. Both the Facebook and Google programmes are at fairly early stages of development. AWN is likely to need additional finance before it can reach commercial deployment. The timing of all of these projects is clearly very uncertain.

Dependent on large internet projects adopting laser technology: Although wireless laser transmission has significant advantages over microwave, so far it has only been adopted on a few government or military space platforms. Most satellite systems still use Ku or Ka band microwave links and it is possible that the large constellations of communications satellites proposed by SpaceX etc may prefer to deploy the more proven technology.

Mynaric's technology not completely proven: While Mynaric's airborne technology has performed well in trials of individual elements of the system, it has not yet been demonstrated to work in a complete system. Mynaric's satellite-to-satellite terminals will not be available until 2018. While Mynaric has launched early commercial stage variants of its airborne terminals, it has not yet completed the work to reduce the finished cost of the terminals, so there is no certainty that it will be able to achieve the price point required for deployment over a network with a thousand or more transmission nodes. Additionally, the economic case will be reduced if communications terminals have to include microwave links as well to provide low data-rate back-up.

Small number of potential customers: Given the high cost of any airborne or space-borne communications network, it is likely that there will be a relatively small number of network operators who Mynaric can sell its equipment to. Moreover, once an operator has selected its preferred supplier for equipment, it will deploy this equipment over the entire network.

EDISON

Frankfurt +49 (0)69 78 8076 960
Schumannstrasse 34b
60325 Frankfurt
Germany

London +44 (0)20 3077 5700
280 High Holborn
London, WC1V 7EE
United Kingdom

New York +1 646 653 7026
295 Madison Avenue, 18th Floor
10017, New York
US

Sydney +61 (0)2 8249 8342
Level 12, Office 1205
95 Pitt Street, Sydney
NSW 2000, Australia