2019

Israeli Innovation in Automotive Cyber Security

Introduction

With the increase of autonomous vehicles and connected cars around the corner, one of the biggest challenges that the automotive industry would face is Vehicle Cyber Attacks. These vehicles are as vulnerable as any other internet-connected computer, smartphone, or anything else. The various parts of the vehicle are connected by means of an internal network and if an expert hijacks it over the Internet, he will be able to have complete control of the safety mechanism, including engine and brakes. The implication of these incidents can be dangerous and life threatening.

The proliferation of connected vehicles and related security incidents has catalysed the growth of companies innovating and providing automotive cyber security. The increasing integration of advanced features and rising adoption of telematics services in automobiles are also strongly boosting the growth of the global automotive cyber security market. According to a research by MarketsandMarkets™, the automotive cyber security market is projected to grow at a CAGR of 23.16% during the forecast period from 2018 to 2025, to reach USD 5.77 billion by 2025 from an estimated USD 1.34 billion in 2018 [1].

Israel, known as the hub of technology innovation and entrepreneurship, is playing a significant role in technological development of secure ecosystem for vehicular network. A large number of companies have come up in recent years which are preparing vehicles to deal with such attacks. Many of the Israeli start-ups in the field have been acquired by giant companies to boost their technology and product portfolio. Moreover, the global car companies have set up their R&D centres in Israel to make their cars equipped with safety features.

These automotive cyber security companies are increasingly protecting their innovative technologies through patent filing in worldwide patent jurisdictions. The report shows some key statistics of patent filing activity of Israeli automotive cyber security industry.

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The list below includes the top companies in Automotive Cyber Security field based in Israel.

Table I: Top Israeli Companies in Automotive Cyber Security Industry[1]

1	Argus Cyber Security
2	TowerSec Automotive Cyber Security
3	Karamba Security
4	Sital Technology
5	ERM Electronic Systems
6	Arilou Information Security Technologies
7	Guardknox Cyber Technologies
8	Aurora Labs
9	Traffilog
10	Red Bend Software
11	Coronet Cyber Security
12	Autotalks
13	C2A Security
14	Check Point Software Technologies
15	Enigmatos
16	Upstream Security
17	Nanolock Security
18	Securepush
19	iOnRoad Technologies
20	Protectivx

Table 1 include the list of companies based in Israel[2] and filed patents in Automotive Cyber Security domain. Recognizing their technology and business capabilities, many of these companies have been acquired by global giants. Argus Cyber Security was purchased by Continental AG in 2017, for $430 million. It was considered as one of the most profitable exit for investors in the Israeli auto-tech sector, with investors receiving about 12.6 times their investment [2]. ERM Electronic Systems operates as a subsidiary of Ituran Location and Control Ltd. NNG LLC, a Hungary based company of automotive navigation and infotainment software acquired Arilou Information Security Technologies in 2016 considering the high-end cyber-security solutions developed by Arilou [3].   HARMAN International Industries, a subsidiary of Samsung, was deeply impressed with Israeli development in cyber security acquiring TowerSec Automotive Cyber Security, Red Bend Software and iOnRoad Technologies.   Start-ups like C2A Security [4], Guardknox [5] and Enigmatos [6] are gaining worldwide attention for their breakthrough technologies.

With industry growth metrics of Israeli cyber security up across the board, funding from venture capitalists and angel investors have also been highly encouraging. In 2018, the total amount

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[1] The companies having patents in Automotive Cyber Security field are considered for analysis.
[2] TowerSec Automotive Cyber Security, Karamba Security and Red Bend Software are headquartered out of Israel.

of funding for Israeli cybersecurity companies across all stages grew 22 percent year-over-year to $1.03B. This closely matched the funding trends of 2016 and 2017 that each saw 23 percent year-over-year growth in funding amount [7]. Some notable funding includes Argus Cyber Security raised $26M in Series B funding in 2015 [8], Guardknox raising $24 million in Series A round of funding [9], C2A Security received $6.5 million Series A funds to bring its best-in-class in-Vehicle Cyber security Solutions to automotive customers [10].

CarsDome, Cycuro, Regulus, SafeMode and SafeRide Technologies are few other notable Israeli companies providing solutions in Automotive Cyber Security.
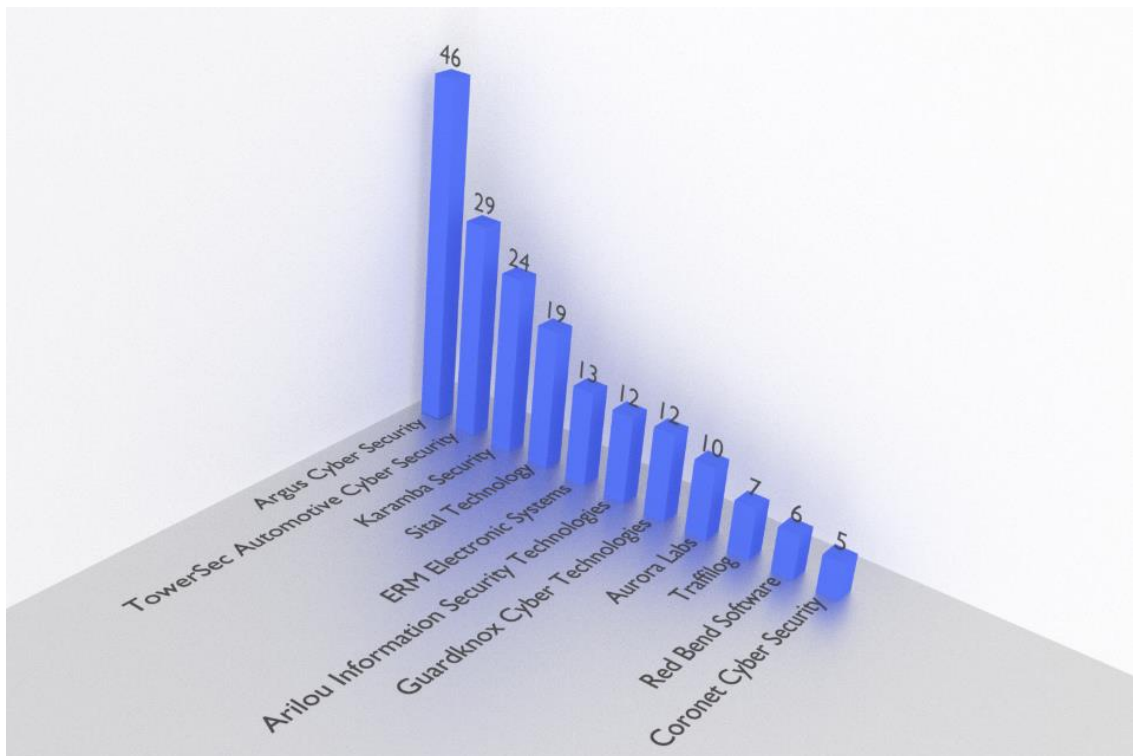

Fig. 1. Filing Activity of Israeli Companies

Figure 1 illustrates the patent application filing activity of top Israeli companies in the domain of automotive cyber security.   Argus Cyber Security clearly leads the patenting activity with significant contribution from TowerSec, Karamba Security and others.
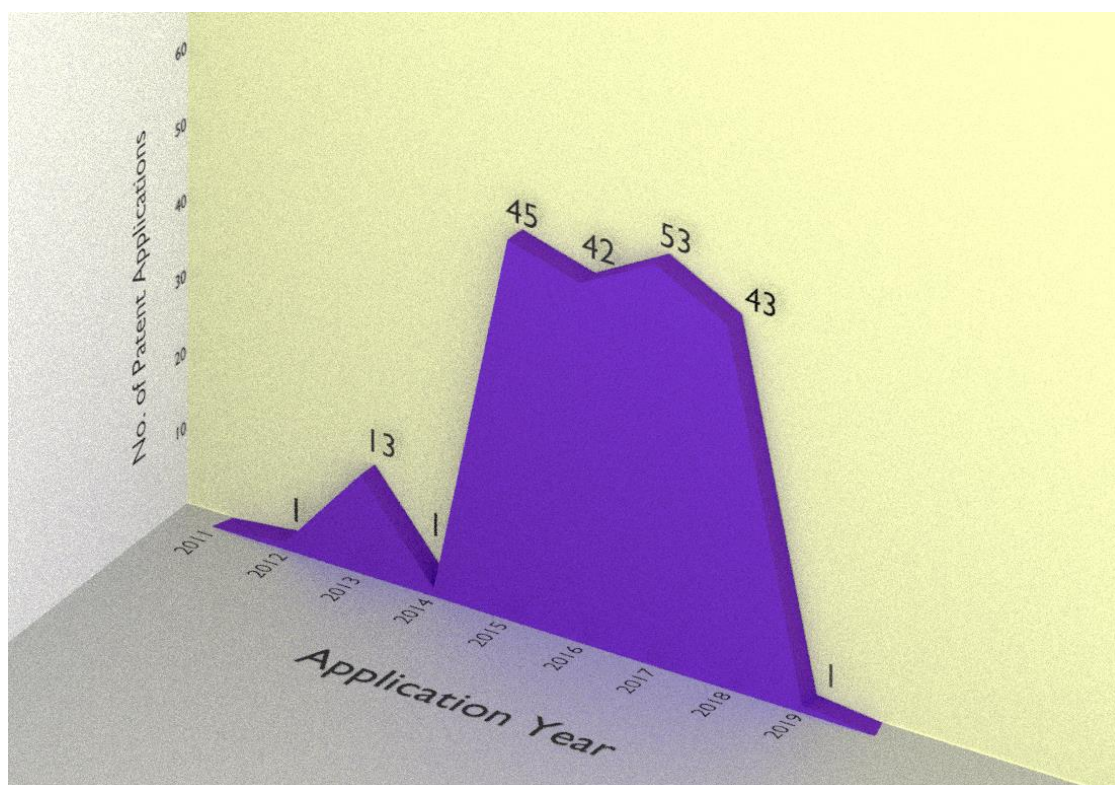
II.   Patent Filing Trends

Fig. 2. Year-Wise Patent Filing Trend of Israeli Companies

Fig. 2 shows the year-wise patent filing trend[3] of companies in Automotive Cyber Security. The filing started in year 2011 by ERM Electronic Systems with low filings till 2014. The high numbers in 2013 credits to Arilou and TowerSec which filed their initial patents in wide jurisdictions. However, the growth in connected cars (which registered revenue of US$41,289.6 million in 2015 and was expected to expand with a CAGR of 34.7% over the forecast period from 2013 to 2019) [11] and growing need for secure automotive systems, catalysed the innovation and patent filing in the year 2015. The low filings in year 2018 and 2019 are due to unpublished applications. The trend is expected to increase in these years with publication of all pending patent applications. Further, the expanding global market of Israeli cyber security solutions will necessitate the protection of technology innovations by means of patent filing.

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[3] The patents published till June 10, 2019 are considered for analysis.

2015
Technology boomed with participation from Argus, Sital Technology, Check Point, Coronet and ERM

2014
ERM Electronic Systems filed 1 patent application

2013
Arilou and TowerSec filed applications in multiple jurisdictions

2011
Patent application filed in Israel by ERM Electronic Systems

2016
Technology advancement continued with new companies like Karamba, Traffilog, Autotalks

2017
Startups like Guardnox, C2A Security and Securepush also contributed to increased filing trend

2018
Enigmatos, Upstream Security and Aurora Labs joined the bandwagon

Future Scenario (2019 and …)
The field of Automotive Cyber Security seems to be attractive to the current players as well as technology startups. Increasing patent filing trend is expected to continue.
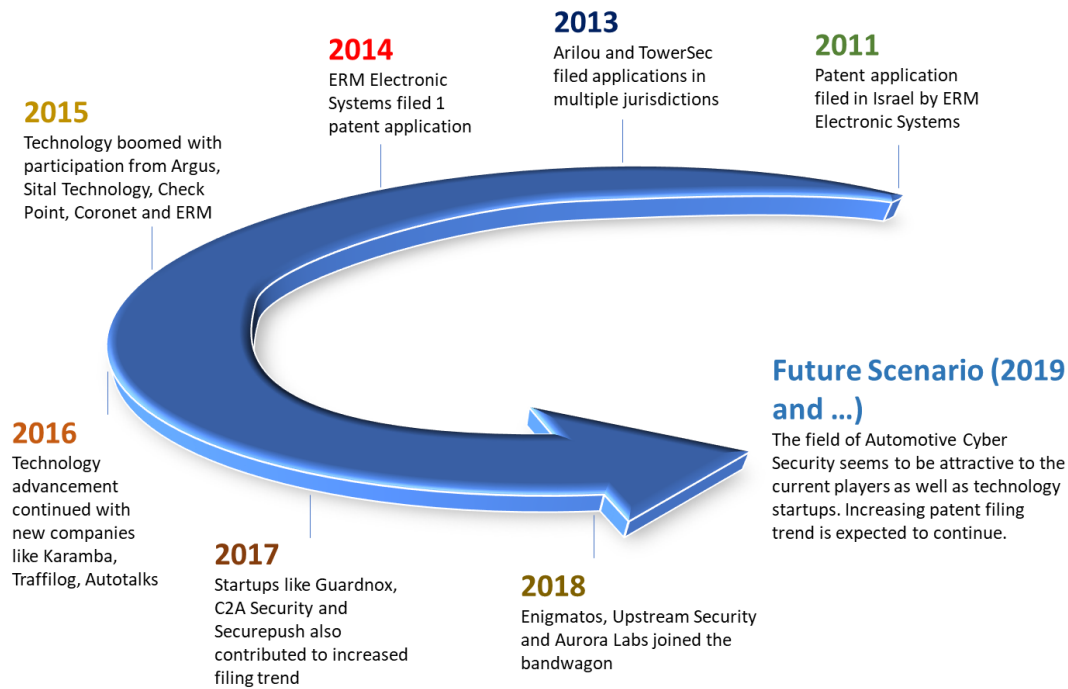
Fig. 3. Key Milestones in Technology Development

Fig. 3 illustrates key milestones of technology development in Israel. The earliest patent in the domain was filed by ERM Electronic Systems in the year 2011. The trend picked up in 2013 when TowerSec Automotive Cyber Security and Arilou Information Security Technologies started patenting their innovations. TowerSec Automotive Cyber Security (founded in 2012) and Arilou Information Security Technologies (founded in 2011) are amongst the earliest Israeli companies' active in cyber security of vehicles. Although companies like Check Point Software Technologies, Red Bend Software, Sital Technology, etc. were founded earlier and contributing to cyber security space, however, they seem to have inclined their interest into automotive sector a little later. The filing activity actually gained momentum from year 2015 when many companies like Argus Cyber Security, Sital Technology, Red Bend Software, Check Point Software Technologies, etc. came into picture. The growth continued for the successive years with more companies like Karamba Security, Traffilog, Guardknox, Upstream Security, Enigmatos, etc. contributing innovation in the field. Foreseeing the current trend, it is expected that Israeli companies will continue to develop secure automotive systems for the world with more start-ups joining the bandwagon.
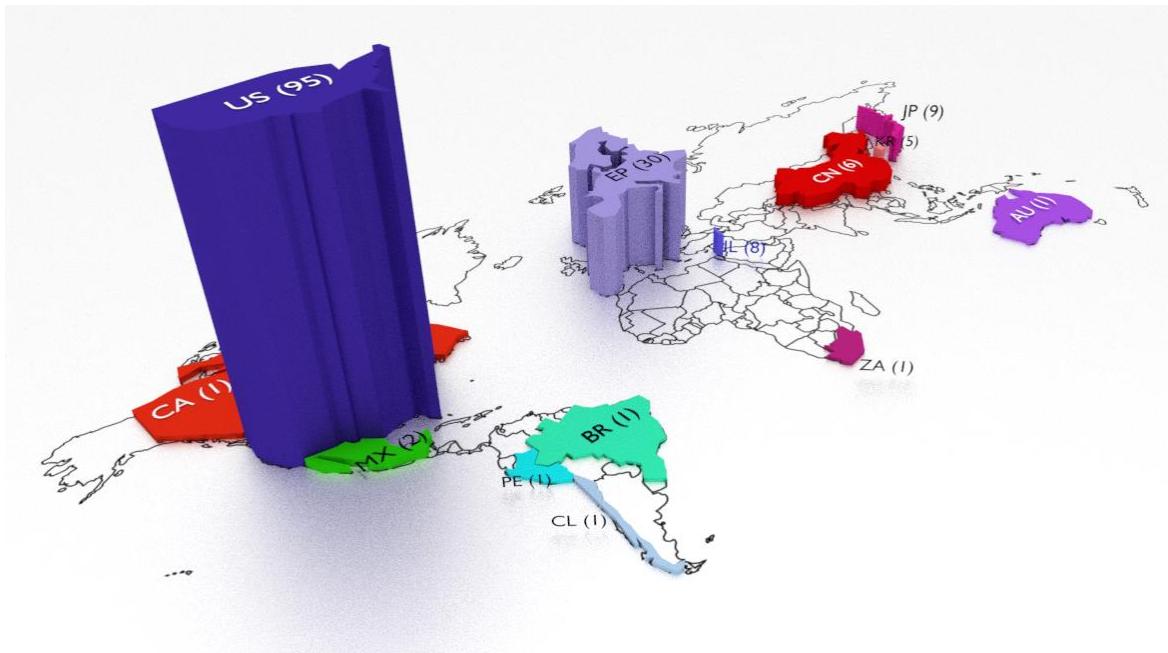
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Fig. 4. Jurisdiction-wise Patent Filing Trend

Fig. 4 shows the patent filing trend of companies in various jurisdictions of the world. United States has been the most favourable country for Israeli innovation in the domain. This can be attributed to large market available for their automotive inventions. Arilou is working with STMicroelectronics on the integration of Arilou's Intrusion Detection and Prevention system (IDPS) Software solution into STM's automotive microcontroller [12]. HARMAN International Industries, an American subsidiary of Samsung, acquired TowerSec Automotive Cyber Security, Red Bend Software and iOnRoad Technologies.

The companies of European countries have also shown significant interest in automotive security companies of Israel for innovating their car's network systems. Argus Cyber Security was purchased by Continental AG, a German automotive manufacturing company. Arilou Information Security Technologies was acquired by a Hungary based company, NNG LLC. Faurecia, a French global automotive supplier, invested in GuardKnox to reinforce the cybersecurity of the connected car [5]. This clearly reason out Europe also being a preferred destination for patent filing by Israeli companies.

Moreover, almost all the global car manufacturing companies including Ford, General Motors, Daimler, Skoda, Renault, Nissan, etc. have set up their research centres in Israel to take advantage of the country's vibrant technology in the fields of connectivity, sensors, automated-systems research, in-vehicle monitoring and cyber security.
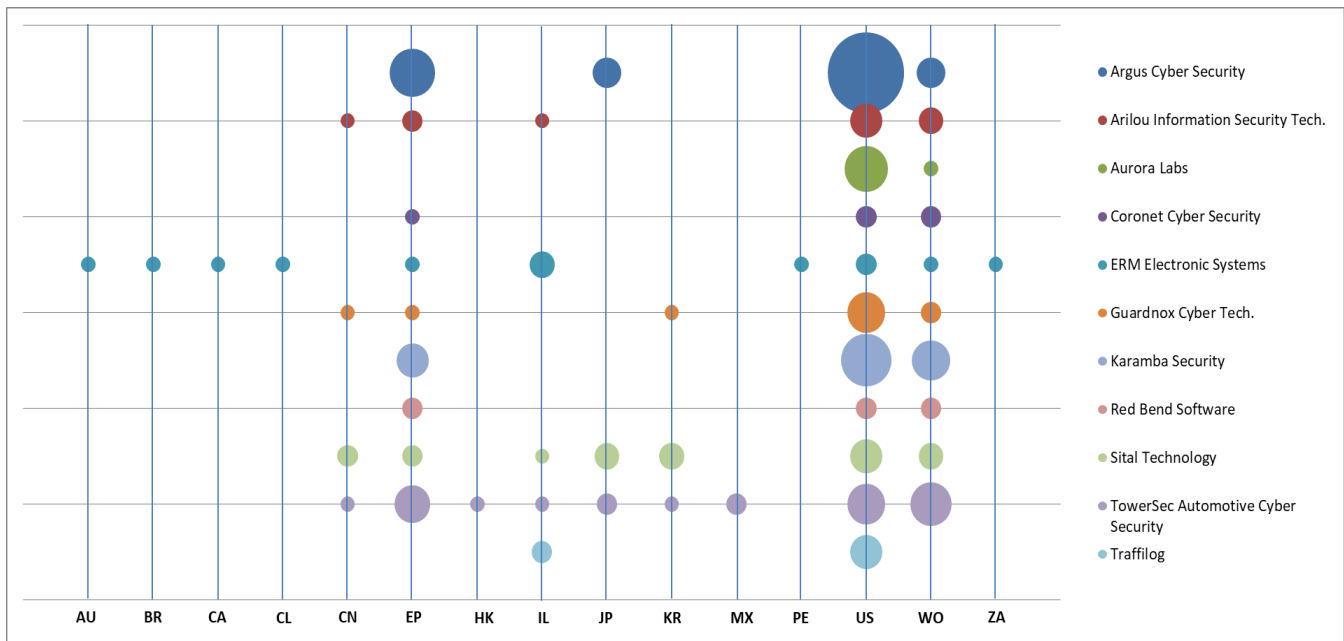
Fig. 5. Geographical Distribution of Patent Filing Activity

Fig. 5 shows the geographical distribution of patent filing of the top Israeli companies in automotive cyber security field. Every company has filed patents in US and WIPO (except Traffilog). European patents have also been filed by most of the companies listed above. ERM Electronic Systems, which is amongst the oldest and first company to file patents in the domain, has the most varied geographical distribution of its patents. It has filed patents in about 10 different jurisdictions of the world to protect its inventions and serve global clients. It has established partnerships with service providers and OEMs from all around the world and implemented its technologies and products in millions of vehicles in over 65 countries in North, Central and South America, Europe, Asia, Africa and Australia.

TowerSec Automotive Cyber Security also has wide geographical coverage of its patent portfolio including 9 different parts of the world. Surprisingly, inspite of being based in Israel, not every company has filed patents in the country. Only 5 companies (Arilou Information Security Technologies, ERM Electronic Systems, Sital Technology, TowerSec Automotive Cyber Security and Traffilog) out of the 11 listed above have patents in Israel. This might be attributed to limited market in Israel for their own technology. This analysis is supported with the fact that Israel does not have a major car manufacturer company which let these companies to focus on automotive manufacturers of other countries.

China, Japan and Korea are also preferred destinations for patent filing owing to the fact that these countries are hub of car manufacturing companies like Toyota, Honda, Nissan, Suzuki, Mitsubishi, Hyundai, Daewoo, SAIC Motor, Dongfeng Motor, etc. Asgent Inc., a

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Japan based leading developer and distributor of network security solutions for enterprises and medium sized organizations, has partnered with many of these Israeli companies like Upstream Security [13], Karamba Security [14], Coronet Cyber Security [15] for selling their products in Japanese market. This obviates the need for protecting their innovations in these markets through IP Rights.

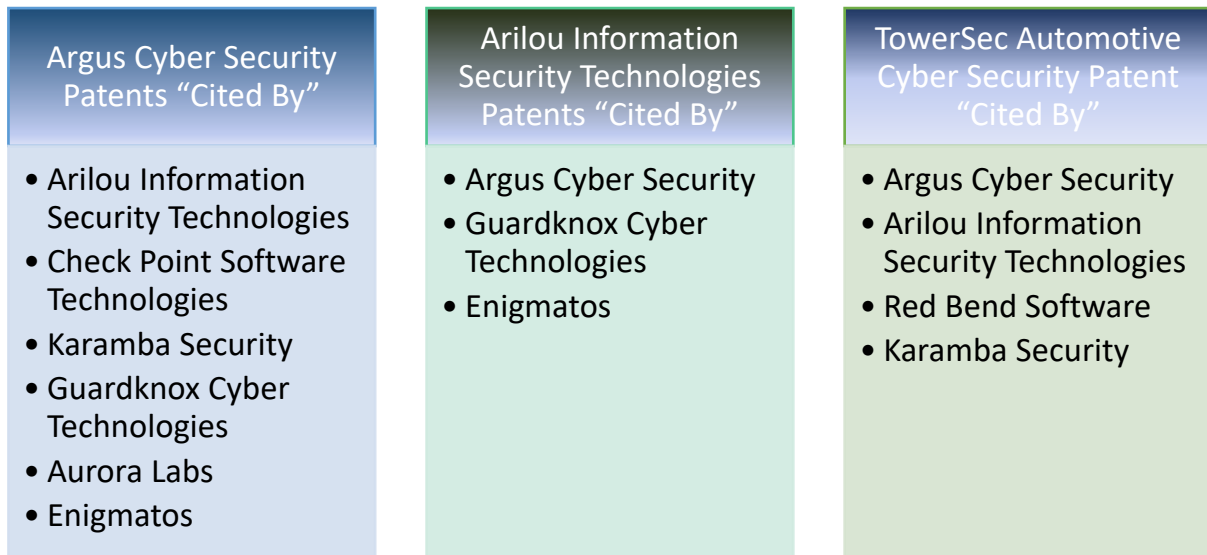| Argus Cyber Security Patents "Cited By"	Arilou Information Security Technologies Patents "Cited By"	TowerSec Automotive Cyber Security Patent "Cited By"
• Arilou Information Security Technologies • Check Point Software Technologies • Karamba Security • Guardknox Cyber Technologies • Aurora Labs • Enigmatos	• Argus Cyber Security • Guardknox Cyber Technologies • Enigmatos	• Argus Cyber Security • Arilou Information Security Technologies • Red Bend Software • Karamba Security

Fig. 6. Technology Inter-Dependency through Patent Citations

Fig. 6 illustrates the citation analysis of patents to determine their technological inter-dependency. In certain cases, the companies seem to have adopted a ladder approach for technology development in the field with advancement over and above the existing technology of other companies. The patents of top companies, Argus, Arilou and TowerSec were used among themselves as well as by other companies like Karamba, GuardKnox, Enigmatos, etc. as technology base to further innovate and develop their inventions.

III.   Summary

The Automotive Cyber Security Companies of Israel are the world leaders in providing secure ecosystem for connected vehicles. Almost all the big names in car industry are looking at Israel for network security. Although patent filing numbers reveals Automotive Cyber Security Industry of Israel is at nascent stage, however, these companies have established themselves as the foremost names on global arena. Many of these top companies have been acquired by global giants as a key addition to their technology portfolio. Also, the start-ups have succeeded in impressing investors with their technology innovations and securing striking funding from them.

Continuing the current trend, the industry is expected to blossom in the coming years with aggressive participation from new start-ups. The patenting activity is also expected to piggyback with coverage of more jurisdictions as these cyber security companies expand their reach worldwide.

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Praveen Goel is a patent professional and CEO of a research firm, PG Technology Research, based out in New Delhi, India. He is an engineer with specialization in Computers & Telecommunications. He is recognized as a Leading IP Strategist in IAM Strategy 300:2019 edition. He shares a strong relationship with many Israeli clients including top IP firms and technology companies. He makes a regular annual visit of Israel for business development purposes and loves hosting of Israeli people.

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References

Patent Data Source: Questel Orbit

[1] Shelly Singh, "Automotive Cyber Security Market worth $5.77 billion by 2025" in MarketsandMarkets research report, April 5, 2019 (https://www.marketsandmarkets.com/PressReleases/cyber-security-automotive-industry.asp)

[2] Dubi Ben-Gedalyahu, "Argus investors, employees win big in $430m acquisition", Globes Israel's Business Arena, Nov 5, 2017 (https://en.globes.co.il/en/article-argus-investors-employees-win-big-in-430m-acquisition-1001210421)

[3] "NNG Announces Acquisition of Arilou Information Security Technologies" NNG LLC Press Release, August 4, 2016 (https://www.nng.com/newsroom/press-releases/nng-announces-acquisition-arilou-information-security-technologies/)

[4] "c2a Security Announces Latest Auto-Cybersecurity Technology at Cyber Week Israel 2018", PR Newswire, June 20, 2018 (https://www.prnewswire.com/news-releases/c2a-security-announces-latest-auto-cybersecurity-technology-at-cyber-week-israel-2018-686037092.html)

[5] "Faurecia invests in GuardKnox to reinforce the cybersecurity of the connected car", Faurecia News, May 27, 2019 (https://www.faurecia.com/en/newsroom/faurecia-invests-guardknox-reinforce-cybersecurity-connected-car)

[6] Gal Eliezer, "Meet Enigmatos: The Startup That is Gaining Worldwide Attention", PR Newswire, October 15, 2018 (https://www.prnewswire.com/news-releases/meet-enigmatos-the-startup-that-is-gaining-worldwide-attention-300731352.html)

[7] Yoav Leitersdorf, Ofer Schreiber, "A look back at the Israeli cyber security industry in 2018", TechCrunch, January 6, 2019 (https://techcrunch.com/2019/01/06/a-look-back-at-the-israeli-cyber-security-industry-in/)

[8] Yoni Heilbronn, Yehuda Swizer, "Argus Cyber Security Secures $26M Series B Funding", Argus Cyber Security News, September 10, 2015 (https://argus-sec.com/argus-cyber-security-secures-26m-series-b-funding/)

[9] "GuardKnox Funding Reaches $24 Million Upon Completion of $21 Million Series A Round Led by Fraser McCombs Capital", BusinessWire, June 04, 2019 (https://www.businesswire.com/news/home/20190604005178/en/GuardKnox-Funding-Reaches-24-Million-Completion-21)

[10] "C2A Security Completes $6.5M Series A Round to Bring its Best-in-Class in-Vehicle Cybersecurity Solutions to More Automotive Customers", BusinessWire, February 11, 2019 (https://www.businesswire.com/news/home/20190211005277/en/C2A-Security-Completes-6.5M-Series-Bring-Best-in-Class)

[11] "Connected Car Market - Global Industry Analysis, Size, Share, Growth, Trends and Forecast 2013 - 2019", Transparency Market Research, September 2013 (https://www.transparencymarketresearch.com/connected-car.html)

[12] "STMicroelectronics and Arilou Collaborate to Detect Automotive Hacking", PR Newswire, January 08, 2019 (https://www.prnewswire.com/news-releases/stmicroelectronics-and-arilou-collaborate-to-detect-automotive-hacking-300774796.html)

[13] "Upstream Security and Asgent Enter into Strategic Partnership to Expand the Connected Car Cybersecurity Market in Japan", PR Newswire, May 08, 2018 (https://www.prnewswire.com/news-releases/upstream-security-and-asgent-enter-into-strategic-partnership-to-expand-the-connected-car-cybersecurity-market-in-japan-300644475.html)

[14] "Karamba Security and eSOL, in Cooperation with Asgent, Demonstrate How to Stop Automotive and Medical IoT Hacks at ESEC 2017", eSOL News, April 26, 2017 (https://www.esol.com/news/news_49.html)

[15] "Asgent and Coronet Strike Up Distributor and MSSP Agreement", Coronet News, April 05, 2017 (https://www.coro.net/asgent-coronet-strike-distributor-mssp-agreement/)