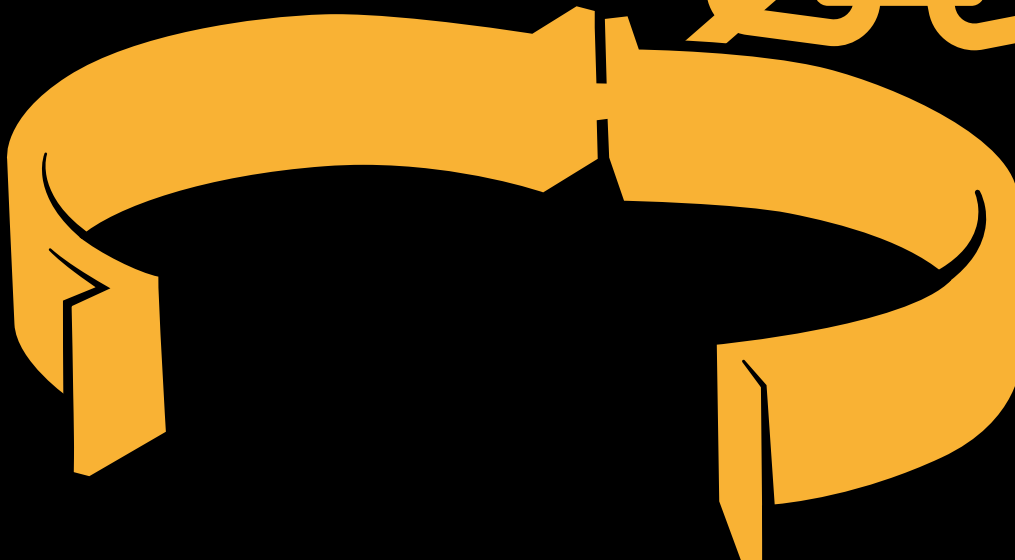




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IoT markets and their patent landscapes

The world of the Internet of Things is becoming increasingly complex in terms of both markets and technology definitions. And that is before we even get to the patents

By Ian MacLean, Raymond Angers and Goran Grbic

Trying to understand and anticipate how the Internet of Things (IoT) IP landscape will evolve is still an imprecise art. Between 2014 and 2016, Gartner revised its IoT market projections significantly. While some numbers rose and others fell, it seems clear that the overall market is still a large one. From a patent ownership and development standpoint, other trends are starting to emerge which could have a significant impact on what the IoT landscape will look like further out. This article examines some of the patent activity in the different IoT segments, taking a broad perspective. We observe that growth for patents in the areas of things and analytics is up, with many of the leaders being as expected; from an M&A perspective, this is still an active market. We also observe that this activity is more about technology than intellectual property. To begin with, let us set some parameters around defining those segments and look at the growth projections for particular markets.

The four main technology segments in IoT and their definitions are illustrated in Figure 1. However, the lines defining the types of product which belong to each segment are not always clear, particularly for the things segment. For example, a smartphone can be a thing (eg, an always-on microphone), but it can also be a gateway which communicates with a smartwatch via Bluetooth and relays the data back to the network. A thing may be a standalone device, such as a heart rate monitor chest strap or a smart lightbulb, or a complex device such as an automobile, with many sensors and cellular connectivity. In addition to data being sent from things to the network, things can communicate directly with each other in a peer-to-peer fashion or by using a gateway as an intermediary. The types of product that fall under each category will depend on the ecosystem of a particular application.

IoT market growth

We compared Gartner's 2016 projections to those from 2014 (Figures 2 to 5) and focused on the smart home and automotive segments. In 2014 the largest shipments were forecast for the smart home and automotive segments. The highest growth rate then was within the medical devices segment, followed by automotive. This changed somewhat in 2016. The growth expectations for medical were radically reduced, while those for the automotive segment are forecast to increase over the next five years, fuelled by self-driving and connected cars. The industrial segment was also projected as having more growth in the 2016 projections than in 2014.

The overall IoT unit shipment forecast through 2020 has been reduced by roughly 17%, compared to 2014 projections. This is due predominantly to reduced smart home projections, although this segment still has the highest level of IoT shipments because of the sheer number of electronic products which can be included as part of a comprehensive connected home. Additionally, the forecast for industrial over the next few years remains positive.

The 2014 and 2016 market shipment forecasts are extremely similar starting in 2016 and going through 2020. In both forecasts, the overall unit shipment charts show a 17% decrease by 2020.

Both the smart home and industrial segments are complex in composition and require a deeper look.

Smart home

The smart home market projections are clearer when the market is divided into two segments: entertainment and home automation and management (Figures 6 and 7).

The home automation and management segment will drive substantial growth in the smart home market. This covers everything in the home with sensors and network modules used to provide anywhere, anytime controlling and monitoring ability, and may include appliances, surveillance, lighting and temperature control systems. While a large variety of products are available, consumers and industry alike are still trying to determine where the actual need resides. This part of the smart home market is in a rapid growth stage. It looks set to eventually surpass the entertainment segment shipments and dominate the entire smart home space.

Industrial

Let us look at the manufacturing segment (Figures 8 and 9). While an increasing number of sensors will be introduced in the industrial market, development will likely be incremental, with well-understood use cases; hence, the growth rate in this segment is much lower than in other IoT market segments.

The evolution in industrial may come from wearables which are designed to provide field workers with real-time communication for remote diagnostic support. For example, miners wearing smart glasses with video transmission could allow above-ground workers to see what they see underground, thereby shortening field-problem resolution times. However, such applications are at a nascent state.

FIGURE 1. Main technology segments

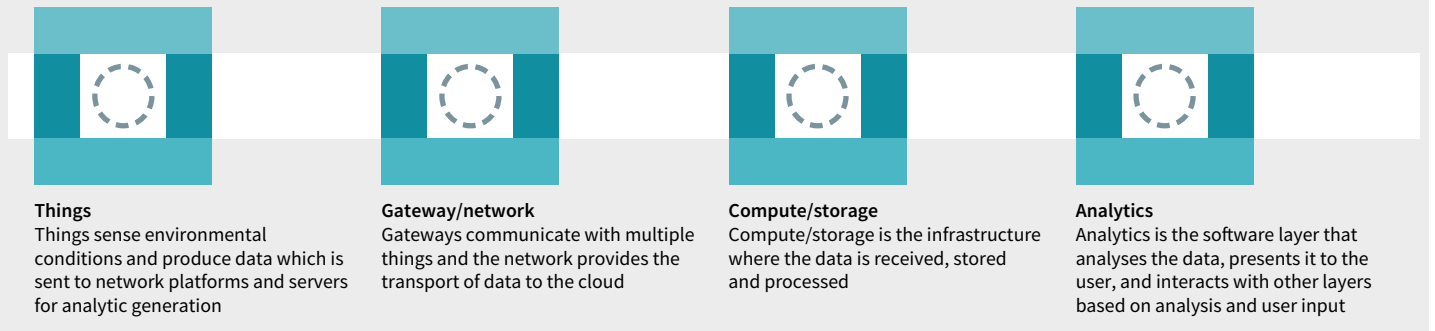


FIGURE 2. Year-on-year growth rate forecast by shipment – 2014

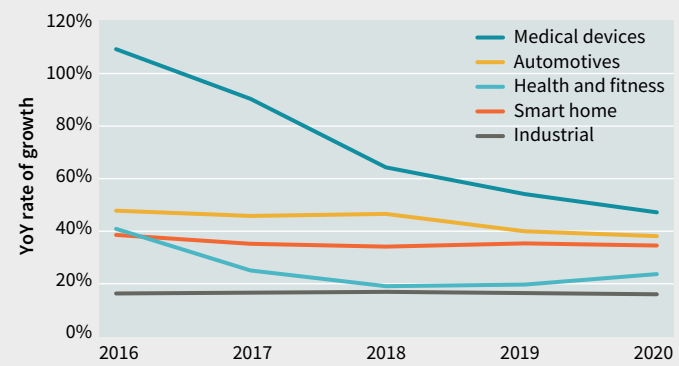


FIGURE 3. Year-on-year growth rate forecast by shipment – 2016

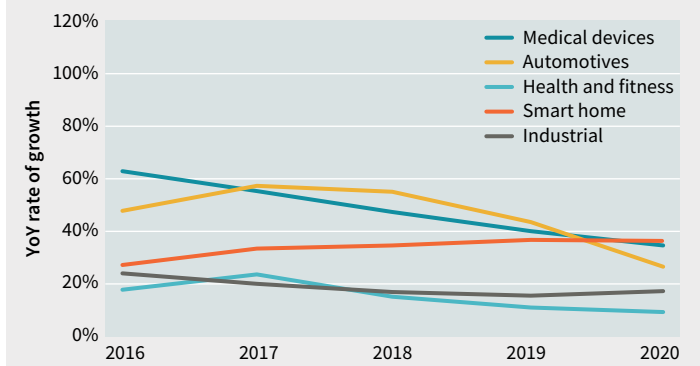


FIGURE 4. Market shipment forecast – 2014

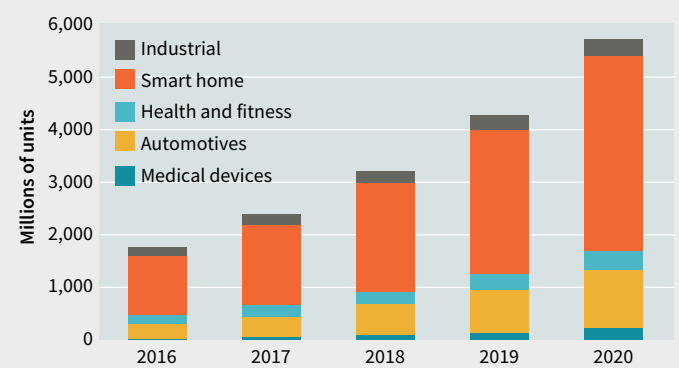


FIGURE 5. Market shipment forecast – 2016

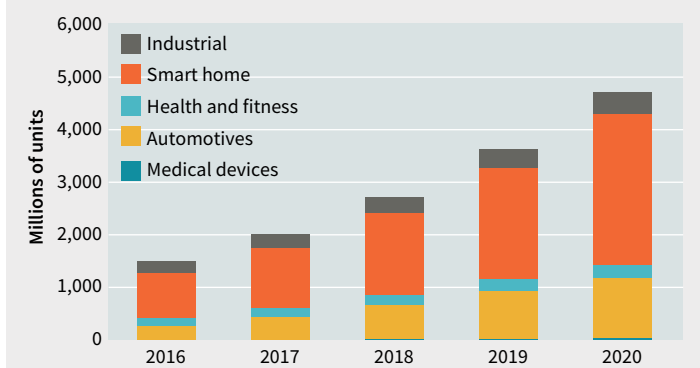


FIGURE 6. Year-on-year growth rate forecast by shipment 2014 versus 2016

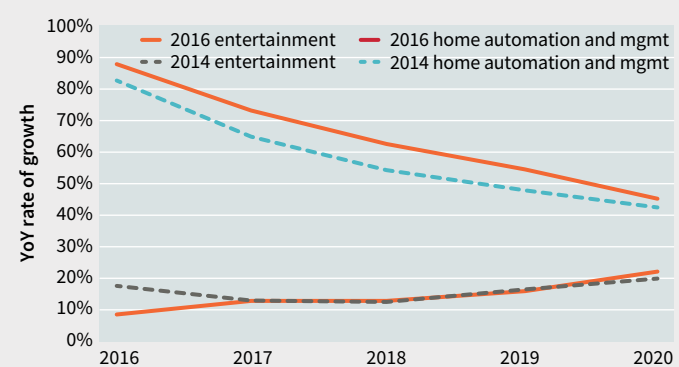
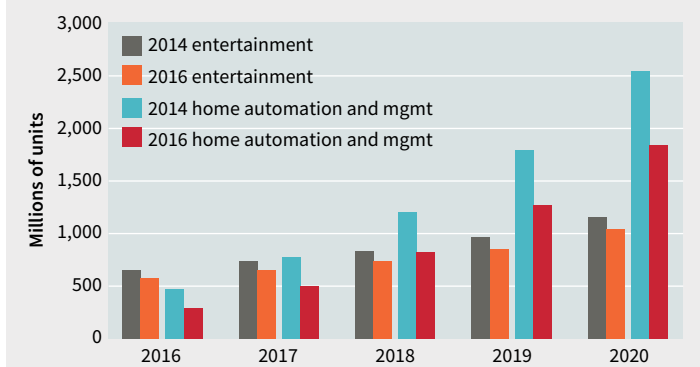


FIGURE 7. Smart home sub-markets shipment forecast 2014 versus 2016



Patenting activity in different market spaces

Early in 2015, TechInsights analysed 38 companies active in IoT and their patenting activity in four specific IoT segments. For this article, we updated the analysis on the original set and for 2017 added a similar list of companies, some of which have since been acquired. Table 1 lists the number of patents for each of the companies in each of the four IoT technology segments. Using publicly available tools, we retrieved the US portfolios (granted patents and pending applications) with title, abstract and independent claims for each company. Next, using a proprietary tool, we compared these portfolios to classifiers created by subject-matter experts, placing each patent in the best match among the four IoT segments. There is some subjectivity in the specific placement of each patent in one segment or another, considering that there is a level of accuracy and recall in any analytic investigation – as well as the blurred boundaries already mentioned between some segments.

In 2015 Samsung, IBM, Microsoft, Qualcomm, Nokia and Intel ranked as the top six companies in terms of number of patents in the IoT space. Also in 2015 a strong percentage of Samsung's, Qualcomm's and Intel's IoT patent portfolios lay in the gateway/network spaces; while IBM and Microsoft IoT patents were concentrated on the compute/storage spaces, since technology in these segments was established well before IoT became so prevalent. Many companies with large patent portfolios which were also big players in the traditional mobile and data centre markets are now expanding into IoT.

The company with the highest number of things patents was Samsung, which had double those of the crowded pack following it – including Panasonic, Microsoft and Qualcomm. The entity with the highest number of analytics patents was Microsoft, followed closely by IBM and Alphabet (Google), then Sony, Samsung and Facebook.

Looking at 2017, we see that from the top 20 from our 2015 list, analytics had the largest growth at 17%, followed closely by gateway/network at 16%, with things at 13% and compute/storage at 3%. The group with the largest overall number of patents among the 20 is compute/storage, followed by gateway/network. The top six companies continue to be well represented across all four segments. Samsung, IBM and Microsoft remain at the top, while Intel moved up to the number four spot, with healthy increases in things, gateway/network and compute/storage. LG Electronics and Google both leap-frogged over Nokia – the former based on strong growth in gateway/network and the latter with consistent innovation efforts in all four areas. Of our top 10 in 2017, only Sony's and Nokia's overall portfolios dropped from 2015 according to our IoT model. The leaders in each segment have not changed: Samsung in things, Qualcomm in gateway/network, IBM in compute/storage and Microsoft in analytics. Growth over all four segments was consistent for Samsung (12%), IBM (11%) and Microsoft (11%), with more significant growth being observed for Intel (22%) and LG (24%).

Cisco's acquisition of Jasper – an industry-leading cloud-based IoT service platform provider – means that it is now well positioned to look towards the compute/storage space.

FIGURE 8. Year-on-year growth rate forecast by shipment 2014 versus 2016

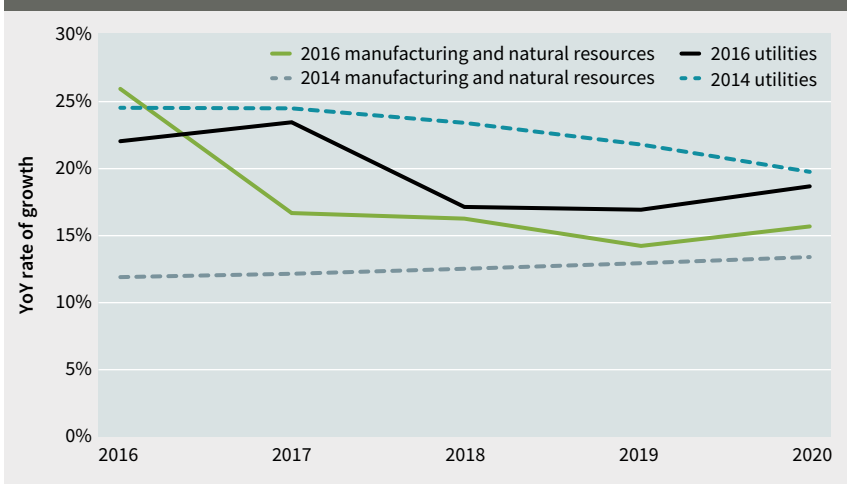
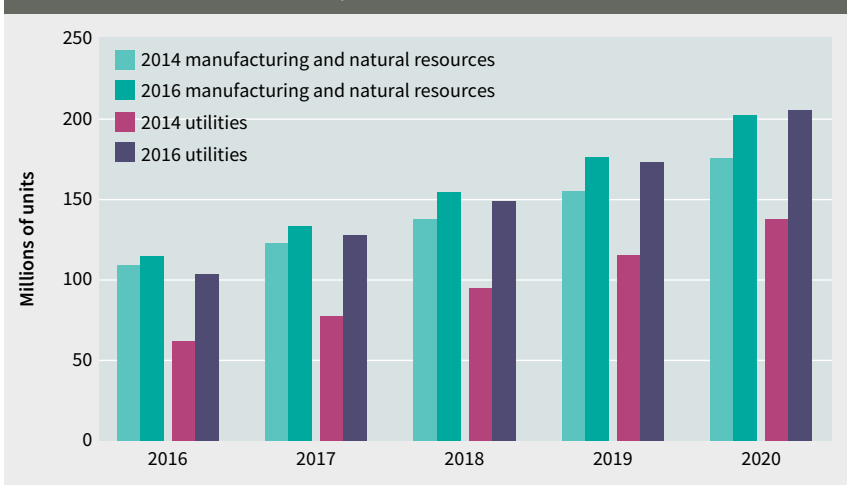


FIGURE 9. Industrial sub-markets shipment forecast 2014 versus 2016



Amazon has a significant number of patents, specifically in the compute/storage and analytics segments. It scored a significant success in the things area with its Echo, which has been referenced as a step forward in consumer acceptance of IoT devices. It will be worth watching to see whether that growth continues.

With its purchase of ARM, Softbank is a strong newcomer. However, from a patent perspective, more intellectual property came from Softbank's legacy rather than from the existing ARM portfolio. Its acquisition of ARM does mean that it has acquired technology which bolsters its position with some other large traditional IoT players, especially in the areas of low-power mobile system-on-a-chip cores.

TDK's purchases of Micronas in 2015 and InvenSense in 2017 are obvious steps towards it becoming a more important player in IoT. By adding InvenSense, TDK has strengthened its position in new sensor solutions in IoT, automotive and information and communications technology; it also brings a significant number of IoT assets, particularly in the things space. All of this makes it a more prominent player in IoT intellectual property.

An interesting and still developing situation is that

of Thoma Bravo, LLC, a US private equity and growth capital firm which has raised more than \$1.5 billion in investor commitments since 2008. Compuware, which it acquired in 2014, was a leader in both application performance monitoring and mainframe solutions. Riverbed provided the application performance infrastructure. Both were involved in the compute/storage segments. Compuware and Riverbed added guided analytics, while the purchase of Qlik added

visual analytics, delivering intuitive solutions for self-service data visualisation. As a result, Thoma Bravo has positioned itself as a presence in IoT intellectual property, especially in compute/storage and analytics. It will be interesting to see what its next move will be.

As was recently announced, Renesas has used the Cadence Perspec System Verifier to verify its new microcontroller unit design for IoT applications. Renesas microcontrollers have more IP blocks and

TABLE 1. Comparison of 2015 and 2017 company ranking of IoT patents in four IoT segments

2015						2017					
Companies	Things	Gateway/ network	Compute/ storage	Analytics	Grand total	Companies	Things	Gateway/ network	Compute/ storage	Analytics	Grand total
Samsung	3351	6203	4384	1204	15142	Samsung	3865	7042	4852	1209	16968
IBM	1452	466	10296	2740	14954	IBM	1582	603	11000	3370	16555
Microsoft	1739	574	8375	3221	13909	Microsoft	1996	783	8849	3772	15400
Qualcomm	1573	7006	1479	572	10630	Intel	1868	4202	5076	714	11860
Nokia / ALU	1162	5032	2835	726	9755	Qualcomm	1805	7884	1516	564	11769
Intel	1466	3260	4402	614	9742	LG Electronics	895	6887	1413	684	9879
Alphabet	1347	2128	2888	2676	9039	Alphabet (Google)	1604	2200	3090	2983	9877
LG	763	5270	1307	643	7983	Nokia	1163	5301	2443	618	9525
Sony	1667	1775	2361	1384	7187	Ericsson	615	5734	1427	220	7996
Ericsson	533	4888	1439	246	7106	Sony	1711	2010	2109	1263	7093
Panasonic	1964	1933	1641	773	6311	Apple	1914	2107	1832	696	6549
Cisco	1090	934	3200	664	5888	Cisco	1230	1239	3265	637	6371
Apple	1489	1635	1718	648	5490	Panasonic	1846	1614	1474	735	5669
GE	1300	441	1473	893	4107	GE	1261	509	1308	904	3982
Bosch	1439	159	1105	491	3194	Bosch	1500	177	1060	528	3265
TI	984	982	703	175	2844	Amazon	437	171	1729	908	3245
Philips	940	560	405	470	2375	TI	1034	1003	687	153	2877
NXP / Freescale	626	559	704	45	1934	Softbank/ARM	269	1543	779	172	2763
ST Micro	791	339	721	64	1915	Philips	1074	663	415	496	2648
Amazon	191	89	1006	608	1894	Facebook	97	91	643	1573	2404
Facebook	57	35	554	1095	1741	NXP / Freescale	736	752	786	43	2317
Renesas	367	270	667	47	1351	STMicro	894	352	718	67	2031
Mediatek	180	654	188	27	1049	Mediatek	205	838	190	25	1258
Infineon	326	209	339	35	909	Renesas	344	247	607	42	1240
Salesforce	20	4	538	184	746	Infineon	348	247	320	35	950
Gemalto	150	49	254	15	468	Microchip/Atmel	230	220	390	11	851
Microchip	120	81	243	7	451	Salesforce	17	10	477	191	695
Atmel	99	133	142	5	379	Gemalto	189	96	297	16	598
Alibaba	5	12	122	110	249	Arris/Pace	67	102	218	79	466
ARM	53	10	121	2	186	TDK/Micronas	167	106	88	64	425
Pioneer	36	21	32	43	132	Alibaba	15	17	225	138	395
Invensense	107	2	5	1	115	ThomaBravo/Qlik	31	0	139	42	212
Pace	13	16	15	6	50	Invensense	166	3	4	4	177
Splunk	5	0	16	24	45	Splunk	12	0	54	85	151
Baidu	0	0	11	4	15	Pioneer	30	16	21	28	95
Micronas	10	0	2	0	12	Baidu	4	0	33	13	50
Tableau	0	0	0	11	11	Tableau	0	0	0	19	19
Qlik	0	0	0	6	6						

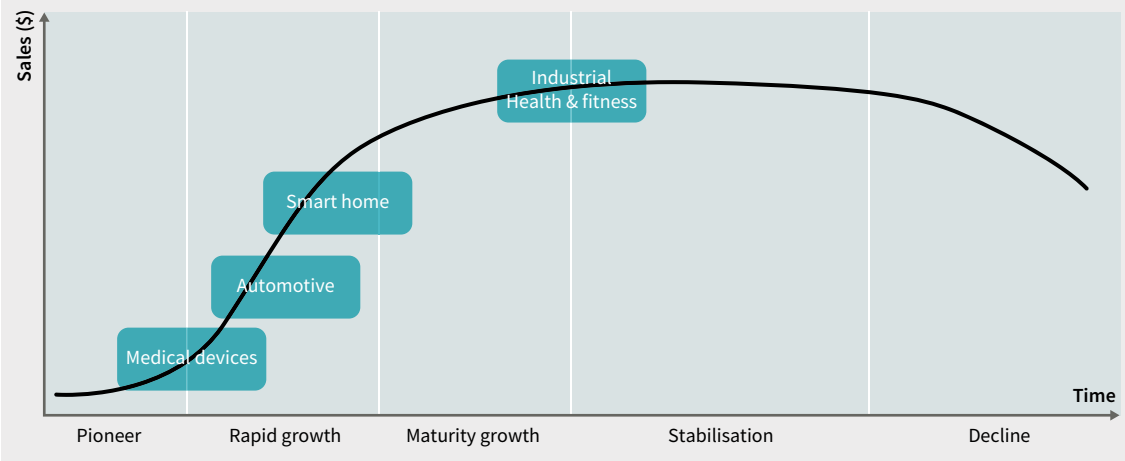
FIGURE 14. 2016 IoT market position on industry lifecycle

Tableau in analytics

Given the overall growth in analytics, Tableau presents an interesting opportunity. Although still relatively inactive in pursuing patents, it could be attractive as a technology addition for a company interested in data visualisation and merging information from multiple data sources.

Lifecycle of different IoT markets

Figure 14 shows the current position of each IoT market in its own industry lifecycle. As the duration of each stage and the peak sales level differ for each market, the figure above does not reflect any absolute or relative sales, revenue level or timeline for IoT markets.

The automotive segment has exited the pioneer stage and is now fully in the rapid growth stage. In the automotive segment, embedded sensors and communication modules are leading the growth; while the connected car segment is still early in its development, but with high expectations.

Medical devices are still at the pioneer phase, with substantially high growth rate but low volume. This could be related to the typically longer industry lifecycle in the medical segment.

The smart home segment position has advanced a little towards the maturity growth stage, but it is still experiencing rapid growth. The home automation and management sub-segment is still the exception, with more than 70% year-on-year growth. Platform consolidation will help the growth of the smart home segment.

The health and fitness segment is now fully in the maturity growth rate and marching quickly towards stabilisation. This is reflected in the proliferation of smart fitness products currently on the market.

The industrial segment is the most mature of all IoT segments and is looking as though it will remain so for some time to come.

What can we learn?

Market growth and unit shipment projections are a moving target. This makes it tricky to understand exactly when mass acceptance will be realised and what the journey to get there looks like. Although the forecast for overall unit shipments may have dropped, IoT is still a significant market with keen interest from many big

Action plan



In the increasingly interconnected world of the Internet of Things (IoT), rights holders can take a few strategic steps to ensure that they are best positioned for market's ongoing growth and development:

- Understand your company's position in the IoT and be aware of which of the four segments your patents are best suited to.
- Monitor growth in the key markets, smart home, medical and automotive segments.
- Monitor the activities of those in adjacent markets or technologies which align with your strategic vision and could have a positive impact on where you wish to be positioned.
- Map your competition's patents to better understand their position. Map their patents and patent applications by technology groups and over time understand where they are focusing their innovation efforts.

semiconductor and electronics businesses. Companies are actively patenting and looking to strengthen their market position through acquisitions. One area creating significant interest is platforms, which are described as overcrowded by IoT analytics report "IoT 2016 in review: the eight most relevant IoT developments of the year", which states that at last count there were over 400 different platforms. Platform issues affect speed of adoption and interoperability, and standards in this area have yet to stabilise. Other factors that will affect the overall IoT landscape and that we have not touched on here include security implications and the legal hurdles around divided infringement, claim scope and subject-matter eligibility. It all adds up to continuing interest from companies which are seeking to ensure they are well positioned from a patent and underlying technology standpoint to leverage this dynamic, as yet not fully realised market. **iam**

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