Internet of Things Market Analysis Forecasts, 2020 – 2030

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***Abstract*— Internet of Things (IoT) environment consists of an enormous smart device that communicate with each other, so they can gather and transmit the sensing information into IoT network. Besides, IoT has now a wide range of live applications such as transportation, smart home, healthcare, industry, smart environment, smart city as well social gaming robots and personal. In parallel, Industrial Internet of Things (IIoT) is empowered by more momentum as businesses integration between Artificial Intelligence (AI), Big-data and IoT technologies. According to the International Data Corporation (IDC), the *worldwide* market for IoT solutions including intelligent systems, connectivity services, infrastructure, applications, security, analytics, and professional services has observed an annual growth rate of 20% CAGR (Compound Annual Growth Rate). Furthermore, IoT will play a crucial role in the near future as per the worldwide statistics. It is expected that there will be a considerable amount of cash flow through the worldwide market in the upcoming years for IoT. At the same time, this paper explicitly provides forecast statistics between 2020 till 2030, as it helps organizations and decision makers in many areas, such as industrial and manufacturing, healthcare and lifestyle, energy and utilization, and many other areas related to IoT spending by sector that show expected growth forecasted in this paper.**

Keywords*— *Internet of Things, Industrial Internet of Things, International Data Corporation, Internet of Things, Artificial Intelligence, Compound Annual Growth Rate

I. INTRODUCTION

IoT will be one of the most technology innovations over the next years. It will change the way we live, by using the benefits of mobility , cloud computing and big-data. IoT will enable the business leaders and decisions makers to enhance customer service standards in different areas such as Smart home, healthcare, Smart farming, Smart energy management and Industrial IoT applications [3] Consequently, by using IoT. We will have more information than ever before. Meanwhile, IoT forecasted data will deliver the insight needed for people to utilize these information's in these areas

II. IOT HISTORY

The term IoT was heard for the very first time 20 years ago. The idea of connecting smart devices has been around longer, in 1990 the first Internet device created by John Romkey, this device was a toaster that could be turned off and on over the Internet. In 1994 Steve Mann invented 'Wear Cam, it is like a near real time performance using a 64-bit processor system. In 1997 the first description about sensors identified by Paul Saffo's. But the term IoT was coined by Kevin Ashton in 1999 during his work at Procter & Gamble Company (P&G), Kevin was working on supply chain optimization, he tried to attract his senior management's attention to the new exciting technology called "RFID", at the same time the internet was the most popular subject in 1999, this situation inspired him to promote his presentation for IoT concept. Although, this idea attracted the attention of some P&G executives, but the term IoT was publicly used after almost a decade [4],[5].

In 1999 the book "When Things Begin to Think" was published by Neil Girchenfeld, which illustrated the principles of the IoT. Additionally, in 2000 the plan about its first generation of Internet refrigerators announced by 'LG company'. In (2003-2004), RFID was deployed on a massive scale by the US Department of Defense in Savi program and 'Walmart retail company' in the commercial world. In 2005 The UN's International Telecommunications Union (ITU) published the first report on the IoT topic. In 2008-2009 The IoT was born according to Cisco's Business Solutions Group [6].

III. GLOBAL MARKET OUTLOOK

The internet revolution has transformed the way humans consume, search and share information by connecting computers all around the world, IoT will be the 'next industrial revolution' to connect 20 billion devices by 2020. Relying on the advanced sensors embedded into everyday objects, this empowers data to make the decision across industries. IoT has enabled smart homes to become a reality through accommodating smart refrigerators that can order groceries through eCommerce. Gadgets such Google Home Hub, Google Home Mini, GE C-Life smart bulbs, Amazon Echo Plus and Echo Dot just the first generation of IoT products. In parallel, IIoT is gaining momentum as businesses integration between Artificial Intelligence (AI), Big-data and IoT technologies to create major cost and speed efficiencies. IoT enables the smart machines to communicate with each other using data, allowing managers to predict a fault before it occurs. An IoT infrastructure uses transmitted data from these sensors to sense, predict and then alert to conduct preventive maintenance of critical machinery this will optimize manufacturing processes and reduce risk of incidents. From the other hand, IoT will play a significant role in Healthcare,

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Energy management, Smart Cities and Smart Home in improving the quality of life, as shown in Figure 1 [12],[27][28].

Fig. 1. IoT Smart Environment [13]

IV. Some Future Areas of IoT

• Smart Home: Smart devices will be the main focus of IoT, entire smart home devices are connected with each other and able to communicate and send information whenever it necessary. Automation of smart home devices can sense and control temperature, Smart TV, light and smart cameras and many other smart devices inside home[7]..

• Smart Cities: Smart cities will be the next big things of IoT innovative wireless technology which opens opportunity both for investors and customers. IoT will change the way we manage traffic control, pollution control systems and disaster management[7]..

• Healthcare: IoT will play a significant role in improving the quality of the health-care services, which is a multibillion-dollar industry demands better quality and rest for all of participants. Healthcare will allow the doctors to monitor the status of patients in real time and provide the treatments remotely. It integrates every participant using wearable and mobile devices[7]..

• Energy management: Energy management system: It will help the people to manage their energy efficient house devices by using smart phone. Therefore, all smart house devices like air-conditioners, refrigerators and washing machines will be able to communicate and alert users during specific scenarios [7].

V. IoT Limiting Factors

Deploying IoT has encountered many limitations and constrains; like limitation in processing capability, storage volume, short in power life and radio range [8]. On the other hand, concentrating on security is an important aspect of IoT, because all devices have an IP Address and are accessible through the internet, hence all IP addresses are subject to vulnerabilities and internet attacks, according to that, security becomes a very important topic as the number of potential attackers is greatly increasing and the devices use a set of novel IoT technologies such as Routing Protocol for Low Power and Lossy Networks (RPL), IPv6 over Low Power Wireless Personal Area Networks (6LoWPAN), and Constrained Application Layer Protocol (CoAP), due to novel technologies it is easy for DDOS to attack the IoT network [10],[26][29][30]. The most common DDoS attack involves flooding of huge amount of traffic to consume network resource, bandwidth, CPU time and many other attacks [8], [9].

To overcome the limitations, we should adapt more security on IoT Networks, the following aspects are some of the security threats:

A. Power Supply

Most of IoT devices have shortage of battery life. therefore, they need efficient power to do the functions appropriately. Sometimes difficult or impossible to replace a device's battery once it runs out because most of them are deployed in an unreachable location [11].

B. Scalability of IoT Networks

IoT devices in the networks are deployed in different ranges, scalability depends on the network scale and number of devices that covers this area, as the network grows the number of devices will increase, this requires high scalability of IoT networks not only for designing routing mechanisms between numerous of devices, but also imposing appropriate security mechanisms [11].

C. Unavailability of Intermediate Nodes

Most of IoT device nodes have a limited battery lifetime, these nodes acting as intermediate devices to other device nodes, suddenly these device nodes could become unavailable and make gap in the network between device nodes either due to exhausted battery power or being compromised by an attacker [11].

D. Memory and CPU Capacity

To decrease the processing costs and energy consumption, the installed memory on the device nodes is considerably small, furthermore; hardware platforms include simple micro-controller along with few kilobytes of RAM with no support for complex operations [11].

VI. IoT Forecast and Benefits

IoT technology is playing a vital role in the projects for their future business. For that, the expected benefits of the IoT are spread widely. But What are the real business benefits of IoT to take advantage? The opportunities that comes with the IoT are enormous and can increase the profits for any organization, especially those focused on digital transformation as shown in the forecasted table which concentrate on most of the sectors that will be spent on, at the same time playing an important role in this technology like IoT Market, Spending by Sector, Expected growth of IoT per Consumer & Industrial applications and IoT & analytics revenue in Billions of US $ from 2020 to 2030. Therefore, it is obvious that IoT market is getting bigger than now. Consequently, huge companies are already starting to invest in IoT in different sectors. The IoT forecast table 1 and the figures shows that the IoT market size is varied, enormous, and steadily growing.

TABLE I. IOT FORECAST (2020 – 2030)

IoT Market (in Billions of US $)												
	2020	*2021*	*2022*	*2023*	*2024*	*2025*	*2026*	*2027*	*2028*	*2029*	*2030*	*CAGR*
Global IoT Market forecast	245[15]	405[15]	585[15]	800[15]	1,110[15]	1,567[15]	2178.13	3027.6	4208.37	5849.64	8,131	39%[15]
Growth of IoT World Wild	30.73[19]	35.82[19]	42.62[19]	51.11[19]	62.12[19]	75.44[19]	91.25	110.42	133.63	161.71	195.7	21%
Growth of IoT Devices in UK	9.9[15]	11.6[15]	13.5[15]	15.8[15]	18.5[15]	21.5[15]	25.15	29.42	34.42	40.26	47.1	17%[15]
Average Device per Person	6.58[17]	7.72	9.03	10.57	12.36	14.46	16.92	19.8	23.16	27.1	31.7	16%
Market Size	457.29[14]	632.3	874.28	1208.86	1671.47	2311.13	3195.57	4418.48	6109.38	8447.38	11680.1	38%
Global Industry Market Size	119[20]	163[20]	223[20]	310[20]	424.7	581.84	797.12	1092.06	1496.13	2049.7	2808.1	37%
Spending by Sector (in Millions of US $)												
Automotive	1325.2	1427	1536.62	1654.67	1,780[18]	1918.66	2066.06	2224.77	2395.68	2579.72	2777.9	7.70%
Construction & Infrastructure	103.31	176.99	303.23	519.49	890[18]	1022.61	1174.98	1350.05	1551.2	1782.33	2047.9	14.90%[23]
Energy & Utilities	103.31	176.99	303.23	519.49	890[18]	1441.8	2335.72	3783.86	6129.86	9930.37	16087.2	62%
Industrial/ Manufacturing	690.57	735.79	783.97	835.31	890[18]	947.85	1009.45	1075.06	1144.93	1219.35	1298.6	6.50%
Healthcare & live style	915.57	1006.09	1105.57	1214.88	1,335[18]	1560.62	1824.36	2132.68	2493.11	2914.45	3407	16.90%[23]
Consumer electronic	1687.75	1808.48	1937.84	2076.46	2,225[18]	2647.75	3150.83	3749.49	4461.89	5309.66	6318.5	19%[23]
Retail	59.2	116.57	229.54	451.99	890[18]	1637.6	3013.18	5544.26	10201.44	18770.65	34538	84%
Insurance	3.33	3.68	4.08	4.52	5[16]	5.88	6.91	8.12	9.55	11.23	13.2	17.50%[23]
Expected growth of IoT per Consumer and Industrial applications (in Billions of US $)												
IoT installed base by category	3,010[21]	3783.63	4756.1	5978.52	7515.13	9446.67	11874.66	14926.69	18763.17	23585.69	29647.7	25,7%
IoT installed base by category per Consumer	1,534[21]	1795.19	2100.86	2458.57	2877.2	3367.1	3940.41	4611.34	5396.52	6315.38	7390.7	14%
IoT installed base by category per Industry	1,476[21]	2097.07	2979.46	4233.15	6014.36	8545.06	12140.62	17249.1	24507.12	34819.13	49470.2	42%
IoT and analytics revenue (in Billions of US $)												
Systems Integration	97	120[22]	283.48	404.38	576.83	822.82	1173.71	1674.24	2388.23	3406.7	4859.5	40%
Data Center and Analytics	92.9	125[22]	205.18	336.79	552.81	907.4	1489.44	2444.82	4013	6587.06	10812.2	64%
Network	20.59	33[22]	39.15	46.44	55.09	65.35	77.52	91.96	109.08	129.4	153.5	18%
Consumer Devices	24.74	37[22]	46.24	57.78	72.2	90.22	112.74	140.88	176.05	219.99	274.9	20%
Things	81.49	115[22]	151.06	198.42	260.64	342.36	449.71	590.71	775.93	1019.22	1338.8	25%
Legacy Embedded	92,24	90[22]	86.71	83.55	80.5	77.56	74.73	72	69.37	66.84	64.4	-3%

Compound Annual Growth Rate (CAGR) is analogous to compound annual growth rate (CAGR) used in business circles for the analysis of growth trends in financial investments. Formula to calculate is: $CAGR = \left(\frac{Ending\ Value}{Beginning\ Value}\right)^{\frac{1}{n}} - 1$, where n= Number of periods in years [25].

Based on CAGR; the forecast investment and number calculated as following: End Value= End Value $= (Last\ Year\ Value)^{(1+CAGR)*n}$ [25].

Gray Colors are Forecasted value based on End Value formula

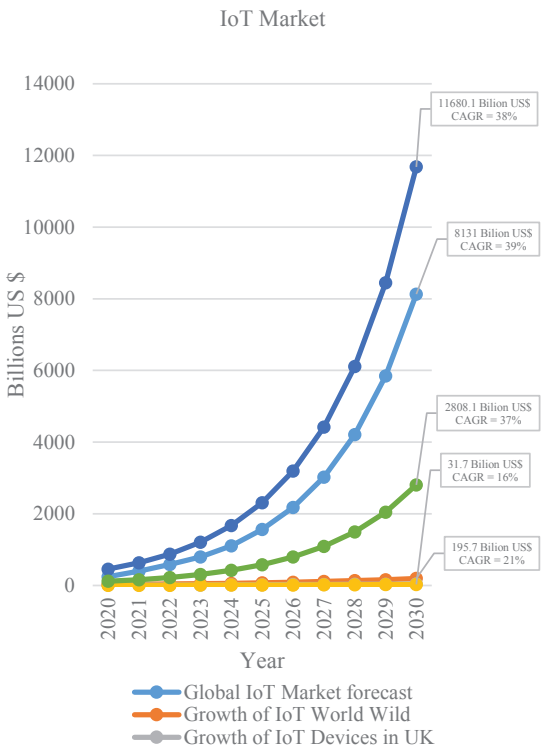

Fig. 2. IoT Market in Billions US $ - (2020 – 2030)

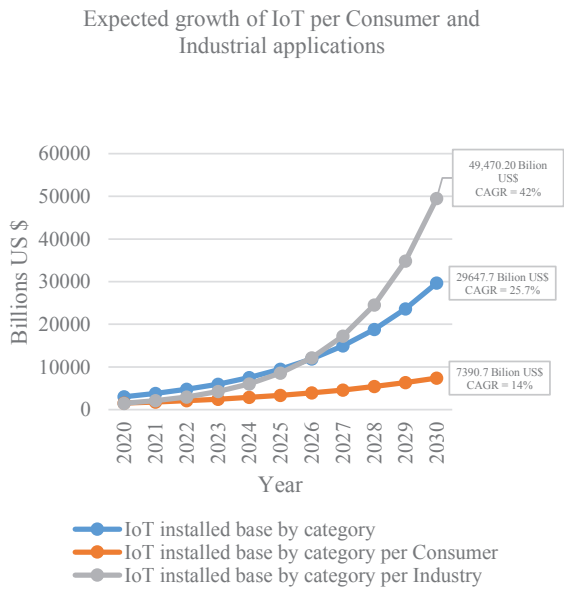

Fig. 4. Expected growth of IoT per Consumer and Industrial applications in Billions US $ - (2020 – 2030)

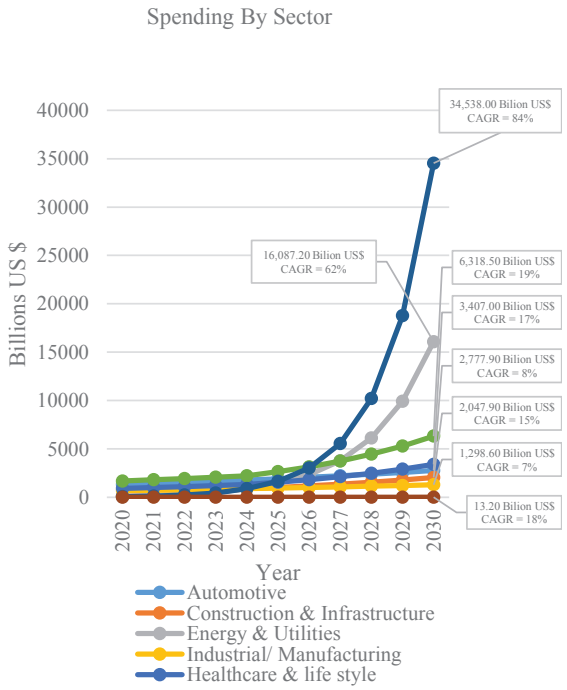

Fig. 3. Spending By Sector in Millions US $ – (2020 – 2030)

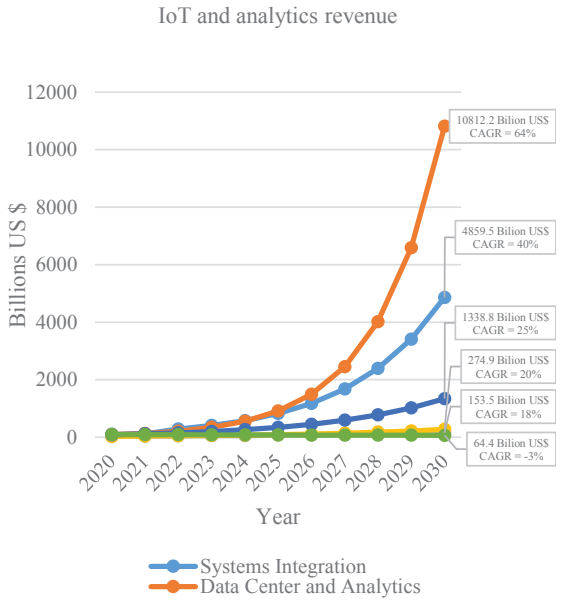

Fig. 5. IoT and analytics revenue in Billions US $ - (2020 – 2030)

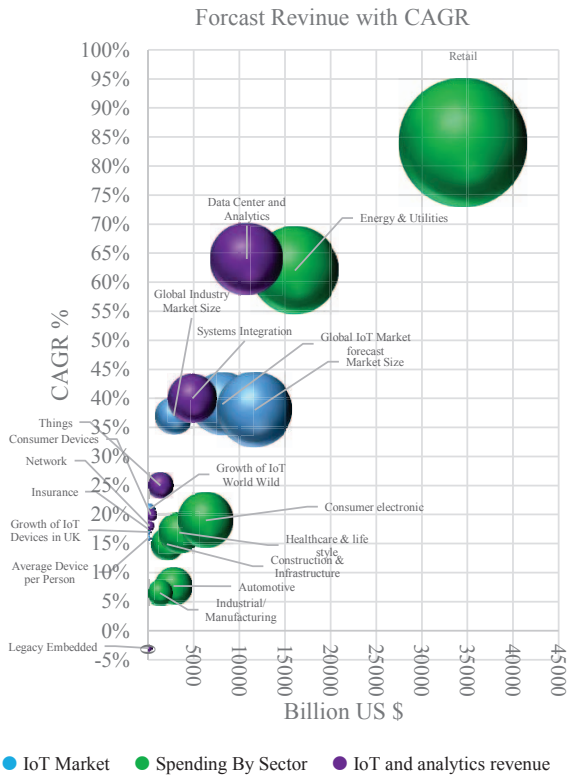

Fig. 6. Forecast Revenue with CAGR

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