

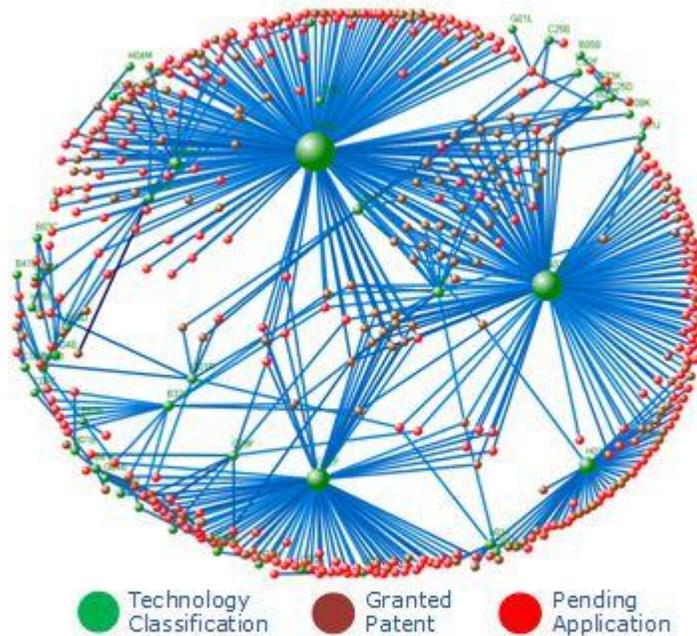
How many patents does it take to build an iPhone?

The role of the patent portfolio in the age of complex product development.

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The products around us are getting smarter every day. Gone are the days when an individual product served a single function and could be protected with a single patent. Want a cell phone that is also a video camera, a compass, a flashlight and a music store? Don't forget a GPS device and a web browser and you've got the iPhone. As products grow more complex, they integrate increasingly diverse components. Those components themselves evolved from the development of multiple and varying technologies. Rooftop solar panels may be one component on the total product that is the Prius hybrid car, but the technologies behind photovoltaic cells range from the refinement of industrial materials to substrate chemicals, from semiconductor manufacturing to information technology and electronic components. Each technology area is built up by a myriad of patented innovations. Even within a single company, there are many patents protecting each innovation.

E-Ink Technology Clusters
Chart 1



E-Ink's patent portfolio falls under three major technology classifications, all of which contribute to their electronic paper display products.

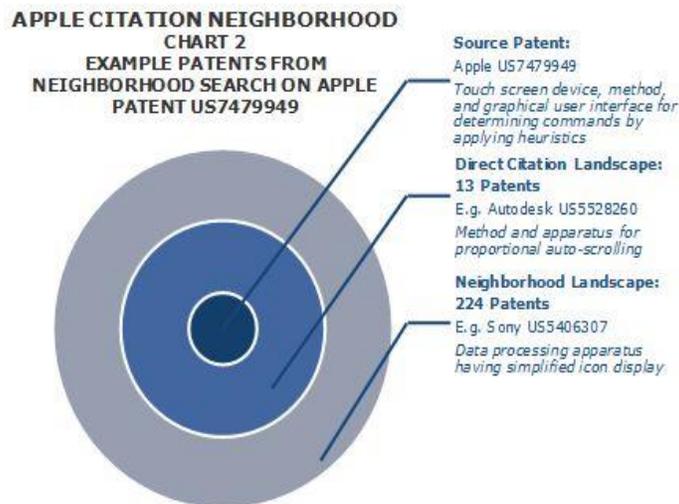
converters). The patent portfolio is stronger than the sum of its individual patents. To maintain a competitive edge in IP, modern companies need a new way of looking at patents - shifting focus from the individual patent to the technology portfolio that creates or provides support for a given product.

Most products are protected by a multitude of patents that can be grouped into portfolios at the product, component or technology level. All too often Intellectual Property managers focus on the value of a single breakthrough patent, but this outlook is as outdated as the idea that a phone is just a phone. Individual patents form technology clusters that contribute to the components of a product [CHART 1: E-INK TECHNOLOGY CLUSTERS]. In the example of E-Ink, the product produced is the Amazon Kindle, the relevant component is the electronic ink display, and yet E-Ink has over 148 patents and 96 pending applications protecting three component technology areas. As classified by International Patent Classification (IPC) codes, they are: G09G (electro-optic displays), G02B (electro-optic materials) and G02F (optical switching, modulating or

The iPhone and Patent Protection

Recent commercials for the iPhone claim that if there is something you want to do, "there's an app for that." Similarly, Steve Jobs has taken great pains to assure consumers as well as investors in Apple, Inc. that for every iPhone function, there's a patent for that too. According to Jobs, the patent portfolio for the iPhone is over 200 patents strong. However, that doesn't include the patents that Apple licenses from other companies in order to bolster the iPhone's capabilities without detracting time and energy from Apple's own research achievements. The recent Nokia suit against Apple for infringement of Nokia's technologies to connect Smartphones to the internet suggests that Apple's 200 patents are still an underestimate of how many patents it takes to build an iPhone and make it work. The 200 patents also do not include Apple's most recent patent applications for additional functionality, such as the 2009 patent application for facial recognition to determine an authorized iPhone user or recognize friends from a photo album or the 2009 application to synch mapping and calendar information so that the iPhone can let you know what time to leave and how to get there when you are having lunch in a new restaurant. Even with all of its one-off patents and applications, Apple has invested a bulk of its energy in a few individual patents that attempt to encompass all of the iPhone's most prominent and defining features. For example, U.S. patent 7479949 *Touch screen device, method, and graphical user interface for determining commands by applying heuristics* (**the patent on the multi-touch and touch-screen input methods**) was granted at the beginning of 2009 and does such a good job of describing the iPhone in general language that Apple will surely want to use the patent to prevent competitors from marketing similar products. The patent's enforceability is an issue for the courts, but identifying potential infringers is a matter for Patent Analytics.

Citations between patents reveal the influence of any given patent on another. Expanding our notion of influence beyond direct citations can illuminate the interconnectivity of a patent neighborhood. The citation neighborhood of Apple's patent US7479949 expands their direct citations into a neighborhood of over 200 other patents [CHART 2: APPLE CITATION NEIGHBORHOOD]. A citation neighborhood serves dual roles as a tool to identify potential infringement and a tool to identify the best protection mechanism. The case of identifying infringement is fairly straightforward, whereas identifying protection mechanisms against infringement suits is less clear-cut. This is where the need to conceptualize patent portfolios around a given product becomes clear. A product's patent portfolio can act as a protection mechanism, buffering the product against legal action. Indeed, the citation neighborhood of Apple's own patents shows that Apple has developed a patent thicket around its seminal patent US7479949.

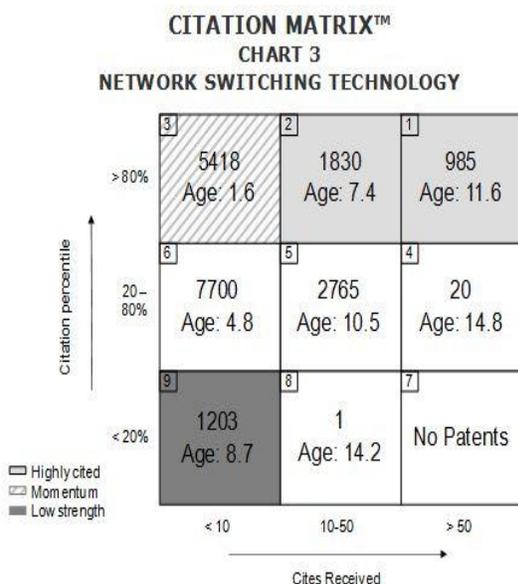


Whenever a company comes out with a hot new product, there is always concern about infringement and protection. This is especially important with the increasing presence of non-patenting entities who gobble up IP for the purpose of litigation. Companies with multi-function phones, such as Palm, Motorola, Research In Motion (RIM) and Nokia, will need to keep close tabs on the functionality in "smart phones" and where the patented technology lies. Should one of these competitors attempt to assert their patents against Apple, Apple can turn to its portfolio and pull out another patent from its cluster of related technologies and file a counter suit or offer up a cross-licensing agreement.

The 4G Network and Patent Pooling

Yet the iPhone, even with its 200 patents, is still a simple product with few components. A telecommunications network, like the 4G wireless network new and ongoing development, has so many moving parts that it depends on tens of thousands of individual patents to keep the entire machine running. As of 2008, there were 18,300 patents and 16,254 pending applications particular to the development of a 4G network. While 4G offers innovation, it hasn't reinvented the wheel and still relies on the over 80,000 patents that form the backbone of telecommunications connectivity. At the product level, the consumer sees wireless connectivity from their mobile devices. At the component level, there are the terminal devices that receive and send information, processors that convert data for transmission, multiple methods for transmitting data, switching centers to direct transmission and more. It would be difficult to make sense of a patent portfolio at the product or component level given the enormity and complexity of a single telecommunications network such as 4G. Therefore the technology level is the most ripe for Patent Analytics.

Even within a given 4G technology area, the landscape is vast and there are multiple players with their own portfolios and technological specializations. As of 2008, there were over 2700 separate entities with active patenting activity in the 4G landscape. No single entity can hope to master the diversity of technologies required to put together a 4G network, let alone component products. Key to the success of the telecommunications industry is the development of industry standards, which allows multiple players in the industry to coordinate their work on multiple components that are interoperable. The method of patent pooling has long been a staple of the industry and will continue to play an important role as the 4G network is rolled out by various wireless carriers and compatible products hit the shelves. A patent pool is built when multiple entities contribute patents in a specific technology to an overall pool that can be licensed - either by each other in a cross-licensing agreement or to the industry at large. It is an easy way to make inventions available and keep costs down for all involved. For telecommunications networks, a patent pool gathers together the necessary intellectual property to comply with industry standards and benefits all of the players in the industry. It enables large companies to adopt cross-licensing agreements without lengthy negotiations or courtroom drama. It also levels the playing field for smaller companies and start-ups, giving them immediate standards compliance for a reasonable licensing fee and thus allowing them to pursue their own niche specialization.



Patent Analytics provides a means to identify candidate patents for a pool in an efficient and methodical manner. One such means is a Citation Matrix™, which identifies the most influential patents in a technology area by plotting the number of citations received against its citation percentile. This method normalizes the citations received across patents in the same technology and year of issue - an imperative, given that patent citations naturally increase over time. For the International Patent Classification (IPC) code H04Q "Selecting", which involves network switching, we can break the relevant patents into nine cells, of which Cells 1 and 2 indicate highly influential patents [CHART 3: CITATION MATRIX™]. Patents in Cell 1 are established patents and have best track record of influence in the industry. Cell 1 is where many seminal patents can be found and is a good starting point to identify patents that may be critical in a technology or industry. There are 246 patenting entities with IP in

Cell 1 who could potentially have seminal patents related to network switching technologies. Analysis can be broken down at even more minute levels to narrow the scope of the technology area. For example, IPC technology classification code H04Q can be narrowed to H04Q/11, which includes only network switching patents for multiplex systems. While the Citation Matrix™ is an automated tool that can quickly prioritize thousands of patents for a closer look, some patents outside of Cells 1 and 2 do provide unique differentiation and may need to be included in a patent pool regardless.

The Prius and Knowledge Sharing

We've discussed so far a product with few components made by a single company and a product with multiple moving parts involving multiple competitive players, but now let's turn to a product with many components made by a single company: the Prius hybrid car. Toyota Corp holds approximately 2,000 patents that make up this single product, not including patents that Toyota licenses or patents that contribute to components that Toyota buys wholesale, such as the rooftop solar panels that Kyocera manufactures for the latest Prius model. Toyota faces different challenges than Apple or telecom companies and so different analytic tools from the repertoire of Patent Analytics are necessary.

Having the research and development to specialize in all of the components behind a hybrid car is simply unrealistic. The main functions of a typical car fall into six categories. The power system, which typically comes from an internal combustion engine, in a hybrid car includes both a combustion engine and an energy harvesting braking system that converts mechanical energy to electric. The drivetrain (which includes transmission, gears and axles), the suspension system, the control system (which includes steering and braking), the electrical system (which stores energy in the battery and disperses it to components like headlights and radio), and the safety system (such as air bags and seat belts) all work together to run a car, but they also are made up of their own numerous components and technologies that are protected by thousands of patents. With all of the moving parts, it is easy to see how a single product like the Prius needs to be protected by over 2,000 patents.

Toyota is a large company with an R&D budget to match in size, mastering all of the necessary technology to create each and every component is a tall order. Instead, Toyota, like many companies dealing with complex products and industries, needs to stick to its strengths and know when to draw on the strengths of other companies. For example, Guardian Industries is the leader in rain-sensing windshield wipers. Toyota, along with most major automobile manufacturers, licenses Guardian's technology in order to include rain-sensing windshield wipers as a component on its cars. Licensing is the single most effective way for a company to capitalize on the innovations of others without sinking costs into research and development. Fortunately for Toyota, it has long recognized the value of knowledge sharing through licensing and has partnered with Ford, among other companies, to license its own emissions purification patents in order to promote the environmental technologies in which they specialize. Licensing is also an effective way for a company to capitalize on its own innovations.

When a company is manufacturing a product made up of so many varying technologies and components, it is a daunting task to decide who would be the best partner or supplier. Patent Analytics can be used to compare the relative strengths of several companies' technology portfolios and provides a useful measure that can help a company make decisions on which partners to cultivate - and whose IP is not as good as it sounds. Looking at the technology behind vehicular Collision Avoidance systems, we can analyze the portfolio strengths of the key players in this technology area using a custom scorecard. Honda clearly dominates the technology area in terms of size, but Automotive Technologies has the most influential portfolio.

Collision Avoidance Scorecard

TABLE 1

Top 10 Patenting Entities in the technology area of vehicular Collision Avoidance

Company	Portfolio	Citation Percentile	Cites Received	Innovation Cycle Time	Science Linkage	Age
Honda	54	79.91	5.57	5.49	2.63	7.18
Panasonic	28	68.50	6.29	6.05	0.50	8.67
Denso	26	79.25	2.42	5.69	0.19	5.59
Nissan	25	77.24	5.08	5.31	0.52	6.84
TRW Automotive	22	78.28	2.91	6.36	0.86	6.94
Daimler	20	67.93	2.70	6.49	2.35	7.34
Automotive Technologies	20	92.02	27.40	8.35	3.10	8.39
Toshiba	17	62.99	3.76	6.28	1.06	6.85
Delphi	17	76.17	0.76	5.68	0.76	5.45
Fuji Heavy Industries	17	73.41	8.94	5.25	0.76	8.37

Portfolio includes U.S. Granted Patents only.
Indicators represent portfolio averages.

Whether Toyota is partnering with Kyocera, licensing from Guardian Industries or licensing to Ford, Patent Analytics provides a method to evaluate the IP that changes hands in each relationship. Understanding the relative strengths of each company's technology portfolio enables informed participation in partnering as well as licensing negotiations.

Summary

Once a product's patent portfolio is identified, the Intellectual Property of that product can be assessed, whether the product is a phone, a car or an entire network. Additionally, a patent portfolio can be built and analyzed around a given technology area that contributes to a product, where it can be evaluated for strengths and weaknesses, as well as signal gaps in the portfolio. This is especially helpful for companies in the Chemicals and Biotechnology industries, where a final product may be the same as a technological innovation, such as an improved cultivar or a better method for gene splicing. Moreover, innovations are constantly evolving, requiring additional patents to protect the new innovations. Future innovations create both new threats and new opportunities. In the first case, if a company develops a seminal patented innovation but then rests on its laurels, it will be threatened by new innovators as it loses its competitive edge. In the second case, continued innovation and constant patenting around a current technology gives a company the opportunity to remain a viable industry force far into the future. Patent Analytics provides an effective measure to weigh a product's IP and make decisions about infringement, licensing, bundling and more. As the products around us become more complex, so too should our analysis tools.