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# THE ISRAELI TECHNOLOGY IMPERATIVE:
## INVESTING AT THE CROSSROADS OF INNOVATION

**June 2018**

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# FOREWORD

Israel today represents arguably the greatest concentration of innovation and entrepreneurship in the world. For Israeli technology stocks, 2017 and the first half of 2018 has been exciting, and in many ways, pivotal. Several records were set including the largest-ever acquisition of an Israeli information technology company; the largest-ever acquisition of an Israeli bio-tech/pharmaceuticals company; the best twelve-month period of performance by Israeli technology stocks on record (other than the 2009 rebound from the lows of the global financial crisis); and the first-ever systematic allocations by Israeli institutional investors into broad, deep, complete, and diversified portfolios of Israeli technology stocks.

This research report on the Israeli technology sector builds upon BlueStar's 2015 *BluePaper*, "Israel's Global Technology Companies: Essential for Israel, Essential for Innovation, Essential for Investors."

Our initial publication set out the historical context of Israel's innovation economy, as well as introduced BlueStar's framework for defining this attractive yet under-recognized asset class. With this *BluePaper*, we aim to dig deeper to explain the essential role that Israeli technology firms play in the modern, dynamic technology ecosystem.

Israel and Israel-based companies are regularly cited as world leaders in disruptive innovation. That Israel is home to one of the world's most successful models for encouraging risk-taking and entrepreneurship is indisputable. Now, more than ever, BlueStar believes that the Israeli start-ups that have grown up and are trading publicly are also at a major inflection point and stand at the cusp of discovery by global investors.

As we look to the second half of 2018 and beyond, BlueStar is proud to continue its co-branded research distribution alliance with the Jefferies Group. This partnership was established in 2017 to broaden the global visibility of the Israel investment opportunity set and to supplement Jefferies sell-side research stock coverage with macro- and sector-level research. Further, Jefferies also distributes BlueStar's monthly market commentary covering the Israeli economy and broad equity market trends.

We hope you find the information and perspectives in this *BluePaper* both interesting and useful in your investment decision-making process.

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## Introduction

Israel's presence on the world stage wasn't always prominent, although its focus on technology always has been. Fifty years ago the country was a land of contrasts, where ancient history and a socialist economy gave birth to a thriving capitalistic "high-tech" industry. A popular children's book from the early 1960s captured this duality, describing Israel as a land of "bibles and Boeings," "camels and Cadillacs."[1] Seventy years after achieving its independence, Israel remains a land of amazing contradictions. How is it that a country the size of New Jersey, with a population less than that of New York City, and one subject to the continual threat of armed conflict, has become one of the top ten most technologically advanced country in the world[2]?

This paper traces the historical arc of the roles technology and public policy have played in Israel's economic development from before the country's founding to today. We examine how technology has become a cornerstone of Israel's economy and how the technology sector has played a role in expanding Israel's global economic footprint. In doing so, we will cover key pieces of legislation that helped Israel's technology sector find its footing before diving into how Israeli companies play a critical role in pushing forward what we call the "global innovation cycle." Then we conclude with some analysis on what exposures investors can expect to find in a diversified portfolio of Israeli high-tech stocks.

***Israel has remained a hidden gem — a largely under-researched and overlooked investment destination with a promising future.***

Through 2016, most investor attention had been channeled into seed- and venture- stage companies, not surprising, as Israel has more start-ups per capita than any other country in the world. In 2017, public equity investors, both in Israel and abroad, began to take notice of the larger "grown-up" Israeli technology companies, and that trend has continued through the first half of 2018.

BlueStar Indexes launched the BlueStar Israel Global Technology Index (BIGITech®) in 2013 so investors and business managers around the world could properly identify Israel's publicly traded high-tech companies, track the growth of the sector's breadth, and serve as the basis for investment vehicles. As of early 2018, three investment vehicles are benchmarked to the BIGITech index including the NYSE-listed BlueStar Israel Technology ETF (ITEQ®), as well as two Israel-domiciled funds offered by KSM/Excellence.

Despite its prominence in the global technology ecosystem, Israel is still a relatively small country with a relatively small aggregate market capitalization. For those reasons, Israel has remained, in our opinion, a hidden gem: a largely under-researched and overlooked investment destination with a promising future.

**Historical Context**

**Innovation Cycle**

**Macro View**

**Conclusion**

## Historical Context

Israel, a once scarcely populated desert land, is now home to 8.8 million people—just 0.10% of the world's population. Despite its small size, Israel boasts the world's 32nd largest economy. The stories of the world's progress in technology over the last 40 years and the history of Israel's economy are intimately linked. Israel would not have one of the developed world's fastest-growing economies without its entrepreneurial spirit and technology sector, and the global technology sector would not have made the same progress over the last half-century without Israel.

Analysis of the economy in Ottoman and British Mandate Palestine provides insight into how technology and innovation became the core of Israel's economy. During the early 1900s, the land that is now Israel was mostly desert and swamps and, apart from two or three small "cities," primarily rural in nature. The Arab and Jewish populations began to increasingly self-segregate in the period between World War I and World War II. It is, therefore, possible to analyze, in isolation, the economic development of the areas that would become present-day Israel, from the inter-war period through the first decade of Israel's independence, and track technology's role in it.

Just prior to WWII, 20% of the Jewish population was employed in the agriculture sector, 20% in manufacturing and 60% in services. As broad categories, manufacturing and services are considered high productivity sectors and imply a significant reliance on technology. By 1950, over 25% of Israel's GDP came from the manufacturing sector[3], which, according to today's standards, would have put Israel in the category of an Emerging, rather than Frontier, market.

Capital investments in irrigation and mechanization of farming techniques led agricultural output to grow by 12% per year during this period, even as the percent of the Israeli population employed in that sector continued to decline.

Israel's embrace of manufacturing and agricultural technology was a trend that set it apart from other countries in the region. Shortly after Israeli independence, in 1948, even after absorbing 350,000 immigrants in its first 18 months of existence, per capita income was three times higher than that of Egypt, double that of Jordan, and slightly higher than that of Saudi Arabia[4]. The Jewish leadership in Palestine realized early on that technology would be crucial to its development and could significantly mitigate the country's precarious geopolitical situation and lack of natural and financial resources.

### Necessity as the Mother of Invention: The Self-Defense Roots of Israel's Tech Prowess

On June 2, 1967, three days before the Six-Day War erupted, Charles de Gaulle imposed an arms embargo on Israel and realigned France's foreign policy toward supporting the Arab states. Mirage jet fighters and advanced missile boats that Israel had ordered and paid for would not be delivered. Nuclear cooperation would be suspended. Israel would be on its own.

Although de Gaulle thought he was punishing Israel, forcing it to be on its own it was a blessing in disguise. The French embargo after the Six-Day War had a historic and strategic impact on Israel that changed the nation's trajectory. It pushed Israel's leadership to understand that the state could not rely on anyone but itself. If it wanted to continue to survive, it would need to develop independent research, development, and production capabilities—not just for arms, but for everything.

### The De Gaulle Embargo

De Gaulle's decision forced Israel to develop its first drone, flown over the Suez Canal in the summer of 1969. It pushed Israel to accelerate plans to design an Israeli tank, the Merkava (the fourth generation of which is still in service with the IDF today). Israeli intelligence services also made a bold move to steal five missile boats from their French shipyard in Cherbourg to complete their initial fleet, and, through reverse engineering, developed a series of increasingly advanced missile boats.

The De Gaulle embargo also pushed Israel Aerospace Industries to build its first fighter jet, the Nesher, designed like the Mirage 5 French fighter it had paid for but could no receive due to de Gaulle's embargo. Manufacturing the Nesher led to the design and production of the Kfir (a more advanced version of the Mirage) and ultimately the Lavi, Israel's most ambitious aircraft project. While the Lavi project ultimately shut down, the knowledge gained from its development laid the foundations for Israel's drones, satellites, avionics, and missile systems

To many observers, it may seem that Israel has been the Start-up Nation since its inception; that is far from the case. One of the critical factors since the 1960s that enabled high-tech industries based on information and communication technologies to take root and flourish in Israel was the heavy investment by Israel's defense and aerospace industries.[5] Israel devoted 17.1% of its GDP to military expenditure in 1988. Even though this share had dropped to 5.8% of GDP by 2016, Israel military spending as a percent of GDP remains among the highest in the world. In comparison, the US devoted 5.7% of its GDP to military expenditure in 1988 and 3.3% in 2016.

Heavy investment in defense and aerospace formed the basis for Israel's high-tech industries in medical devices, electronics, telecommunications, and computer software and hardware. In academia, the Technion—Israel's equivalent of MIT—invested in new fields of study, including computer science and electronic engineering. The government appointed chief scientists throughout its various ministries and started investing in technology incubators.

France's embargo in 1967 changed Israel. It took a country that was barely 20 years old and forced it to understand once again that it could rely only on itself. It made the country innovate, think out of the box, and adapt to changing realities

## Gaining Momentum: The State's Role in Transforming Israel's Economy

Israel's leaders understood that sustainable, long-term economic growth would be critical for Israel's national security if it were to survive as a country. Being an 'island economy', devising such a strategy was not an easy task. Through its first 70 years, Israel has not traded much with its closest neighbors, either for political reasons or because Israel's neighbors' economies are relatively small and under-developed. To overcome this limitation, Israel's economic model needed to rely on a world-class services export sector.

The State's formal role in technology transfer was established with the creation of the Office of the Chief Scientist (OCS) within the Ministry of Trade in 1969. The Office of the Chief Scientist's mission and objectives were enshrined in the 1984 R&D Law, covered more thoroughly in the following section. Despite having this framework in place, economic growth in Israel followed a familiar boom-and-bust pattern. Only after the financial crises of the 1970s and early 1980s (marked by inflation that peaked at 400% and burgeoning and unsustainable public debt levels) did Israeli politicians and economic policymakers become willing to abandon the socialist, interventionist economic policies of the country's Zionist founders.

Moreover, the introduction of a broad stability program in July 1985 enabled Israel to finally break the boom-and-bust, high-debt/high-inflation cycle that characterized much of its economy since independence. Broad reforms implemented during this period included budgetary discipline, prudent monetary policy, and reduction in the size of government. Furthermore, Israel's huge inflow of Russian immigrants (of almost 1 million into a population of just 4.5 million) in the early 1990s amplified its workforce, doubling the number of engineers and scientists in Israel overnight.

Together, these factors laid an enviable foundation for Israel's technological developments.

### Israel's Academic Prowess

Advanced academic research is also a key ingredient of Israeli technological success.  Israel has seven research universities, and Israeli Universities are ranked among the top 50 academic institutions in the world in the following scientific disciplines: chemistry (Technion, est. 1912); computer science (Weizmann Institute of Science, est.1934, Technion, Hebrew University, Tel Aviv University); math and natural sciences (Hebrew University, Technion); and engineering (Technion).

All Israeli research universities have technology transfer offices. Recent research conducted by the Samuel Neaman Institute has revealed that, between 2004 and 2013, the universities' share of patent applications constituted 10%–12% of the total inventive activity of Israeli applicants. This is one of the highest shares in the world and is largely due to the intensive activity of the universities' technology transfer offices. The Weizmann Institute's technology transfer office, Yeda, has been ranked the third-most profitable in the world[6].

# Israel Becomes a Global Tech Hub

## The Foundation of Israel's Technology Prowess: The R&D Law of 1984

Israel was fortunate that a global technological revolution was beginning to unfold just as it was finally getting its economic house in order and codifying the role of the State in encouraging and funding research and development in the R&D Law of 1984. The confluence of these two events put Israel on the path toward becoming a global technology powerhouse. Thus, after a lost decade of growth from the mid-1970s to the mid-1980s, the technology transfer infrastructure put in place by Ezer Weizman as Minister of Science and Technology, became a crucial force multiplier for the Israeli economy.

The first objective of the R&D Law[7] was and continues to be to create "places of employment in industry and the absorption therein of scientific and technological manpower." The word "absorption" quite explicitly expressed the realization that, to foster its own technology and industrial sectors, Israel needed to recruit foreign entities and human capital to supplement its own population of engineers and scientists. Another objective of the law is "the improvement of the balance of payments of the State through the manufacture and export of science-intensive products developed therein; all by way of the encouragement of industrial Research and Development."

The Minister of Industry and Trade and the Minister of Finance were jointly charged with the task of providing grants, loans, and exemptions to achieve the law's objectives. Specific actions taken by the Ministers of Industry and Finance include a grant program whereby the Israeli government offers up to a 20% subsidy for investments in fixed assets, production equipment, or facilities for companies registered in Israel setting up operations with export capabilities. Furthermore, the grant program is eligible only for companies that plan to employ at least 250–500 people in Israel or invest past a certain threshold in productive equipment.

The R&D Law specifically addresses foreign companies wishing to cooperate in the R&D incentive program. Interestingly, the website, http://www.investinisrael.gov.il refers to the Global Enterprise R&D Collaboration Framework as the flagship program of the R&D Law. Through this program, the law aims to encourage partnerships between multinational corporations and start-up companies in Israel, to maximize the synergy between the partners' strengths.

The R&D Law, along with early players in the Israeli technology scene (like IBM, Elron, and Motorola), set the stage for a boom in Israel's technology sector.

## R&D Becomes Israel's Global Calling-card

According to BlueStar's proprietary research, which undergirds the BlueStar Global Israel Exposure Universe, out of close to 4,000 of the most heavily traded publicly listed companies around the world, nearly 400 have a meaningful presence in Israel. Of those 400 companies, 150 report Israel in their annual filings as either a stand-alone asset, employee, or revenue segment; specifically discuss Israel-based R&D facilities; list the Israeli Shekel as an important currency impacting financial statement translation; have entered into a joint venture or strategic partnership with an Israeli company; or are otherwise known to have important R&D or manufacturing facilities in Israel. Roughly two-thirds of these companies operate in what BlueStar defines as high-tech industries such as information technology, biotechnology, or aerospace and defense.

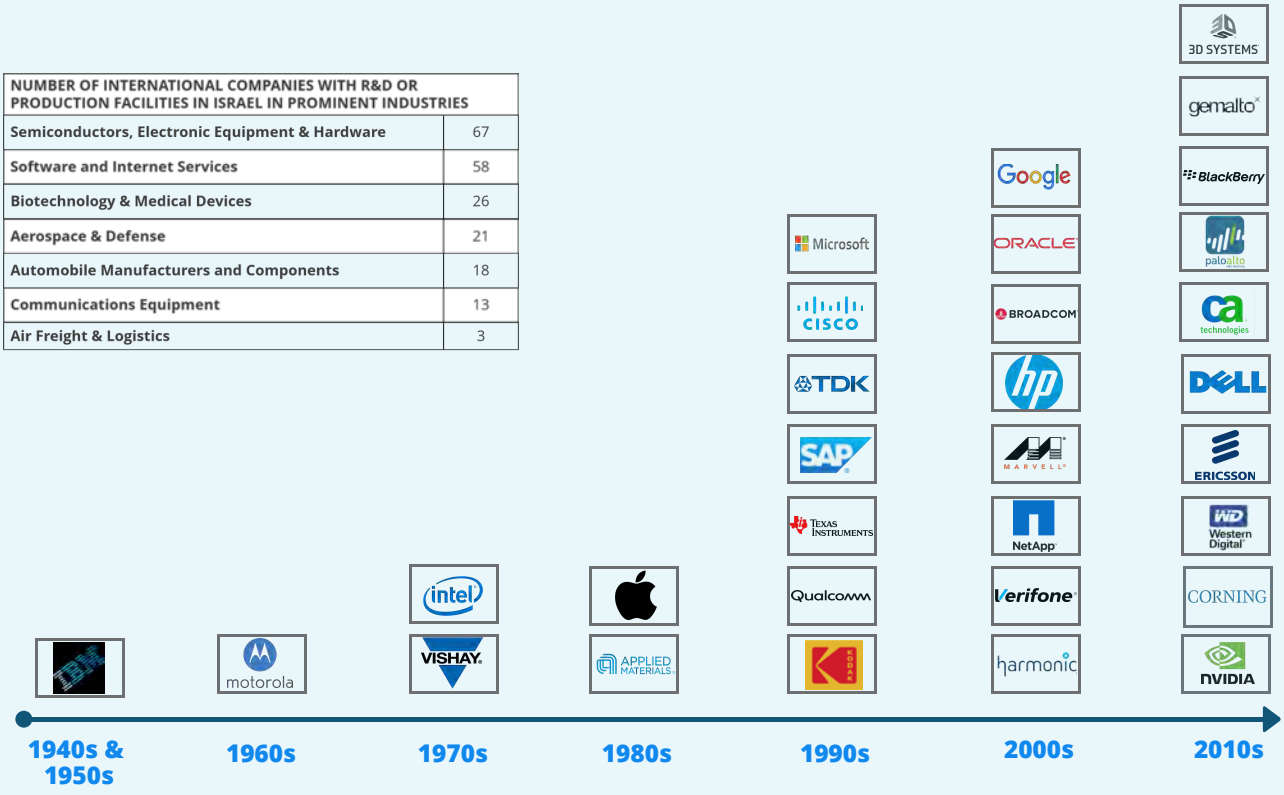
***When Intel established its first Israeli R&D center in Haifa in 1974 the world was put on notice.***

Also, according to BlueStar's Global Israel Exposure Universe, 40 international information technology companies are considered core players in Israel's technology ecosystem. Members of this group have hundreds or even thousands of employees in Israel or have been operating significant R&D centers in Israel for more than a decade. These companies have come to Israel to benefit from its innovation and technology ecosystem from all around the world including the US, Germany, France, India, Japan, Canada, and China. This unique list of international technology companies includes players in different industries ranging from business software and cybersecurity to consumer electronics and high-powered computing equipment.

When Intel established its first Israeli R&D center in Haifa in 1974—with five employees—the world was put on notice that Israel's technology sector was officially open for business. According to Intel, the company now has approximately 10,000 employees in Israel making it the country's largest private sector employer; Intel is also the country's largest exporter. Over the decades, hundreds of other international companies have joined Intel to help transform Israel into one of the world's most important hubs for technology and innovation.

EXHIBIT 1: **SAMPLE OF FOREIGN TECHNOLOGY COMPANIES ESTABLISHING R&D CENTERS IN ISRAEL**

| NUMBER OF INTERNATIONAL COMPANIES WITH R&D OR PRODUCTION FACILITIES IN ISRAEL IN PROMINENT INDUSTRIES | |
|---|---|
| Semiconductors, Electronic Equipment & Hardware | 67 |
| Software and Internet Services | 58 |
| Biotechnology & Medical Devices | 26 |
| Aerospace & Defense | 21 |
| Automobile Manufacturers and Components | 18 |
| Communications Equipment | 13 |
| Air Freight & Logistics | 3 |



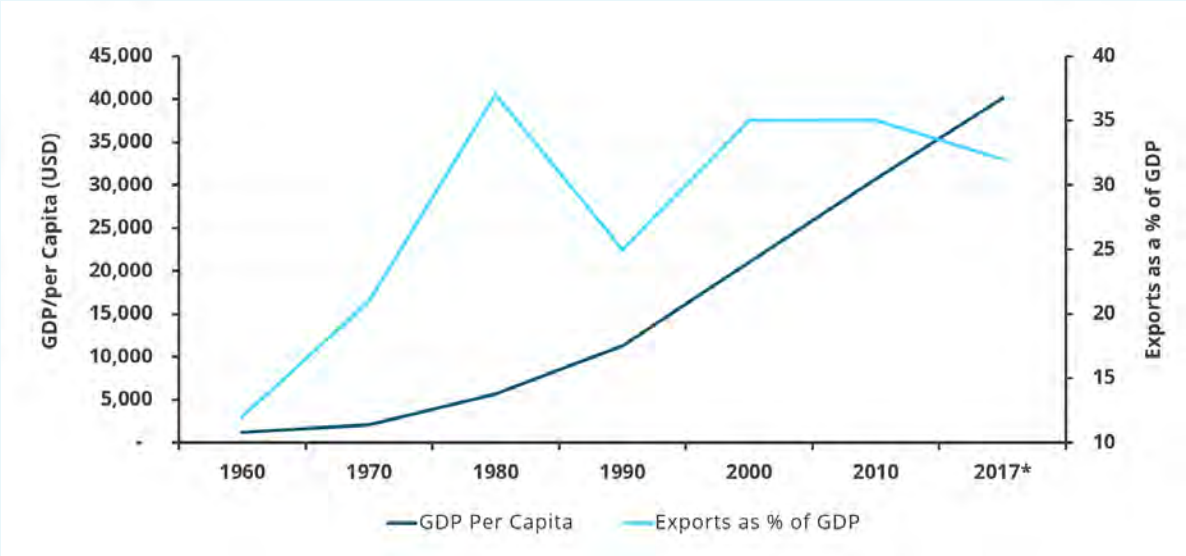

Source: BlueStar Indexes
For Illustrative Purposes Only.

## R&D Success: Staggering on a Macroeconomic Level

Due in large part to its innovation and technology ecosystem, Israel has been able to put up some staggering numbers on a macroeconomic level. Israel has benefited tremendously from the effect of capital deepening, a key objective of the R&D law. According to the 2017 OECD Science, Technology and Industry Scoreboard, "Israel has the highest ratio of R&D expenditures to GDP (4.5%) in the OECD… 65% of business R&D is performed by foreign-controlled affiliates."

The chart shows that Israel's policy of directing investment in capital expenditures toward export-oriented industries resulted in exports as a percent of GDP that grew from 12% in 1960 to more than 30% in 2017. Furthermore, according to the World Bank and Israel's Bureau of Statistics, per capita GDP in Israel grew from $1,230 to more than $40,000 over the same period—$40,000 per capita GDP is more than three times the world's average. Israel's export sector was beginning to take off in the 1980s, just as its technology sector was finding its footing. In fact, Israeli high-tech exports grew by more than 1100% from 1988 to 2017, or roughly 10% on an annualized basis.

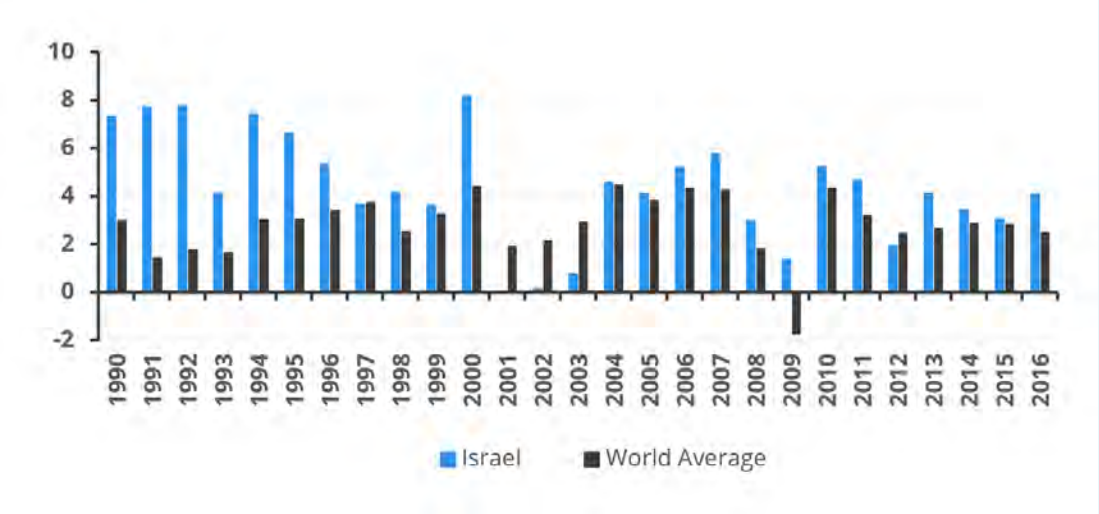
EXHIBIT 2: **EXPORT EXPANSION LEADS TO PER CAPITA GDP GROWTH**




Source: OECD
For Illustrative Purposes Only.

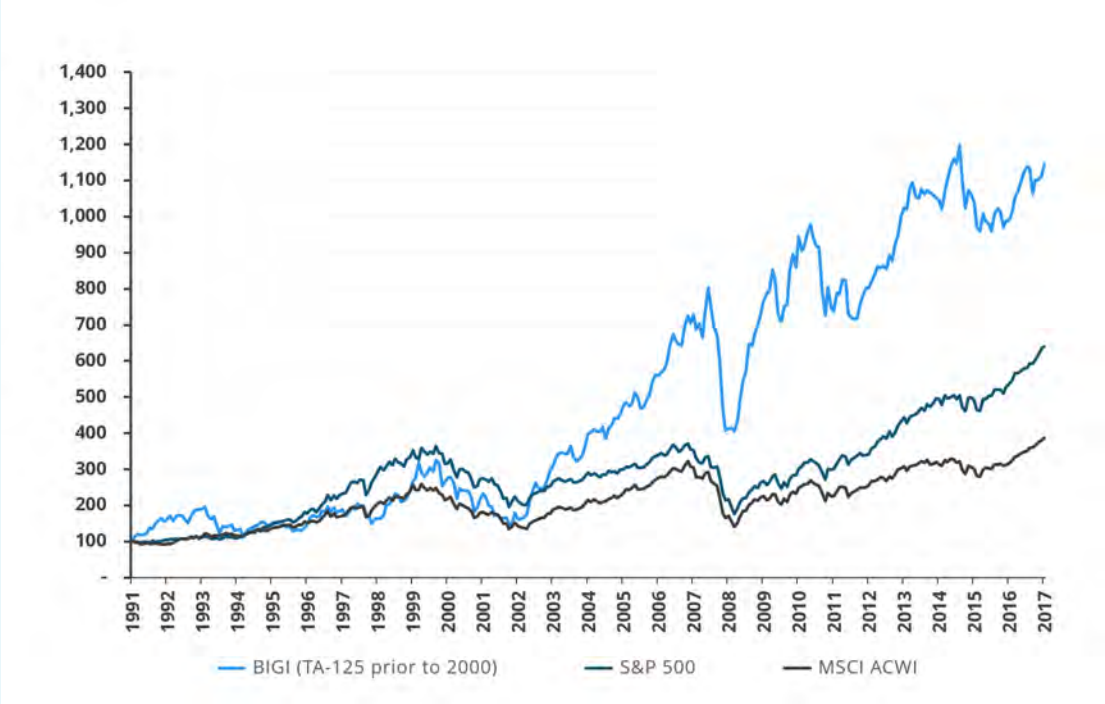
Israel's export industry is one of the key reasons why it has been able to achieve faster-than-average GDP growth in 24 of the 28 years from 1990 through 2017. Israel underperformed the world's average GDP growth in the three years following the dot-com crash of the late 1990s and once again in 2012. This relative growth manifested itself in Israel's impressive stock market performance over the long term.

## EXHIBIT 3: **GDP GROWTH - ISRAEL VS WORLD AVERAGE**




Source: OECD
For Illustrative Purposes Only.

## EXHIBIT 4: **LONG-TERM EQUITY PERFORMANCE (INDEXED TO 100)**




Source: BlueStar Indexes, TASE, Bloomberg LP
For Illustrative Purposes Only.

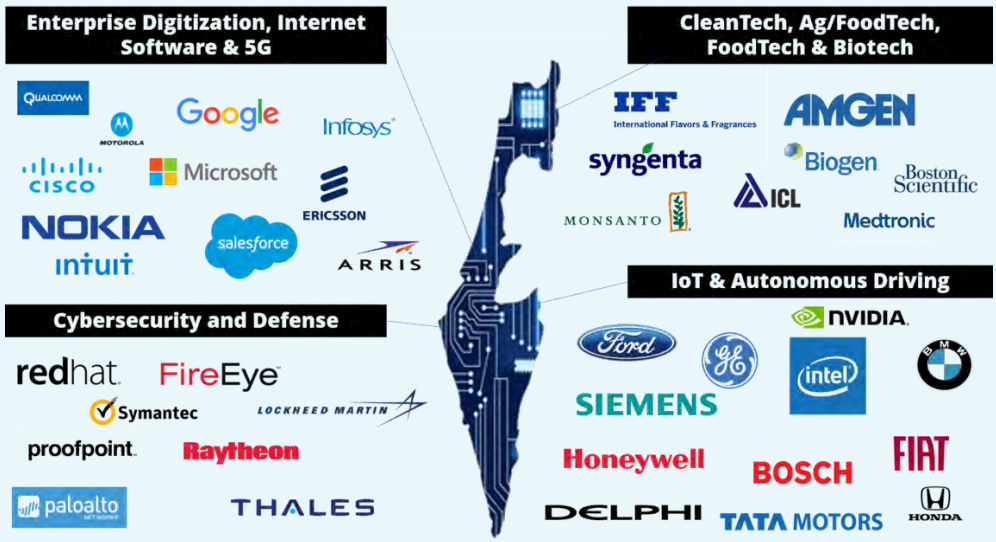
## R&D Today

Israel's economy has clearly benefited from the technology and innovation ecosystem its leaders worked so hard to put into place. The combination of these global world-leading technology companies with R&D and production facilities in Israel, along with Israel's own home-grown technology companies, has shaped the Start-up Nation into one large incubator for innovation and R&D in virtually every major technology trend set to transform our world over the years and decades to come.

**According to the OECD, World Economic Forum and the Bloomberg Innovation Index Israel ranks...**

- **#1** in R&D Spending as a % of GDP
- **#2** in Innovation
- **#3** in Quality of Scientific Institutions
- **#3** in Company R&D Spending
- **#3** in University Industry Collaboration on R&D
- **#4** in Capacity for Innovation
- **#5** in Patent Application per Million Citizens

EXHIBIT 5: **GLOBAL CENTERS OF INNOVATION**




Source: BlueStar Indexes
For Illustrative Purposes Only.

We will demonstrate in the following section how Israel's own technology companies benefit from access to these international companies, which serve as a source of strategic partnerships, customer bases, and acquirers. Further, Israeli companies have become an integral—and irreplaceable—link in the global high-tech supply chain. This unique environment has enabled Israeli companies to push the boundaries and stay one step ahead of the innovation cycle.

# The Innovation Cycle

## The Innovation Cycle Framework: Quality of Experience & Quality of Service

Israel's actual contribution to the global technology industry is not always readily apparent. To appreciate Israel's role, we must first establish a framework by defining two basic concepts that drive the global innovation cycle: **Quality of Service (QoS)** and **Quality of Experience (QoE)**.

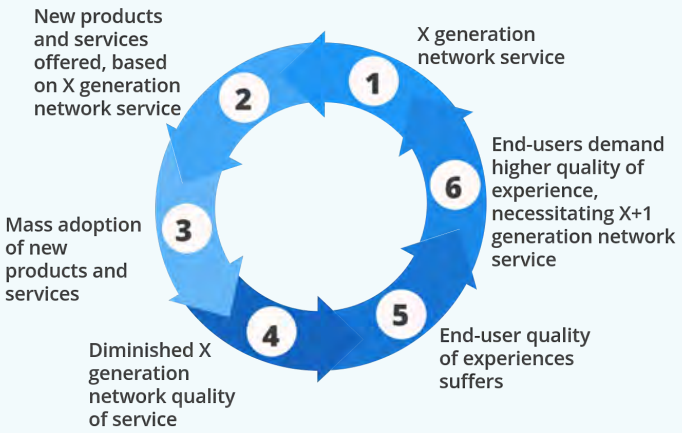
When we bifurcate technology companies into these two broad buckets—those whose success is driven by delivering a quality end-user experience (QoE) versus a product or service focused on the network infrastructure (QoS) that delivers it—an interesting pattern emerges. Exhibit 6 summarizes how QoS and QoE push and pull the technology sector forward in the innovation cycle. To demonstrate the concepts of QoE and QoS, let us consider the evolution of the cellular network (Exhibit 7) from its early stage of 2G in the early 1990s and how advances in the network gave birth to innovative end-user technologies and faster, more ubiquitous coverage.

### How QoS Brought Us Netflix

Introduced in 1998, 3G networks allowed mobile video streaming for the first time. That same year, Netflix launched its website enabling customers to order DVD rentals by mail. It wasn't until 2007 that Netflix announced it was going to launch a video streaming service harnessing the power of 3G networks. However, Netflix's video streaming service became so popular that its databases and content delivery systems were overwhelmed and could no longer deliver a high QoE. The company was at risk of losing customers who saw diminishing value in paying for Netflix's service.

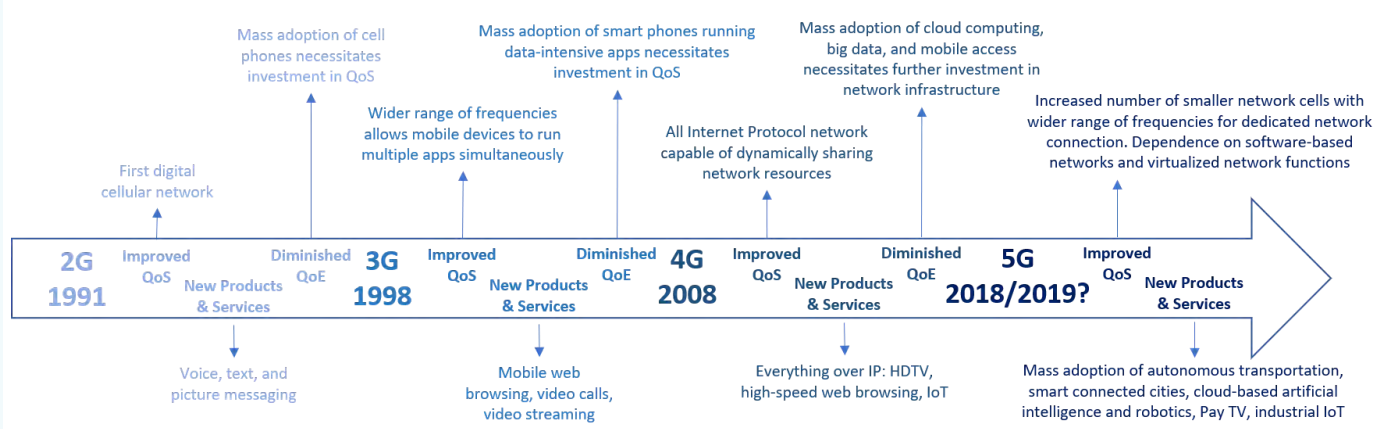
In 2008, the same year that 4G networks were first rolled out, Netflix moved its data to the Amazon Web Services' cloud, which offered a greater QoS, and the QoE its customers came to expect was restored. Netflix's stock rose roughly 20% on an annualized basis from its IPO in 2002 through 2007. Since moving to Amazon's cloud in 2008, Netflix stock price has gained nearly 60% on an annualized basis. While many factors have contributed to Netflix's success—including international expansion and development of proprietary content—its growth would not have been possible without investment in the infrastructure needed for 4G networks, which in turn enabled expanded capabilities in cloud computing and better video streaming quality on mobile devices. QoE's interdependency on QoS pushed Netflix forward.

EXHIBITION 6: **THE INNOVATION CYCLE**




Source: BlueStar Indexes
For Illustrative Purposes Only.

EXHIBITION 7: **CELLULAR TIMELINE**




Source: BlueStar Indexes
For Illustrative Purposes Only.

## Israeli Pioneers in QoS & QoE

While many investors are naturally drawn to familiar names like Netflix or Amazon, at BlueStar we recognize something deeper. We see all the Israeli companies that have been delivering the critical hardware and software needed to ensure that Amazon's cloud services can deliver a high QoS to Netflix and that Netflix can deliver a high QoE to its customers.

In fact, Israeli companies have played a critical role in, and often pioneered, the global technology sector's innovation cycle at every step of the way since its tech industry launched in the 1980s. The following are several examples:

**1981** *ORBOTECH*

In 1965, just nine years before establishing its foothold in the Israeli technology ecosystem, Intel's Gordon Moore predicted that the power of computing would increase—and cost decrease—at an exponential pace. Specifically, Moore's law states that the number of transistors in an integrated circuit would nearly double every two years. **In 1981**, the Israeli company, Orbotech, became the world market share leader in printed circuit board manufacturing equipment. Today, with the help of Israeli companies like Orbotech, Camtek, and Nova Measuring Instruments, technology companies are closing in on the physical limits of how much computing power can be packed into integrated circuits.

**1989** *M-SYSTEMS*

Before the invention of flash memory, data stored in computers would be lost without the constant flow of electricity. **In 1989**, Israel's M-Systems, in partnership with IBM, developed and patented the first flash memory and USB flash memory drives known as "disk on key". In 2006, M-Systems was acquired by Sandisk, which was acquired by Western Digital in 2017. The global market for flash memory reached $51 billion in 2017. As demand for flash memory grows from sources ranging from machine learning to blockchain, the market is expected to reach $64 billion[8] by 2021.

**1989** *DSP GROUP*

**In 1989**, Israel's DSP Group developed the world's first telephone answering machine voice processor. DSP Group became the global market share leader in wireless phone chipsets in the 1990s and is now a leader in voice processing and speech recognition chipsets. The global market for voice recognition chips[9] is expected to reach $127 billion by 2024.

**1993** *CHECK POINT*

**In 1993**, Check Point Software Technologies' CEO invented the Firewall-1, which launched the world's information technology security industry. Global spending on cybersecurity reached $75 billion in 2017. Global spending on cybersecurity[10] is expected to reach $200 billion as the world becomes more digital, more people and internet of things devices are accessing networks remotely, and traditional physical security, national defense, and cybersecurity are becoming deeply integrated.

**1996** *MIRABILIS (AND VIBER)*

**In 1996**, Israel's Mirabilis developed the world's first instant messaging software, which was used by AOL. Two years later, in 1998, AOL acquired Mirabilis for $400 million. In 2010, the Israeli start-up, Viber, created the world's first cross-platform instant messaging and Voice over Internet Protocol (VoIP) application. Viber was later acquired by Japan's Rakuten for $900 million in 2014. the global market for mobile messaging apps[11] is projected to reach 2.1 billion users by 2020.

**1999** *MOBILEYE*

Finally, **in 1999** an Israeli professor at Hebrew University invented a solution for a camera-based vision software algorithm. This solution was the core technology used by Israel's Mobileye to pioneer to world's Advanced Driver Assistance Systems technology, the precursor to autonomous cars. In 2015, Intel acquired Mobileye for $15.3 billion, the largest-ever sale of an Israeli company. The global autonomous vehicles market[12] is expected to reach $125 billion by 2027.

**Pushing innovation in QoS Today: Cloud Computing, Big Data, and Mobile Access**

Throughout its history, the Israeli technology ecosystem has consistently produced world-changing technologies. The innovation cycle today is being pushed forward by network infrastructure developments within cloud computing, big data, and mobile, which serve as the foundation for some of the most exciting new technology products and services including artificial intelligence, autonomous transportation, enterprise digitization, Pay TV, and Internet of Things (IoT).

Consider the following examples: big data is a required input for machine learning systems, a critical component in artificial intelligence; businesses and individuals that lack the same resources as Fortune 500 companies will be able to access artificial intelligence software through the cloud, and autonomous driving relies on all three network innovations simultaneously. Specifically, autonomous vehicles will generate big data and depend on cloud-based artificial intelligence systems, facilitated through mobile network connections. In the case of autonomous vehicles, QoE is literally a question of life-and-death, so the quality of network service is paramount.

Taking a closer look at the key challenges posed by cloud computing, big data, and mobile will help us recognize the importance of many of the technologies Israeli companies are contributing to the world today.

***Cloud Computing*** is a network configuration that moves away from onsite data storage, processing, and connectivity and toward the use of remote and geographically distributed hardware accessed through the internet. Cloud computing is a complicated technology because it doesn't rely on the storage and processing power of the servers in a single data center, but many data centers around the world that need to be connected and function harmoniously, as if all the computing was happening on a single device.

Amazon defines ***Big Data*** "…in terms of data management challenges that—due to increasing volume, velocity and variety of data—cannot be solved with traditional databases." In the big data paradigm, volume of data can be measured not in gigabytes but petabytes and exabytes. Variety of data refers to standard structured data as well as unstructured data like images, voice, social media interactions, or financial transactions. Velocity of data describes the need for this volume and variety of data to be available and usable in real-time or near real-time.

***Mobile Access*** adds pressure on networks by introducing a new way for end users and devices to connect to wireless networks, whether through WiFi, public cellular, or other wireless network connection modes. A few challenges that mobile access presents to the quality of network service are a seamless transition from one type of mobile network to another, ability to watch HD video and facilitate HD voice conversations, use of apps rather than web browsers, and the ability for applications and services to be location dependent.

## Together, Cloud Computing, Big Data, and Mobile Access put massive pressure on network service providers' ability to deliver a high quality of service.

Thankfully Israeli companies continue to be on the cutting edge, providing solutions to enhance the speed of data, manage the structure of the data, and optimize network infrastructure and security through the following technologies that enhance the quality of network service:

- **Data center connectivity** *using Ethernet and other wired network connections*
- **WiFi** *in the home and backhaul internet access*
- **Cellular** *in the transition from 4G to 5G networks*
- **Software Defined Network and Network Functions Virtualization** *to create Intelligent Networks*
- **Cybersecurity** *to protect it all*

### Data Center Connectivity: Ethernet and other wired network connections

Ethernet is the most commonly used wired local network data transmission technology. The ports and cables in most of our laptops have become somewhat commoditized. But, have you ever wondered what it takes to make Google, Verizon, Vodafone, Facebook, or Oracle datacenters work? The answer is high-powered computers and cutting-edge routers and switches that all need to be connected.

Ethernet, followed by InfiniBand and fiber optic connections, is the dominant transmission technology used in large-scale enterprises and data centers.

Currently, Ethernet is typically used to transmit data at speeds between 10 and 40 gigabytes per second, but next-generation products, such as those offered by Israel's Mellanox and Silicom that can move data at up to 100 gigabytes per second, are now available, with 200 and 400 gigabytes per second in development. The global Ethernet Internet Protocol market13 is predicted to grow from $24 billion in 2016 to $85 billion in 2023, implying a compound annual growth rate of nearly 20%.

The following are key innovations in Ethernet technology that investors should watch:

- How quickly speeds and throughput evolve to cope with the demands of big data and keep up with innovations in network, central, and graphic processors used in data centers facilitating cloud computing;
- Powerlines that can carry data through Ethernet technologies and vice-versa. Think of a SmartTV getting both power and internet connection via Ethernet rather than a traditional electrical plug and WiFi;
- Carrier Ethernet used by telecom companies in larger areas such as connecting metropolitan area networks to a wide area network.

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### Wired Connectivity Solutions

**Mellanox Technologies – 5.18%***

*Ethernet and Infiniband cards, adapters and switches used in data centers for cloud computing, high powered computing, machine learning, financial services, and telecommunications networks.*

**11.5% share of global application-specific semiconductor devices market;**

Key historical breakthroughs:

- 2001: Shipped world's first InfiniBand semiconductors capable of supporting multiple switches and channel adapters
- 2015: Announced development of world's first 10, 25, 40, 50 and 100 gigabit per second end-to-end ethernet solutions
- 2016: World's first 200 gigabit per second Ethernet network card

Notable Customers and Partners:

- Cisco, Nvidia Deep Learning Super Computer, Facebook, Yahoo, Baidu Machine Learning Systems

**Silicom Connectivity Solutions – 0.42%**

*Server adapters (1-100 gigabyte per second), switches, field programmable gate arrays, and network edge routers designed for cloud and data center environments, enabling network functions virtualization, software defined wide area networks, and cybersecurity.*

Key customers, partners and integrators:

- Intel, Xilinx and major telecommunication service providers.

*Weight in BIGITech as of April 30, 2018

### WiFi and Other Wireless Local Area Transmission Technologies

Wireless network access has facilitated the emergence of IoT and mobile devices, both of which contribute to big data and rely on cloud computing. WiFi is the dominant technology for wireless local area networks. Like Ethernet, WiFi might seem like an old technology. But WiFi's importance is only set to grow as video and TV streaming become mainstream, the IoT market hits mass adoption, businesses adopt bring-your-own-device-to-work policies, and wireless network connections become standard in cars and airplanes.

While WiFi has been around for some time now, innovations are still required to facilitate the mass adoption of the products and services listed above. For example, satellite-based WiFi availability is helping remote areas of the world gain access to the internet, and faster gigabyte per second WiFi speeds are still being rolled out.

Overall, WiFi and other local area wireless technologies like Bluetooth and DECT [digital-enhanced cordless telecommunications], such as those offered by Israel's DSP Group and Ceva, are facilitating the adoption of IoT both in the home and office. Investable areas of innovation in WiFi include:

- The development of gigabyte-per-second WiFi devices;
- Video and multimedia consumption on mobile devices over WiFi connections;
- The potential use of WiFi to provide internet to more remote locations, including satellite WiFi hotspots coverage.

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### Wireless LAN Connectivity Solutions

**CEVA- 1.14%***

*Wi-Fi and Bluetooth connectivity platforms for home wireless networks and digital signal processors (DSP); WiFi offload to core cellular network infrastructure.*

**90% share of global DSP intellectual property market**

Notable intellectual property licensees:

- Broadcom, Cirrus Logic, Fujitsu, Intel; LG Electronics; Nokia; NXP; Samsung; Texas Instruments; SONY, and ZTE

CEVA-powered consumer products:

- Samsung Sport Smartwatch, Polycom phones; Vivo phones, ASUS phones, Fujifilm cameras; HiSene smart glasses, Samsung Galaxy J7, DJI drones

**DSP Group – 0.53%**

*HDClear and HDVoice speech processing chipsets with advanced noise elimination and speech enhancement; Leader in Ultra Low Energy chipset for always-on connected devices used in home automation, home gateways, mobile devices, and office; Enablement of connected devices through WiFi, DECT and radio frequencies.*

Key historical breakthroughs:

- Developed world's first answering machine voice processor in 1989

Notable customers, partners and integrators:

- Samsung Galaxy S7 and S8 phones Amazon Echo Polycom/Avaya/Cisco Office VoIP Phones, Cisco, Motorola, ZTE, Philips, Panasonic, Deutsche Telecom, Turkcell, AT&T, Comcast, Vodafone, Orange, and Verizon.

*Weight in BIGITech as of April 30, 2018

**Public Cellular**

Public cellular networks have contributed the most to push the global technology innovation cycle forward (see Exhibits 6 & 7). Continued investment in 4G, and the rollout of 5G cellular networks around the world present interesting opportunities for investors. As communication service providers like Verizon and AT&T compete for market share, they will need to invest in network infrastructure upgrades. Many Israeli technology companies stand to benefit from any upcoming capital expenditure cycle.

Cellular networks provide the most ubiquitous high-speed wireless access to the internet. Using satellite-enabled internet and telecommunications access, cellular networks have the greatest potential to bring internet access to remote and developing parts of the world that have not been able to invest in previous stages of telecommunications infrastructure. Israeli companies like Gilat Satellite Networks and Sky and Space Global are participating in satellite-based communication technologies.

Unlike 2G and 3G networks, 4G is an all Internet Protocol network, facilitating the move to everything over the internet. 4G networks provide the connection needed to support mobile web access and high-bandwidth–usage applications like HD mobile TV, gaming, and unified communications including video conferencing. Equally as important as speed is that 4G networks can dynamically share network resources to support more users in each location and allows users to move between networks more smoothly; these capabilities are fundamental to the rollout of 5G.

Investors may want to pay closer attention to technologies required by 5G networks:

- A predominately distributed computing environment where most of processing and access to software happens over the cloud rather than on devices;
- A Larger number of smaller cells utilizing a wide range of radio frequencies—including millimeter wave—to provide greater bandwidth and lower latency connections over smaller geographies than 4G. Ceragon Networks is an example of an Israeli company offering millimeter-wave wireless backhaul solutions;
- Home router usage as 5G cell sites;
- Heavier reliance on advanced carrier-grade routers, Software Defined Networks, and Network Functions Virtualization to enable the coordinated connection of many more devices and delivery of new applications over the internet. Several Israeli companies are leading in these areas, including Mellanox, Radcom, and Amdocs.

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## Cellular Networks

**Ceragon Networks – 0.48%***

*Wireless backhaul solutions for mobile network operators: Advanced FibeAir IP-20 Platform handling a wide range of frequencies including microwave and millimeter waves. Suite of short haul, long haul and small cell outdoor wireless backhaul and enterprise network nodes.*

Notable customers:

- AT&T, Singapore Telecommunications, Vodafone, and Telefonica

**Gilat Satellite Networks – 0.52%**

*Satellite-based cellular backhaul coverage for 4G networks in remote areas; broadband access equipment; Satellite on the move terminals for military and commercial aircraft, boats and unmanned vehicles.*

Key historical breakthroughs:

- Patented techniques enabling mobile network operators to achieve LTE speeds over satellite connections; World's fastest airborne modem

Notable customers:

- Lockheed Martin, Boeing, Vodafone, Telefonica, Orange, General Dynamics, Boeing, L3 Technologies, China Telecom Corp., Singapore Telecommunications

**Sky and Space Global – 0.24%**

*Nanosatellites with full functionality at a mass of less than 10 kilograms. Hundreds of nanosatellites are launched into space and set into a constellation around the Earth, allowing for uninterrupted satellite-based voice and text coverage for remote areas around the equator. SSG's constellation will be the first fully autonomous network.*

*Weight in BIGITech as of April 30, 2018

### Software Defined Networks and Network Functions Virtualization

Software Defined Networks (SDN) and Network Functions Virtualization (NFV) are the technical terms for how network operators can leverage advanced transmission technologies like Ethernet and millimeter wave wireless network nodes, into "intelligent networks."

From data center all the way to end-user device, SDN and NFV enable the prioritization and optimization of the path that data takes throughout a network.

Without careful planning and coordination of data traffic throughout a network, QoS will not be able to meet our needs. The responsibility of moving data through a network falls chiefly on a couple key pieces of equipment including routers and switches. Given the surge in demand for network capacity, today's distributed computing environment (cloud), advancements in speed of data transmission technologies (Ethernet/fiber/InfiniBand, WiFi, and cellular), stricter requirements for low latency and data loss, and a growing number of sources of data (mobile), routers need to simultaneously optimize network capacity usage and minimize latency and data loss.

Traditionally, routers were manufactured and programmed so that both the control function, or network traffic path decision, and the physical data forwarding function were integrated based on a pre-determined set of protocols on each device. Such traditional network equipment is incapable of optimizing network and internet traffic because they do not have visibility throughout the entire network path to the end-user device. Therefore, traditional routing technology is unable to adjust routing protocols in response to changing network traffic patterns.

Software Defined Networks solve this problem by separating the devices responsible for the more complex control function, which decide which routes specific data packets should take through the network, from the physical data packet forwarding and receiving function. In addition, SDNs can make network path decisions based on specific QoS requirements depending on whether the QoE is based on the urgency of the need for information. For example, a first responder team to a terrorist attack's communication channels can be given priority over video streaming services, which will be given priority over less time-sensitive applications like e-mail. SDN will play an ever-increasingly important role as multiple high priority applications (i.e., autonomous driving, robotic surgery performed remotely, and the aforementioned first responders) compete for bandwidth.

While the focus of SDN is on facilitating efficient flow of traffic throughout a network, NFV seeks to automate certain network processes by running those processes via software rather than dedicated hardware. For example, in the Cybersecurity section below, which highlights Check Point, we mention the Software Blade product. Whereas in years past, networks would have a physical router "blade" with a firewall, Check Point now offers virtual firewall blades implemented through software running on commoditized hardware.

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### SDN and NFV

**Amdocs – 7.55%***

*Amdocs Network Cloud Orchestrator used by virtually all leading telecommunications and media providers for real-time data management software/SDN; digital customer experience and media/content delivery optimization; network functions virtualization.*

**6% share of global business process outsourcing market**

Key historical contributions:

- Founding platinum member of ONAP (Open Network Automation Platform) which is the de facto industry standard for NFV and SDN automation and market adoption

Notable customers and partners:

- AT&T: Selected as integrator for telecommunication companies and cloud developers who want to use AT&T's ECOMP (enhanced control, orchestration, management and policy) platform to build their own software-based network services
- Amazon, Dish, Microsoft, Vodafone, Sprint, Orange

**Radcom – 0.47%**

*Network Service Assurance solution, MaveriQ provides service quality monitoring, customer experience management, customer QoS monitoring for network service providers offering IoT platforms, 2G-5G and mobile broadband services.*

Key historical breakthroughs:

- Patented first-to-market virtual test probe technology used to test network performance in real-time

*Weight in BIGITech as of April 30, 2018

### Cybersecurity

Cybersecurity is comprised of a series of technologies and procedures used to protect networks, databases, devices, and applications from attack, damage, or unauthorized access. Security of information technology and data is a major factor in users' overall QoE. Investors should be aware that trends such as big data, cloud, mobile devices, and network virtualization are rapidly changing how information technology and telecommunications systems need to be secured.

New approaches to cybersecurity need to be taken in response to changing regulatory requirements around data protection and to be effective in the distributed computing environment driven by cloud adoption and IoT. Investors should be on the lookout for cybersecurity companies offering integrated platforms for cloud, IoT applications, and end-point security. Global spending on cybersecurity solutions[10] is expected to grow by 8% to $96 billion in 2018, with the number of organizations adopting multiple data security tools growing from 35% to 60% by 2020.

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### Cybersecurity and NFV

**Check Point Software Technologies – 6.78%***

*Cybersecurity Software "Blades" for advanced network and cloud security. Advanced endpoint and mobile security solutions with protection and remote access.*

**9% share of global security software market**

Key historical breakthroughs:

- Pioneered the global information technology security industry in early 2000s with Stateful Inspection, the foundational technology for the world's first cyber security firewall, called the FireWall-1

**CyberArk – 2.84%**

*Privileged account security systems & enterprise password vault, focused on protecting network and enterprises from hackers entering a network through critical accounts such as that of the Chief Technology Officer.*

Key historical contributions:

- Patented the Network Vault in 1999, which serves as the foundational technology in CyberArk's solutions today

**Radware – 1.37%**

*Carrier grade application delivery NFV, cyber security, and network monitoring solutions for virtual, cloud and software defined data centers.*

Key historical breakthroughs:

- Silver Member of Open Daylight with industry's first open SDN security application called Defense4All
- First to market with IP-based multimedia service delivery solution
- First OnDemand Switch, a hardware platform for application delivery control in SDN environment

Notable customers and partners:

- Cisco, Oracle, VMWare, SAP, Verizon, IBM, AT&T, NEC Corp, Nippon Telegraph, and Telefonica

*Weight in BIGITech as of April 30, 2018

## Investable Trends Built on Faster and Smarter Networks

Enhancements in the quality of network service described above will enable a new generation of disruptive applications and technologies, providing an elevated level of QoE in the following areas:

- Artificial Intelligence: *Machine Learning and Applied AI*
- Internet of Things & Machine-to-Machine Communication
- Autonomous Vehicles
- Enterprise Digitization

Artificial Intelligence (AI) is set to be as foundational to the quality of experience to the next generation of applications as 5G networks will be to quality of network service.

In fact, many applications discussed in this section such as Enterprise Digitization, Internet of Things, and Autonomous Driving either feed raw data into AI systems or are derived from AI systems. For that reason, the company examples noted on the right can only loosely follow the organization of this discussion.

### Artificial Intelligence

BlueStar thinks about AI in two distinct, but mutually dependent, buckets: Machine Learning (ML) and Reasoning Systems (Applied AI).

Machine Learning has more to do with the hardware and software that help computers sense their surroundings with a high degree of accuracy, while Applied AI has to do with the way we can use computers' ability to sense for a commercial or social purpose.

We anticipate that ML will dominate the investable trend in AI for the next few years, while Applied AI will take some time to reach mass adoption for two reasons. First, Applied AI depends upon strong and well-seasoned ML systems. Second, Applied AI, in most cases, will need to be delivered through the cloud and therefore will loosely depend on the rollout of 5G networks.

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### Machine Learning & Big Data Management

**CEVA - 1.14%***

*Offers AI processors and deep learning systems to complement its family of image and vision digital signal processors. CEVA's focus is to brings ML to embedded devices such as in autonomous vehicles and cameras.*

**Attunity – 0.46%**

*Pioneer in real-time heterogeneous big data availability. Attunity offers a suite of software solutions aimed at accelerating data delivery and big data, and automation of data readiness for analytics. Attunity supports and integrates databases across the industry's broadest array of platforms, including its change data capture product.*

Notable customers and partners:

- Amazon Web Services Advanced Technology Partner; Google Cloud Platform; Microsoft Data Platform; SAP Silver Partner; Cisco, Cloudera, Oracle

**Mellanox Technologies - 5.18%**

*Mellanox data connectivity solutions are used by leading global companies such as Facebook, Nvidia, Baidu, PayPal, JD.com, Tencent and Yahoo to improve neural network training performance.*

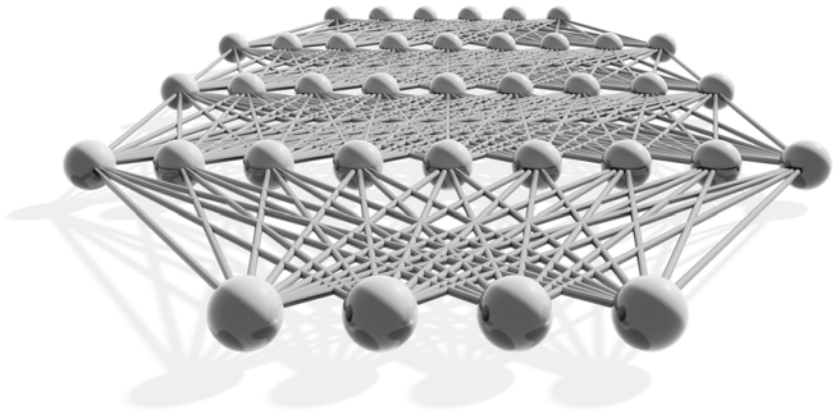
*Weight in BIGITech as of April 30, 2018

Artificial Intelligence: *Machine Learning*

Machine Learning is difficult to describe concisely. Intel has summarized ML as "… the development of computer programs that can learn and create their own rules, based on data." Machine learning is an important step toward harnessing big data generated by IoT and mobile devices for some practical use. Examples of ML include machine-based pedestrian recognition, image recognition, and speech recognition all with self-correcting capabilities. Essentially, ML is the ability for machines to sense their surroundings or patterns, identify their surroundings or patterns, and remember or learn from their process of identification to improve their accuracy over time.

Here is an example of how ML is the critical first step toward Applied AI. Taboola is a privately-held Israeli technology unicorn that powers content recommendations. For example, for someone reading a hamburger recipe on Foodnetwork.com, Taboola might suggest they next read an article on how to brew beer at home. Taboola is using an ML process by taking in big data from other articles that person has read or purchases they made to recommend the beer brewing content (the recommendation is the reasoning or Applied AI part of the process, as BlueStar defines it). If you click on the link to the article, Taboola's ML system will believe it did something correctly and learn from that experience.

At a basic level, what investors need to take away from the emerging trend in ML is that ML systems are dependent on inputting data into very sophisticated and powerful statistics-based computing processes built into or enabled by high-end memory devices, central processing units, and/or graphic processing units that can retrieve and manipulate big data in real-time or near-real time. Therefore, investors can participate in the growth in ML over time through companies that develop sensors to gather big data (such as speech recognition), through leading semiconductor and semiconductor manufacturing companies, and providers of big data management solutions such as Israel's Attunity.



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## Electronics Manufacturing / Machine Learning

**Tower Semiconductor – 3.58%***

*Specialty custom integrated circuit manufacturer including: CMOS image sensors used in digital cameras; manufacture of silicon materials for integrated circuits; flash memory; and non-volatile memory devices.*

Notable customers:

- Panasonic, Broadcom, Maxim Integrated Products, On Semiconductor, Texas Instruments, Skyworks Solutions, Intel, FLIR Systems, Marvell Technology, Samsung, Qualcom, and NXP Semiconductor

**Nova Measuring Instruments – 1.25%**

*Offers measurement and manufacturing process control solutions to manufacturers of semiconductors and integrated circuits.*

Notable customers:

- Global Foundries Inc., Samsung, SK Hynix, Micron Technology, Applied Materials, Toshiba, and Taiwan Semiconductor

**Orbotech – 3.83%**

*Offers quality control and automated inspection machinery used in manufacture of consumer electronics, semiconductor packaging, and flat panel displays and touch screens.*

Key historical contributions:

- Orbotech became the global market share leader in printed circuit board manufacturing equipment in 1881

**Camtek – 0.45%**

*Camtek develops measuring and inspection equipment for quality control in semiconductor manufacturing. Offers 3D printing solution for certain aspects of printed circuit board manufacturing.*

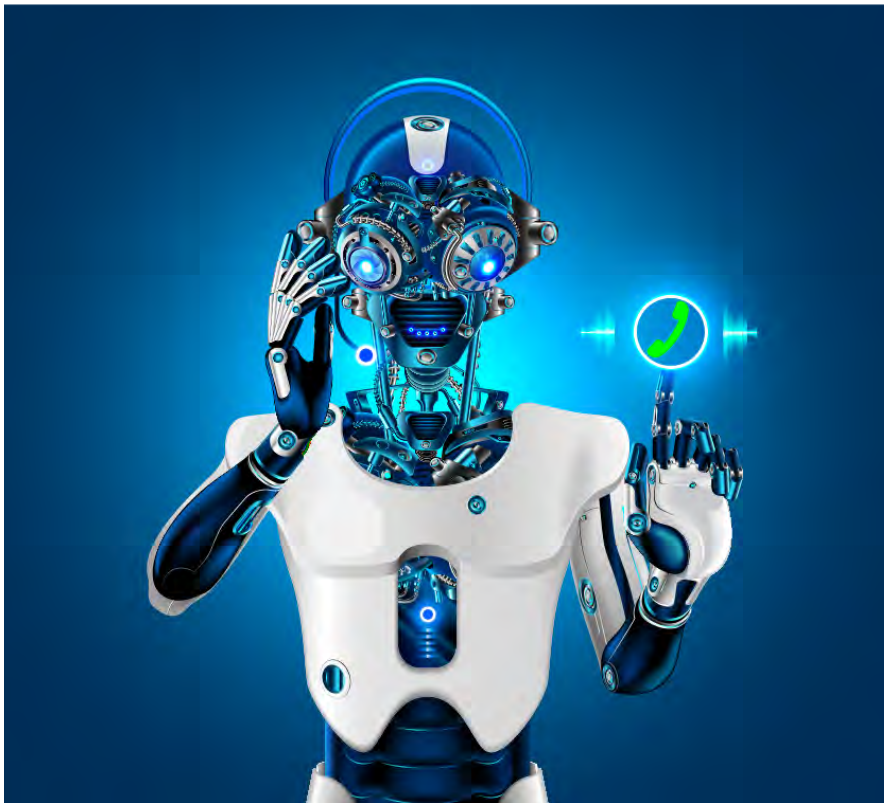
*Weight in BIGITech as of April 30, 2018

Artificial Intelligence: *Applied AI*

Applied AI relates to the ability of computers and machines to make decisions based on the output of ML. Autonomous driving is one of the best examples of how this works. In autonomous cars, the ML process will sense and synthesize big data from various sources including traffic patterns, speed of the car, speed of surrounding cars, navigation systems, and weather conditions. Applied AI will take the output of the ML process and decide whether the car should accelerate, brake, change lanes, or take a new route.

But Applied AI also extends to many other applications used today and will extend to many unknown use cases in the future. Some of the most popular implementations of Applied AI are related to automating certain cost- and labor-intensive tasks in the workplace, such as customer service; revenue-generating activities, such as suggestive selling or advertising technology; online social engagement; and public safety/national defense. Israeli companies offering AI-based services include NICE ltd., Verint, Wix.com, LivePerson, and Taptica.

Most of the world's largest companies likely will be able to develop AI-based solutions in-house. However, many less–well-resourced small and medium businesses will be able to embrace the power of AI through cloud-based third-party software and IT services.



*Weight in BIGITech as of April 30, 2018

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## Artificial Intelligence

**NICE – 7.85%***

*NICE's slogan is "Perfecting Customer Experience". NICE offers AI-based workforce optimization, customer interaction recording, back office efficiency and contact/call center solutions. NICE's Actimize product is a financial fraud monitor used by financial institutions around the world.*

**11.5% share of global communications software market**

Key historical breakthroughs:

- In 1989 NICE became the world's first company to develop software to analyze phone conversations

Notable customers:

- Avaya, Thales, Arrow Electronics, Northrop Grumman, Berkshire Hathaway, IBM, Tata Consullting, Cognizant Technologies, Orange, Airbus, Nippon Telegraph, Infosys, Rayytheon, Accenture, and Wipro

**Verint – 3.89%**

*Software and hardware products for customer engagement, security and surveillance, and business intelligence based on big data analytics and AI.*

**Taptica – 0.46%**

*AI-based mobile advertising and customer acquisition solutions offers quality control and automated inspection machinery used in manufacture of consumer electronics, semiconductor packaging, and flat panel displays and touch screens.*

Notable customers and partners:

- Disney, Amazon, Facebook, Twitter, OpenTable and Expedia

**LivePerson – 1.61%**

*Enterprise-class LiveEngage platform enables customers to utilize Artificial Intelligence for how "people communicate with brands." LivePerson develops chat bots for company websites and ecommerce situations.*

Notable customers, partners, and integrators:

- Adobe, Citibank, HSBC, IBM, L'Oreal, Orange, PNC, Home Depot, Cisco, Verizon, and Sky PLC

**Internet of Things & Machine-to-Machine Communication**

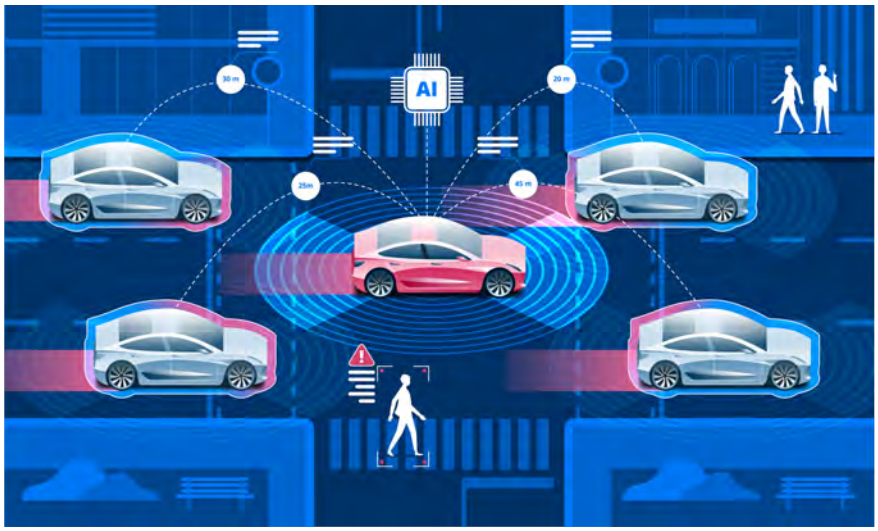
According to Cisco, IoT and machine-to-machine (M2M), or the Internet of Everything, is "the networked connection of people, process, data, and things." Internet of Things and M2M are the broadest disruptive technology themes covered in this paper, with a deep impact on not only the technology sector but also virtually every other vertical industry imaginable.

Deeply embedded devices drive IoT. The industry for production of sensors and actuators may move toward commoditization over time. However, what might distinguish one provider of sensors and actuators from another are the energy consumption for "always on," low-interference radio frequency, and low bandwidth usage. Also important to watch for are companies offering IoT platforms that integrate embedded and connected devices from multiple vendors.

*Autonomous Vehicles*

One implementation of IoT, M2M Communications, and Applied AI (as noted above), is autonomous driving and automated driver assistance systems. It is still unclear how automobile manufacturers will receive an economic benefit from autonomous driving. However, several technologies are key to the rollout of safe and reliable autonomous cars: 5G networks; vehicle-based network access devices like Cellular Vehicle to "X" (C-V2X); on-car ML and AI chips; GPS, real-time/3D spatial maps, and instant localization; and fleet management.

Israel is nothing less than a pioneer in the IoT and autonomous transportation space with AI and GPS companies like Mobileye, Ituran, Telit, Pointer, and Foresight.

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## Internet of Things & Autonomous Transportation

**Ituran – 0.93%***

*Offers vehicle tracking GPS products and services. Ituran focus on two segments: stolen vehicle recovery, and fleet management systems. Vehicle owners and insurance companies are the primary users of Ituran's stolen vehicle recovery systems. Ituran's fleet management platform allows business managers to track trucks and other company vehicle's movement in real time.*

**Telit Communications – 0.50%**

*Telit has been a pioneer in enterprise-level IoT products and services, including an IoT management platform. Products include device connectivity modules that incorporate GPS, WiFi, Bluetooth, public cellular – including automotive grade cellular, and global IoT SIM cards.*

Key historical milestones:

- In 1998, launched Datablock, the company's first machine to machine communication module,
- In 2011, acquired Motorola M2M and GlobalConnect ltd.
- Acquired NXP Semiconductor's Automotive On-board unit Platform, enabling the company to launch Telit Automotive Solutions division

**Foresight – 0.23%**

*Develops an advanced accident prevention systems utilizing 3D, multi-camera advanced driver assistance system . Foresights systems can provide real-time information about a vehicle's surroundings while in motion.*

*Foresight is also investing in R&D on V2X technology solutions for automotive communications and autonomous driving.*

**Pointer Telelocation – 0.29%**

*Pointer offers cloud-based IoT software platform for "Mobile Resource Management" including the management of logistics networks, vehicles, trailers, containers, cargo, and drivers.*

*Weight in BIGITech as of April 30, 2018

## Enterprise Digitization

A majority of small and medium-sized businesses are still using legacy IT systems, as moving from onsite data centers or use of traditional desktop computers can be an expensive and daunting task for resource-limited organizations. Enterprise digitization and the shift to cloud-based computing and virtual networks, or any migration from traditional to IP-based technologies present a massive opportunity for investors.

The biggest winners in past IT capital expenditure cycles were hardware and traditional software companies. But in future IT capital expenditure cycles, cloud-based application and service providers will be the winners. For larger organizations that have already adopted virtual cloud computing and big data, the immediate next steps in Enterprise Digitization will focus on Unified Communications, workflow optimization, and using AI for cost savings.

Robotics and manufacturing automation also fall under enterprise digitization. For example, 3D printing has been a technology used for many years by architects and engineers for modeling and conceptualizing projects. Going forward, 3D printers, such as those offered by Israel's Stratasys, promise to revolutionize the way manufacturers procure specialized components and parts on demand, forgoing the need to order parts in bulk to achieve economies of scale.

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### Enterprise Digitization

**WIX.com – 4.63%***

*Wix.com is a global leader in do-it-yourself website building platforms. Wix.com also offers artificial-intelligence-based automated website design based on just a few inputs from the user.*

**23% share of global website builders market**

Key historical milestones:

- Reached 1 million users in 2009
- Reached 110 million users in 2017

**AudioCodes – 0.45%**

*Designs, manufactures and distributes high-end VoIP and data networking products for Unified Communications systems to enterprises and network service providers. Products include IP-based phones, media gateways, call recording, voice dialing, routers and session border controllers. Services include VoIP network function virtualization, and call center network infrastructure management.*

Notable customers and products:

- Microsoft: AudioCodes has a very close relationship with Microsoft based on its AudioCodes One Voice for Microsoft 365 Unified Communications Platform. This turnkey offering helps enterprises simplify the adoption of Skype for business within on-premise as well as cloud enterprise networks

**Stratasys – 1.44%**

*Global leader in "additive manufacturing" commonly known as 3D printing. Stratasys offers products suitable to multiple end markets from individuals, to small-scale modeling for architects and engineers, to manufacturing parts on demand for large-scale OEMs in multiple industries.*

**45% share of global 3D printer market**

*Weight in BIGITech as of April 30, 2018

## Other Key Investment Themes

Roughly 70% of the investable universe of Israeli high-tech companies are involved in the information technology sector. The other 30% are involved in three non–information technology fields: defense and aerospace technology; agriculture, clean energy, and water technology; and biotechnology/medical devices.

### Defense Technology

Defense and security-related technologies benefit from many sources of demand. In general, governments' ability to spend more on defense technologies depend on sustainable overall economic growth. As we move through 2018, global economic growth is becoming entrenched, and government budgets are stabilizing.

While governments in the US and Western European countries are constantly investing in the latest technologies and equipment, spending has declined in recent years either on an absolute basis or as a percentage of GDP. But defense contractors are now enjoying growing demand from new markets such as Eastern Europe, Saudi Arabia, India, China, and South Korea.

Global defense spending[14] is estimated to grow 3.3% in 2018. Larger budgets for defense spending will be deployed in different ways around the world. Some of the greatest areas of growth are likely to be training equipment and systems (including artificial and augmented reality), armored and unmanned vehicles, missile defense systems, and space-based systems.

Another important area of defense technology is in public safety and border security. Interesting technologies in this field include biometric identification, smart fences for border security, and advanced cameras equipped with machine learning capabilities to help public safety officials and police departments identify unusual behavior in crowded places.

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### Defense Technology

**Elbit Systems – 3.91%***

*Training and simulation; aircraft and helicopter control systems; helmet-mounted systems; space-based intelligence and surveillance systems; unmanned air and watercraft; cybersecurity.*

**2.5% share of global aerospace & defense electronics**

Notable customers and integrators:

- Airbus, Raytheon, Embraer, Lockheed Martin, General Dynamics, and Boeing
- US Air Force uses Elbit Systems' Joint Strike Fighter – F35 Helmet Mounted Display
- Israel Defense Forces make up roughly 20% of Elbit Systems' revenue

**Aeronautics – 0.36%**

*Unmanned aircraft and aerial surveillance systems for national security and defense including the Orbiter line of drones and the SKYSTAR surveillance balloon. Core technologies include: navigation systems, autonomous flight controls, automatic take off and landing systems, and real-time integrated ground control systems.*

**Magal Security Systems – 0.34%**

*Critical site security and safety solutions including: airports, borders, correctional facilities, energy infrastructure, and seaports. Core technologies include: Vibration sensors, indicative "smart" fences, perimeter intrusion detection, and unmanned surveillance systems.*

*Weight in BIGITech as of April 30, 2018

## AGRICULTURE, WATER, AND CLEAN ENERGY TECHNOLOGY

### ORMAT – 3.20%*

*Designs, builds and supply power-generating equipment for geothermal and recovered energy power plants in 30 countries.*

**12% share of global geothermal energy generation market**
**50% share of global geothermal energy equipment market**

Key historical contributions and milestones:

- Pioneer in turbine designs for generating electricity from low thermodynamic energy sources in 1965
- First geothermal power plant developed by Ormat in Nevada in 1980s.

### FLUENCE – 0.28%

Key products offered include:

- NIROBOX containerized and portable water treatment systems;
- MABR membrane aerated biofilm reactor provides energy efficient form of aerobic wastewater treatment;
- Decentralized wastewater treatment for schools;
- Small rural communities, malls, resports, industrial plants, and construction sites;
- SmartAerator system adds intelligence to water treatment.

### SOLAREDGE – 2.59%

*Intelligent inverter solution that maximizes the power generated from solar modules and lowers the cost of producing solar energy.*

*SolarEdge recently announced its entry into the Uninterruptable Power Supply Industry with the acquisition of Gamatronic Electronic Industries. Gamatronic specializes in electrical devices that provide emergency power to appliances when the main power source fails.*

### ARAD LTD. – 0.29%

*4G advanced and connected water metering technology. Smart meters can help maximize municipality water revenue, identify leaks quickly, and optimize the use of water over very large spaces like farms and cities by using WiFi and cellular network connections for communication between meters and management.*

## BIOTECHNOLOGY AND MEDICAL DEVICES

### MAZOR ROBOTICS – 1.92%

*Renaissance Guidance System and Mazor X for robotic guided spinal surgery distributed by Medtronic.*

### NOVOCURE – 2.90%

*Optune Tumor Treating Fields delivery system for glioblastoma launched in 2011. Tumor Treating Fields is a technology that uses electric fields to disrupt cell division, inhibiting tumor growth and destruction of cancer cells.*

### COMPUGEN – 0.48%

*Predictive discovery drug technology with a focus on immune-oncology and autoimmune diseases. Compugen also offers a web-based gene discovery tool for pharmaceutical, biotechnology and other life science companies and researchers.*

*Weight in BIGITech as of April 30, 2018

## The Macro View of Israeli Tech

After exploring key technology trends Israeli companies are leading, it is useful to take a step back and view what the Israel high-tech sector looks like on the whole. For this purpose, we base our discussion around the BlueStar Israel Global Technology Index (BIGITech), the leading benchmark of Israeli high-tech equities. This section reflects data as of March 31, 2018, unless otherwise noted.

The sidebars in the previous section highlighted just some of the 76 Israeli high-tech companies that are large and liquid enough for inclusion in BIGITech (float-adjusted market capitalization of at least $60 million USD). Those 70-plus companies' stocks are listed on exchanges around the world including the Tel Aviv, New York, Nasdaq, London, Singapore, Hong Kong and Australia.

### EXHIBIT 8: **BIGITECH STATS AND TOP 15 CONSTITUENTS**

| INDEX STATS | |
|---|---|
| No. of Securities | 76 |
| Currency | USD |
| Total Index Market Cap | $90 billion |
| Largest Market Cap | $16 billion |
| Smallest Market Cap | $60 million |
| Weighted Average Market Cap | $1.3 billion |
| **LISTING VENUE (%)** | |
| Weight on NYSE/Nasdaq only | 54 |
| Weight on TASE only | 4 |
| Weight on LN/SGX/ASX only | 7 |
| Dual-listed | 35 |
| **MARKET CAP SEGMENTATION (%)** | |
| > $5 Billion | 26 |
| $750 Million to $5 Billion | 51 |
| < $750 Million | 23 |

| COMPANY NAME | GICS SUB INDUSTRY | WEIGHT | 2017 TOTAL RETURN | 2018 YTD RETURN |
|---|---|---|---|---|
| NICE LTD | Application Software | 7.85% | 19.76% | 8.55% |
| AMDOCS LTD | IT Consulting & Other Services | 7.55% | 12.42% | 2.59% |
| CHECK POINT SOFTWARE TECH | Systems Software | 6.78% | 21.90% | -6.92% |
| MELLANOX TECHNOLOGIES LTD | Semiconductors | 5.18% | 58.09% | 21.86% |
| WIX.COM LTD | Internet Software & Services | 4.63% | 31.96% | 39.29% |
| ELBIT SYSTEMS LTD | Aerospace & Defense | 3.91% | 19.23% | -10.43% |
| VERINT SYSTEMS INC | Application Software | 3.89% | 18.53% | 0.48% |
| ORBOTECH LTD | Electronic Equipment & Instruments | 3.83% | 49.75% | 16.14% |
| TOWER SEMICONDUCTOR LTD | Semiconductors | 3.58% | 62.21% | -20.78% |
| ORMAT TECHNOLOGIES INC | Renewable Electricity | 3.20% | 8.10% | -5.92% |
| NOVOCURE LTD | Health Care Equipment | 2.90% | 167.97% | 33.17% |
| CYBERARK SOFTWARE LTD/ISRAEL | Systems Software | 2.84% | -8.12% | 31.67% |
| SOLAREDGE TECHNOLOGIES INC | Semiconductor Equipment | 2.59% | 209.80% | 38.74% |
| PLUS500 LTD | Specialized Finance | 2.34% | 133.79% | 58.49% |
| VARONIS SYSTEMS INC | Systems Software | 2.27% | 82.23% | 35.58% |

Source: BlueStar Indexes, Bloomberg LP
For Illustrative Purposes Only.

Exhibit 9 breaks down the weight of BIGITech's broad investment themes:

### EXHIBIT 9: **THEMATIC REPRESENTATION WITHIN BIGITECH**

| | |
|---|---|
| **Enterprise Digitization, Big Data and Applied AI** | 25.41% |
| **Cybersecurity** | 15.76% |
| **Biotech and Medical Devices** | 13.33% |
| **Electronics and Semiconductor Manufacturing** | 8.99% |
| **Data Center Hardware & Communications Equipment** | 7.45% |
| **Clean Energy and Water Tech** | 7.17% |
| **Internet Software & Advertising Tech** | 5.91% |
| **Defense Tech** | 4.81% |
| **Financial and Gaming Tech** | 4.55% |
| **IoT, VoIP & Autonomous Driving** | 3.41% |
| **3D Printing & Consumer/Business Electronics** | 3.21% |

Source: BlueStar Indexes
For Illustrative Purposes Only.

In addition to BIGITech, BlueStar maintains a broader family of Israel equity benchmarks, including our flagship BlueStar Israel Global Index (BIGI), which captures all sectors of Israel's equity market. Since BIGI's construction includes Israeli companies traded outside of Tel Aviv – a majority of which are high-tech – the comparison between BIGI and the TA-125, which includes only those companies listed locally, makes a powerful point.

## EXHIBIT 10: **ISRAEL EQUITY BENCHMARK COMPARISON**

| | BLUESTAR ISRAEL GLOBAL INDEX | TA-125 INDEX* |
|---|---|---|
| **Total Index Market Cap** | $220 B USD | $176 B USD |
| **Average Market Cap** | $1.8 B USD | $1.3 B USD |
| **Average Market Cap (Top 20)** | $6.4 B USD | $5.4 B USD |
| **Average Market Cap (Sub Top 20)** | $880 mm USD | $660 mm USD |
| **Weight of Constituents with TASE listing** | 68% | 100% |

*Excluding non-Israeli copmanies (Mylan)

Source: BlueStar Indexes, TASE
For Illustrative Purposes Only.

Up to this point the *BluePaper* has focused on the importance of Israel's technology sector to its GDP and export growth. Exhibit 11, demonstrates how impactful the technology sector has been for Israel's equity markets.

## EXHIBIT 11: **ISRAEL TECH SECTOR IMPACT ON EQUITY MARKET PERFORMANCE (INDEXED TO 100)**


Source: BlueStar Indexes, Bloomberg LP
For Illustrative Purposes Only.

## Israel within Global Benchmarks

The prominent role Israeli companies play in the global innovation cycle does not comport with its representation in the most widely-used global equity benchmark indexes. Prior to 2010, Israel held ~4% weight in Emerging Market indexes. Since graduating to Developed Markets in 2010, Israel represents less than 0.50% of the MSCI EAFE Index.

### EXHIBIT 12: **ISRAEL EXPOSURE WITHIN MSCI EAFE INDEX**

| MSCI EAFE INDEX | TOTAL MARKET CAP | $15 TRILLION |
|---|---|---|
| COUNTRY | NUMBER OF SECURITIES | WEIGHT (%) |
| Japan | 321 | 24.16 |
| United Kingdom | 93 | 15.23 |
| France | 75 | 10.53 |
| Germany | 63 | 9.56 |
| Switzerland | 41 | 8.17 |
| Australia | 67 | 6.75 |
| Netherlands | 22 | 4.79 |
| Hong Kong | 44 | 3.44 |
| Spain | 22 | 3.13 |
| Sweden | 32 | 2.55 |
| Italy | 20 | 2.12 |
| Denmark | 17 | 1.70 |
| Singapore | 25 | 1.32 |
| Finland | 12 | 1.03 |
| Belgium | 10 | 1.01 |
| Norway | 9 | 0.68 |
| Ireland | 10 | 0.62 |
| **Israel** | **11** | **0.47** |
| Luxembourg | 6 | 0.34 |
| Austria | 5 | 0.25 |
| New Zealand | 7 | 0.16 |
| Other | 14 | 0.55 |

| ISRAELI TECH STOCKS AND WEIGHTS (%) IN MSCI EAFE | |
|---|---|
| CHECK POINT SOFTWARE TECH | 0.08 |
| ELBIT SYSTEMS LTD | 0.02 |
| NICE LTD | 0.04 |
| **Total** | **0.14** |

| | |
|---|---|
| **Market Cap of MSCI EAFE Info. Tech Sector** | $990 Billion |
| **BIGITech Market Cap** | $ 90 Billion |
| **Israeli Tech as % of EAFE Info. Tech Market Cap** | 9.9% |

Source: BlueStar Indexes, Bloomberg LP
For Illustrative Purposes Only.

***Using BlueStar's globally-inclusive approach to benchmarking Israeli equities, Israel's technology sector would comprise 10% of MSCI EAFE's technology sector.***

Despite the recent explosion in the number of ETFs available to investors, Israel technology is stilll underrepresented. There are a handful of Emerging Market Technology ETFs, but as noted previously, Israel is no longer an Emerging Market economy.

One might think then that Israeli stocks would be found within broad International benchmarks. But this is also not the case. Focusing on the S&P Global 1200 Information Technology Index in Exhibit 13, you can see that Israel is absent yet again. Why? The S&P Global 1200 index family does not include Israel in its methodology, therefore Israeli technology stocks are not in the index. Further, although there are many Israeli companies listed on the NASDAQ, only one (Check Point) is large enough for inclusion in the Nasdaq-100.

EXHIBIT 13: **S&P GLOBAL 1200 TECHNOLOGY INDEX COUNTRY EXPOSURE**

| S&P GLOBAL 1200 TECHNOLOGY INDEX | | |
|---|---|---|
| **COUNTRY** | **NUMBER OF SECURITIES** | **WEIGHT (%)** |
| United States | 68 | 75.73 |
| Japan | 18 | 4.86 |
| South Korea | 4 | 4.13 |
| China | 1 | 3.76 |
| Taiwan | 4 | 2.79 |
| Germany | 4 | 2.25 |
| Ireland | 1 | 1.25 |
| Netherlands | 2 | 1.21 |
| France | 3 | 0.68 |
| Switzerland | 2 | 0.65 |
| Canada | 4 | 0.58 |
| Sweden | 2 | 0.49 |
| Finland | 1 | 0.46 |
| Spain | 1 | 0.45 |
| United Kingdom | 2 | 0.23 |
| Australia | 1 | 0.09 |
| Austria | 1 | 0.07 |
| Brazil | 1 | 0.07 |
| **Israel** | **0** | **0.00** |

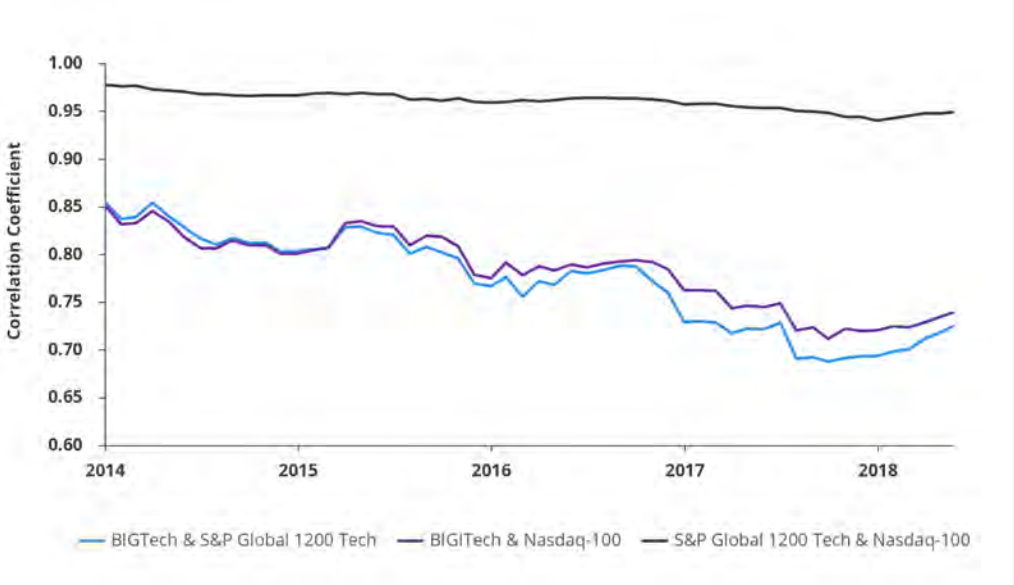
Source: BlueStar Indexes, Bloomberg LP
For Illustrative Purposes Only.

The tables on the previous pages, together with Exhibits 14 and 15, below, may help investors and portfolio managers establish a framework for including Israeli technology stocks in a globally diversified portfolio. Investors can start by assessing their global technology sector allocation or their international developed market equity allocation. In either scenario, Israeli technology stocks could serve as a performance enhancer or tool for diversification while maintaining a given level of exposure to the technology sector.

## EXHIBIT 14: **ISRAELI VS GLOBAL AND EAFE TECH INDEX PERFORMANCE (INDEXED TO 100)**


Source: BlueStar Indexes, Bloomberg LP
For Illustrative Purposes Only.

## EXHIBIT 15: **BIGITECH OFFERS MEANINGFUL DIVERSIFICATION**



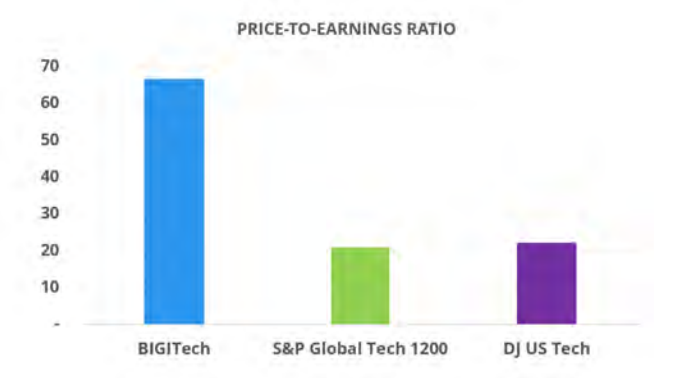

Source: BlueStar Indexes, Bloomberg LP
For Illustrative Purposes Only.

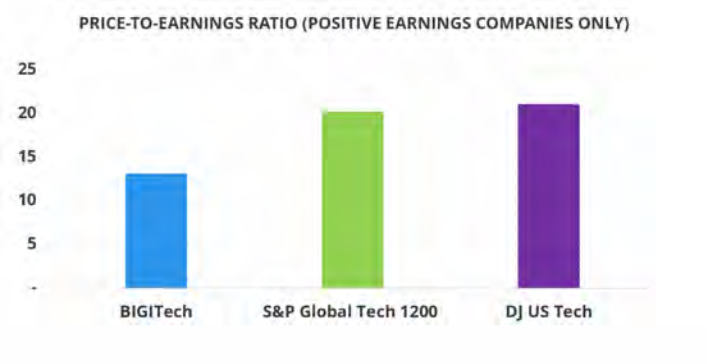
## BIGITech Valuation

Israel's technology sector has sported a relatively high Price-to-Earnings (P:E) ratio. However, the validity of the P:E ratio is diminished due to the ~12% weight in biotechnology and life science stocks, most of which have negative earnings. When looking only at companies with positive earnings, BIGITech's P:E ratio falls from nearly 70 to less than 15. This represents a better valuation than its global peers while providing similar earnings growth.

Perhaps a better measure of valuation is Price-to-Sales ratio, a metric often considered by acquirers of technology companies. On a Price-to-Sales basis, Israeli technology stocks are still less expensive than global peers:

EXHIBIT 16: **BIGITECH RELATIVE VALUATION METRICS**






Source: Bloomberg LP
For Illustrative Purposes Only.

## Conclusion: The Israeli Tech Imperative

As you have seen in this *BluePaper*, to fully appreciate the essential role that Israeli technology firms play in the modern, dynamic technology ecosystem, one must dig beneath the surface. Although ice hockey is not popular in Israel, Israeli firms certainly "skate to where the puck is going" and have demonstrated over the past two decades that they are leaders in cutting-edge innovation and its commercialization.

Israel's technology ecosystem was not built overnight, rather through a series of specific, purposeful government policies, a world-class academic research infrastructure, further enhanced by the challenges of Israel's geopolitical realities since the formation of the State 70 years ago.

***The Israeli innovation model has undeniably delivered astounding results and is inextricably linked to providing the Quality of Service and the Quality of Experience that enables the evolution and adoption of technology.***

The R&D Laws codified in 1984 were critical to laying the foundation for the Israeli technology sector, which has benefited from foreign investments into R&D and human capital by predominantly North American and European companies. And today the Israeli government is doubling down on this strategy through new bilateral ties into Africa, Asia, and Latin America and through additional capital market support of Israeli start-ups to help them realize their potential.

As we've demonstrated, the current global innovation cycle is being pushed forward by cloud computing, big data, and mobile. It is within these important technology developments that **Israel is firmly implanted at the crossroads of innovation**.

Just like Check Point pioneered the Cyber Security industry, and DSP Group the voice processing revolution, Israeli companies are leading the disruptive technologies of tomorrow that these network infrastructure developments enable, including Autonomous Vehicles, Artificial Intelligence & Machine Learning, Enterprise Digitization, and the Internet of Things—just to name a few.

With such an enviable foundation in place—massive R&D and human capital, supportive government policies, and integrated global partnerships—the imperative to invest in Israeli technology companies will only strengthen.

And yet Israel—and Israeli companies—remain mostly undiscovered.

Why? Partly because of Israel's market weight in global index frameworks (less than 0.5% of the popular Developed Market and 'All-Country' benchmarks from MSCI and FTSE) and their absence from the leading US and global tech sector indexes and ETFs.

This results in Israeli technology companies "falling through the cracks" of most portfolios. The BlueStar Israel Global Technology Index—BIGITech—was built to help investors fill this gap. And through the US-listed ITEQ ETF and Israeli-registered index funds. investors can now capture all investible Israeli tech companies in a single trade.

The 'discovery' of Israel and Israeli tech stocks is inevitable. Investors exploring how to participate in the future of the technology cycle would certainly want to capture US companies centered in Silicon Valley; perhaps those within Asian leaders like Taiwan, Korea, and China; and most certainly Israel.

The future trajectory of innovation is unknown, but one thing is certain... the recognition of Israel within smart technology portfolios is already underway.

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## Disclosures

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The BlueStar Israel Global Index® (BIGI® or BLS & BLSTR INDEX on Bloomberg) is the broadest and deepest benchmark for Israeli equities trading worldwide in Tel Aviv, New York, London, Singapore and Australia. The VanEck Vectors Israel ETF (ticker ISRA) tracks BIGI® and is listed on the NYSE. In addition, Israel-domiciled investment vehicles tracking BIGI® are offered by Psagot and IBI.

The BlueStar Israel Global Technology Index™ (BIGITech® or BGTH & BGTHTR INDEX on Bloomberg) is the broadest and deepest benchmark tracking the performance of Israeli companies operating in innovative sectors like information technology, defense technology, clean technology, and bio-technology. The BlueStar Israel Technology ETF (NYSE ticker: ITEQ®) tracks BIGITech®. In addition, there are two Israel-domiciled investment vehicles tracking BIGITech® managed by KSM/Excellence.

BlueStar also maintains five additional Israel Equity Indexes (BIGI®-TIM, IGEI, IDEI, BIGI®-SD and BIGI®-SV), one Israel Government Bond Index (BIGUSD), and three global thematic equity indexes.

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- Solactive – BlueStar Israel Domestic Exposure Index (IDEITR INDEX)
- Solactive – BlueStar Israel Global Exposure Index (IGEITR INDEX)

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- BlueStar Robotics Index (BRBTNTR INDEX)
- BlueStar IoT Index (BIOTUNTR INDEX)
- BlueStar Autonomous Driving Indexes (BAUTNTR INDEX & BZCARTR INDEX)
- BlueStar Blockchain Technology Index (BBLKNTR INDEX)
- BlueStar Quantum Computing and Machine Learning Index (BQTUMTR INDEX)
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- BlueStar Global Israel Exposure Universe

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