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1 Executive Summary

The recent $525 million sale of Kodak’s patent portfolio to a consortium of technology companies sheds light on the evolving digital imaging patent landscape and its importance in the mobile device category. The sale also helps to highlight the dominant players in this space, as well as those seeking to bolster their competitive position in the market.

In the era of Smartphone, telephony is no longer a selling point for mobile devices. High quality display, superior touch-screens, exemplary digital photography and applications that enhance productivity are some of the features that are most desired by consumers.

While there are multiple technology domains that are driving convergence in computing, advancement in the field of digital imaging is one of the prime reasons for increased adoption of Smartphone and tablets. Beyond superior networks and high-end processors, it is the ease of recording, editing, viewing and sharing personal memories that are driving device sales and more importantly consumer engagement.

Digital imaging is, in fact, a multi-faceted process. This research report focuses on the patent and technology landscape of digital imaging within mobile devices. It defines and categorizes different components that combine to make digital imaging possible – i.e. image acquisition, image storage, image manipulation, image display, image networking and image recognition. The report highlights the companies that control key patents along with the strength and relevance of these patent assets. It offers also insight on those companies that hold a competitive advantage and how this may affect licensing and litigation strategies in the near future.

Technology majors like Canon, Microsoft, Sony, Samsung and Kodak lead the list with sizeable patent portfolio. Beyond these top players, the landscape is fragmented with hundreds of smaller and mid-size companies who collectively own ~70% of patents. A number of these SMEs have strong digital imaging patents and have successful patent monetization program in place.

The report provides particular attention to Kodak’s digital imaging patent portfolio, examining the company’s assets and providing a comparative analysis between Kodak and other leading industry players to shed light on how the portfolio sale will impact the players in the digital imaging arena.
2 Introduction

2.1 Overview

The demand for better image quality, superior display, better frame rates, and easier editing and sharing has been driving technological growth in the Smartphone industry. The competition has become intense with the introduction of Nokia Pure View 41 MP camera, better display technologies such as Super AMOLED screens, Apple’s retina display and panorama capture capabilities in mobile devices.

2.2 Digital Imaging Technology

Digital imaging is the technology of creating digital images – capturing an instance in space and preserving it. It also includes motion pictures and digital videography. Digital imaging is a very broad term encompassing everything related to processing, compression, storage, editing and display of images. These images are created more often by digital cameras; however, scanners and other means can also be used for this purpose.

The incorporation of the camera into mobile devices has been, and continues to be, a necessary user demand. According to the NPD Group, by end of November 2011 point-and-shoot cameras took 44 percent of photographs, down from 52 percent in 2010, while camera-equipped Smartphone accounted for 27 percent of photographs clicked in 2011, up from 17 percent in 2010.

The domain of digital imaging related to mobile devices comprises digital photography, sensors deployed in mobile device to improve image quality, image processing hardware and software routines to obtain and preserve higher quality in lower file sizes, and numerous image analysis and editing tools among other functionalities.

**Note**: The term Digital Imaging in this report refers to the technology landscape of Digital Imaging in Mobile Devices.
3 Digital Imaging – Patent Landscape

The field of digital imaging is very large and technically complex. It borrows significant amount of technologies from the “point-and-shoot” digital camera and general image editing software domain, creating an admixture of the tasks of a digital camera and a desktop PC pertaining to digital images and adding them to mobile devices.

The digital imaging landscape can be classified into six broad categories based on the technology fields of patents and other IP assets:

- Image Acquisition
- Image Storage
- Image Manipulation
- Image Display
- Image Networking
- Image Recognition

The landscape can further be classified into sub-groups as shown in figure 1 below:

![Diagram of Digital Imaging Patent Landscape]

3.1 Image Acquisition

Image acquisition covers patents pertaining to systems and techniques for creating digital images. Image acquisition includes optical systems for focusing the image onto a sensor, capturing analog light signals and converting them into digital data to be sent for processing and storage. It also covers color filter technology for acquiring color data describing the
image, digital shutter technology for controlling light capture duration, camera settings such as focus, flash, white balance, etc., and digital zoom technology.

The sub-categories of image acquisition include:

- **Lens and Aperture Systems** – Systems and techniques which describe capturing and transferring light for creating images.
- **Image Sensors and Filters** – Systems and techniques which help convert captured light into digital signals, and record and incorporate colors in images.
- **Camera Settings** – Settings which can be altered by the user. E.g. – setting of flash, white balance, focus, etc.

### 3.2 Image Storage

Image storage covers patents pertaining to systems and techniques for storing and managing digital images and related data. Image storage includes algorithms, programs and applications that help in the creation of data files such as RAW and TIFF, when a photograph is taken. Image storage also includes patents that pertain to optimization of the stored data by using techniques such as compression to reduce file size.

The sub-categories of image storage include:

- **File Management** – Formats in which images are saved after being captured by users, and their management.
- **Image Compression** – Systems and methods for reducing the size of images stored.

### 3.3 Image Manipulation

Image manipulation covers patents related to systems and techniques for editing, correcting, enhancing and recognizing images and videos. It includes various content reworking techniques such as slicing, merging, smudging, cropping and morphing. Patents pertaining to techniques that correct undesired qualities in an image or video such as lens distortion, noise and warping are also included. Methods that allow minute aesthetic adjustments such as changing the image tonality, color temperature, sharpening and softening are also included in the scope of Image Manipulation.

The sub-categories of image manipulation include:
• **Content Rework** – Systems and techniques such as smudging, cropping, in painting for touching images.

• **Image Correction** – Systems and techniques for correctional actions on images, e.g. – gamma corrections and noise reduction.

• **Image Enhancement** – Improvement of aesthetics and quality of images using techniques such as saturation adjustment, brightness and contrast adjustment, etc.

### 3.4 Image Display

Image display covers patents pertaining to systems and techniques for displaying digital images. Image display includes various technologies for processing the images and displaying them on a screen as per user specifications. It covers the traditional 2D display technologies like AMOLED display, Super-AMOLED display, TFT-LCD display, Retina display etc; touch-screen technologies like haptic touch screen and tactile touch screen; and display protection technologies like Gorilla glass. Image display further covers 3D display technologies like autostereoscopy, parallax-barrier techniques for Glass-less 3D incorporated by phones such as HTC Evo 3D, LG Optimus 3D, and others.

The systems and technologies pertaining to image processing techniques carried out by Graphic processors have also been covered under the field of Image Display.

The sub-categories of image display include:

- **2D Display** – Two-dimensional display of digital assets.
- **3D Display** – Three-dimensional display of digital assets.
- **GPU** – Systems and techniques for graphic processing and display.

### 3.5 Image Networking

Image networking covers patents that describe systems and methods pertaining to image sharing, searching and storing images in databases. It includes patents that cover searching and retrieval techniques such as meta searching, content-based image retrieval and concept-based image retrieval. Image networking also encompasses patents that describe efficient management techniques in image management databases. Technologies that enable sharing of images and videos over an electronic network such as the internet are also covered by the patents under this domain.

The sub-categories of image networking include:
• **Database Management** – Systems and techniques that improve management of multi-media databases.

• **Image Sharing** – Technologies that allow sharing and tagging images on social networks and other online media.

• **Image Retrieval** – Systems and techniques for searching and retrieving images stored in online databases.

### 3.6 Image Recognition

Image recognition covers methods and techniques that enable a device to identify patterns, shapes, objects etc. in an image. Technologies that specialize in recognizing human faces and facial expressions such as smiling are also covered by the patents in this domain. Image recognition further takes into account patents that recognize landscapes, scenery, landmarks, terrains, weather and time of the day.

The sub-categories under Image Networking include:-

- **Pattern Recognition** – Systems and techniques that recognize patterns, shapes and forms in an image.

- **Facial Recognition** – Specialized techniques that help identify faces and expressions.

- **Object Recognition** – Systems and techniques for recognizing objects, articles and items captured in an image.
4 Analysis of Digital Imaging Patents

4.1 Patent Distribution

<table>
<thead>
<tr>
<th>Level 1 Category</th>
<th>Count of Patents</th>
<th>Level 2 Category</th>
<th>Count of Patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image Acquisition</td>
<td>8459</td>
<td>Lens and Aperture Systems</td>
<td>2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Image Sensors &amp; Filters</td>
<td>3711</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Camera Settings</td>
<td>2739</td>
</tr>
<tr>
<td>Image Storage</td>
<td>4110</td>
<td>File Management</td>
<td>704</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Image Compression</td>
<td>3406</td>
</tr>
<tr>
<td>Image Manipulation</td>
<td>6033</td>
<td>Content Rework</td>
<td>1778</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Image Correction</td>
<td>1932</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Image Enhancement</td>
<td>2323</td>
</tr>
<tr>
<td>Image Display</td>
<td>6532</td>
<td>2D Display</td>
<td>2922</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3D Display</td>
<td>2144</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GPU</td>
<td>1466</td>
</tr>
<tr>
<td>Image Networking</td>
<td>7978</td>
<td>Database Management</td>
<td>1459</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Image Sharing</td>
<td>4882</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Image Searching</td>
<td>1637</td>
</tr>
<tr>
<td>Image Recognition</td>
<td>4187</td>
<td>Pattern Recognition</td>
<td>1897</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Facial Recognition</td>
<td>488</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Object Recognition</td>
<td>1802</td>
</tr>
</tbody>
</table>

Table 1: Distribution of Digital Imaging Patents across Level 1 & Level 2 Categories

4.2 Patent Trends

The field has seen significant investment in the last decade and continues to gain importance in the world of IP. In the last decade, the landscape has witnessed ~300% increase in the number of patents being granted. Figure 2 shows the patent filing trend from 1985 to 2011. Image networking domain has seen tremendous growth in the last decade, largely driven by image searches and sharing/ tagging of pictures in social networks.

Note: The figure below includes projections for the last few years (2008 – 2011) to account for unpublished patent applications by USPTO.
4.3 Assignee Analysis

The top companies in this field with respect to their patent portfolio size are:

<table>
<thead>
<tr>
<th>Company</th>
<th>No. of Patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canon</td>
<td>1,929</td>
</tr>
<tr>
<td>Microsoft Corp.</td>
<td>1,815</td>
</tr>
<tr>
<td>Sony Corp.</td>
<td>1,650</td>
</tr>
<tr>
<td>Samsung</td>
<td>1,255</td>
</tr>
<tr>
<td>Eastman Kodak Co.</td>
<td>1,191</td>
</tr>
<tr>
<td>Panasonic Corp.</td>
<td>1,008</td>
</tr>
<tr>
<td>IBM</td>
<td>922</td>
</tr>
<tr>
<td>Ricoh (Asahi)</td>
<td>744</td>
</tr>
<tr>
<td>Fujifilm</td>
<td>736</td>
</tr>
<tr>
<td>Mitsubishi (Nikon)</td>
<td>674</td>
</tr>
</tbody>
</table>

(Source: iRunway analysis based on patent data from USPTO)
• The top 10 companies have 11,926 patents in the digital imaging space constituting 32% of the landscape
• Other companies in the top 50 list cover 24% with 9037 patents
• The rest of the companies cover 44% of the landscape with 16336 patents.

Table 2 illustrates the distribution of patents for top companies across level 1 category.

<table>
<thead>
<tr>
<th>Company</th>
<th>Image Acquisition</th>
<th>Image Storage</th>
<th>Image Manipulation</th>
<th>Image Display</th>
<th>Image Networking</th>
<th>Image Recognition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canon</td>
<td>480 (5.7%)</td>
<td>247 (6%)</td>
<td>504 (8.4%)</td>
<td>117 (1.8%)</td>
<td>439 (5.5%)</td>
<td>142 (3.4%)</td>
</tr>
<tr>
<td>Microsoft</td>
<td>62 (0.7%)</td>
<td>260 (6.3%)</td>
<td>276 (4.6%)</td>
<td>106 (1.6%)</td>
<td>347 (4.3%)</td>
<td>765 (18.3%)</td>
</tr>
<tr>
<td>Sony</td>
<td>408 (4.8%)</td>
<td>307 (7.5%)</td>
<td>236 (3.9%)</td>
<td>165 (2.5%)</td>
<td>355 (4.4%)</td>
<td>179 (4.3%)</td>
</tr>
<tr>
<td>Samsung</td>
<td>281 (3.3%)</td>
<td>98 (2.4%)</td>
<td>134 (2.2%)</td>
<td>533 (8.2%)</td>
<td>158 (2%)</td>
<td>51 (1.2%)</td>
</tr>
<tr>
<td>Kodak</td>
<td>337 (4%)</td>
<td>64 (1.6%)</td>
<td>349 (5.8%)</td>
<td>325 (5%)</td>
<td>87 (1.1%)</td>
<td>30 (0.7%)</td>
</tr>
<tr>
<td>Panasonic</td>
<td>258 (3.1%)</td>
<td>209 (5.1%)</td>
<td>158 (2.6%)</td>
<td>96 (1.5%)</td>
<td>201 (2.5%)</td>
<td>86 (2.1%)</td>
</tr>
<tr>
<td>IBM</td>
<td>57 (0.7%)</td>
<td>122 (3%)</td>
<td>79 (1.3%)</td>
<td>172 (2.6%)</td>
<td>348 (4.4%)</td>
<td>144 (3.4%)</td>
</tr>
<tr>
<td>Ricoh (Asahi)</td>
<td>267 (3.2%)</td>
<td>73 (1.8%)</td>
<td>138 (2.3%)</td>
<td>40 (0.6%)</td>
<td>152 (1.9%)</td>
<td>74 (1.8%)</td>
</tr>
<tr>
<td>Fujifilm</td>
<td>231 (2.7%)</td>
<td>51 (1.2%)</td>
<td>224 (3.7%)</td>
<td>20 (0.3%)</td>
<td>119 (1.5%)</td>
<td>91 (2.2%)</td>
</tr>
<tr>
<td>Mitsubishi (Nikon)</td>
<td>375 (4.4%)</td>
<td>69 (1.7%)</td>
<td>83 (1.4%)</td>
<td>50 (0.8%)</td>
<td>63 (0.8%)</td>
<td>34 (0.8%)</td>
</tr>
</tbody>
</table>

Table 2: Patent distribution of top companies across level 1 categories
(Source: iRunway analysis based on patent data from USPTO)

4.4 Seminal Analysis

The digital imaging patents were analyzed and ranked using iRunway’s portfolio analysis solution - COMPASSSM. A list of seminal patents (strong patents) was generated based on a combination of manual research and a proprietary algorithm for strength calculation. The seminal patent set constituted the top 5% of the ranked digital imaging patents.

Unlike essential patents, which are declared by companies (primarily larger firms) on standards such as ETSI, IEEE, etc, seminal patents are a set of strong and significant patents (‘STAR’ patents) identified from the entire portfolio. These are selected based on 22 parameters such as infringement detectability, number of independent and dependent claims, technology activity rate, backward and forward references, age of patent, etc.

Table 3 illustrates the distribution of top patent holders, their share of all digital imaging patents and their share of seminal patents among all digital imaging seminal patents.
### Table 3: Patent distribution of top companies including seminal patents
(Source: iRunway analysis based on patent data from USPTO)

<table>
<thead>
<tr>
<th>Company</th>
<th>Count of All Digital Imaging Patents</th>
<th>Share of All Digital Imaging Patents</th>
<th>Count of All Seminal Digital Imaging Patents</th>
<th>Share of All Seminal Digital Imaging Patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canon</td>
<td>1929</td>
<td>5.2%</td>
<td>84</td>
<td>4.4%</td>
</tr>
<tr>
<td>Microsoft</td>
<td>1816</td>
<td>4.9%</td>
<td>64</td>
<td>3.4%</td>
</tr>
<tr>
<td>Sony</td>
<td>1650</td>
<td>4.4%</td>
<td>124</td>
<td>6.6%</td>
</tr>
<tr>
<td>Samsung</td>
<td>1255</td>
<td>3.4%</td>
<td>58</td>
<td>3.1%</td>
</tr>
<tr>
<td>Kodak</td>
<td>1192</td>
<td>3.2%</td>
<td>27</td>
<td>1.4%</td>
</tr>
<tr>
<td>Panasonic</td>
<td>1008</td>
<td>2.7%</td>
<td>46</td>
<td>2.5%</td>
</tr>
<tr>
<td>IBM</td>
<td>922</td>
<td>2.5%</td>
<td>57</td>
<td>3.1%</td>
</tr>
<tr>
<td>Ricoh (Asahi)</td>
<td>744</td>
<td>2.0%</td>
<td>44</td>
<td>2.4%</td>
</tr>
<tr>
<td>Fujifilm</td>
<td>736</td>
<td>2.0%</td>
<td>24</td>
<td>1.3%</td>
</tr>
<tr>
<td>Mitsubishi (Nikon)</td>
<td>674</td>
<td>1.8%</td>
<td>25</td>
<td>1.3%</td>
</tr>
</tbody>
</table>

- Sony owns the biggest chunk of seminal patents (6.6%) in the digital imaging landscape. Its share of seminal patents is about twice the size of Microsoft, while Canon has the second largest share at 4.4%.
- Kodak has a significant portfolio in terms of size and has some strong patents in this field, but the number of seminal patents is relatively small compared to other top players.

Patents within the image networking category have high infringement detectability and consequently higher perceived value in terms of monetization through licensing and litigation (~38% of patents asserted in litigations are from the image networking category). Sony, Microsoft and IBM seem to have an edge over their competitors in terms of the strength of patents within image networking.
5 Key Players in Digital Imaging Landscape

5.1 Canon

- Canon is a major player in the digital camera market. It specializes in the manufacture of imaging and optical products, including cameras, camcorders, photocopiers, steppers and computer printers.
- Canon has made significant patent investments in image acquisition, image manipulation and image networking categories with a high number of patents filed during the period 2003 – 2009.
- Growth in image acquisition category before 2003 can be linked to the release of Canon EF-S lens mount, a derivative of the EF mount that is strictly for digital EOS camera. And increase in patent filings in image acquisition from 2005-2010 is related to the launch of Canon’s EF-M series lens mount in 2012.
- High activity in image networking over the years is related to the re-launch of an improved Canon iMAGE GATEWAY in 2007, with the addition of video sharing in 2008 and an improved version launched in April 2012.
5.2 Microsoft

- Microsoft has the highest concentration of patents in the image recognition field with significant patent activity between 2003 and 2006. The underlying technology, protected by these patents, is being used in its gesture and image recognizing product – Kinect (for Xbox)
- Microsoft also filed a higher number of patents in the image networking, image storage and image manipulation space between 2003 and 2006. Its products such as MS Office, MS Digital Image, MS Paint, etc utilize these patents to produce excellent tools for image editing and processing in PCs, Smartphones and Tablets.
- A lot of the software patents across categories also powers the Windows Phone, a mobile operating system launched by Microsoft in 2010.

Figure 5: Technology Evolution Tree of Microsoft’s Digital Imaging Patents
(Source: iRunway analysis based on patent data from USPTO)
5.3 Sony

- Sony Corporation has substantial IP in digital imaging technology through research and development of its digital camera and TV line of products, which it has successfully incorporated into mobile devices.
- Sony made significant patent investments in the image acquisition space between 2005 and 2009.
  - These patents protect the Exmore R back-illuminated CMOS sensor that Sony introduced in 2008 and its implementation in devices in 2009.
  - And also the NEX lens series, with their NEX-6 planned to be released in 2013.
- Sony’s patents also protects the technology behind Sony’s Bionz Image Processing Engine that converts raw image data from a CCD or CMOS image sensor into a format that is can be stored on a memory card; and also its Vscreens – photo/ video sharing app which allows viewing of mobile content on a larger screen.

<table>
<thead>
<tr>
<th>Year</th>
<th>Patent Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>500</td>
</tr>
<tr>
<td>2010</td>
<td>512</td>
</tr>
<tr>
<td>2011</td>
<td>523</td>
</tr>
</tbody>
</table>

Figure 6: Technology Evolution Tree of Sony’s Digital Imaging Patents
(Source: iRunway analysis based on patent data from USPTO)
5.4 Samsung

- Samsung – a market leader in the Smartphone segment in terms of number of devices sold – has anticipated higher demand for display modules in consumer electronics and significantly ramped up its research in image display.
  - It significantly increased in patent investments in image display between 2005 and 2009 and has highest number of patents in this field.
  - In 2008, Samsung acquired the IP assets of Clairvoyante Inc. which developed the PenTile™ subpixel rendering display technology which offers significant reduction in power consumption for high resolution mobile LCDs.

- Samsung also has significant number of patents in the image acquisition sub-domain.

![Figure 7: Technology Evolution Tree of Samsung’s Digital Imaging Patents (Source: iRunway analysis based on patent data from USPTO)](image-url)
5.5 Kodak

- Kodak - a pioneer in both film and digital photography - has some seminal patents in the digital imaging landscape. The company filed for bankruptcy in January 2012 and subsequently tried to auction its digital imaging IP assets.
- While Kodak’s portfolio size is good compared to other top players, the number of seminal patents is fewer and form a smaller fraction as compared to its peers in the industry.
  - There has been a decline in the patenting activity since 2005, while others in the industry stepped up their technology investments.
  - This is true even in the image acquisition and image manipulations sub-domains which have been Kodak’s forte in the past decade – an area which saw significant investments in the 90s.
- Kodak has relatively lower number of patents in the image networking and image recognition sub-domains – which have become important for digital imaging in the 21st century.

Figure 8: Technology Evolution Tree of Kodak’s Digital Imaging Patents
(Source: iRunway analysis based on patent data from USPTO)
6 Litigations & Licensing in Digital Imaging

Around 347 digital imaging patents were involved in lawsuits between 1990 and 2012. Patents in the image sharing, image compression, image sensors and content rework sub-domains have been asserted against companies the most.

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of Patents involved in Litigation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Image Acquisition</strong></td>
<td></td>
</tr>
<tr>
<td>Lens &amp; Aperture Systems</td>
<td>7</td>
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<td>Image Sensors &amp; Filters</td>
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<td><strong>Image Storage</strong></td>
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<td><strong>Image Manipulation</strong></td>
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<td>3D Display</td>
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<td>GPU</td>
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<td><strong>Image Networking</strong></td>
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<tr>
<td>Database Management</td>
<td>31</td>
</tr>
<tr>
<td>Image Sharing</td>
<td>76</td>
</tr>
<tr>
<td>Image Retrieval</td>
<td>27</td>
</tr>
<tr>
<td><strong>Image Recognition</strong></td>
<td></td>
</tr>
<tr>
<td>Pattern Recognition</td>
<td>18</td>
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<tr>
<td>Facial Recognition</td>
<td>1</td>
</tr>
<tr>
<td>Object Recognition</td>
<td>21</td>
</tr>
</tbody>
</table>

Table 4: Distribution of Litigations across Categories

6.1 NPEs & SMEs with Strong Digital Imaging Patents

Apart from the top players, there are quite a few NPEs and SMEs that have strong digital imaging patents. In the past, these companies have successfully monetized their patents, either through licensing or litigation and we can expect them to pursue their efforts.
Table 5: NPEs & SMEs with Strong Digital Imaging Patents

- **Silverbrook Research**: Silverbrook is a research institute founded serial entrepreneur Kia Silverbrook. The institute has a strong digital imaging portfolio with around 82 patents and a significant number of seminal patents. Silverbrook also has a successful technology commercialization and patent licensing program.
- **Digimarc**: Digimarc is a pioneer in digital watermarking technology which enables a user to embed information into images, videos, audio and other objects. It has 159 patents of which 22 are seminal.
- **OmniVision Technologies Inc.**: OmniVision is a leading provider of advanced digital imaging solutions. It is the key provider of image sensors to the popular iPhone 4 and holds 104 patents (and 14 seminal patents) mostly in the field of image sensors.
- **Aptina Imaging Corp.**: Aptina is an imaging solutions company which holds 75 patents and 12 seminal patents, most of which are in image acquisition sub-domain. It provides its image sensors and image processors to major mobile handset OEMs.
- **California Institute of Technology**: Caltech holds 50 patents with 2 seminal patents. It has litigated its patents related to pixel sensor technology against Canon Inc., Nikon Inc., Panasonic Inc., Sony Corp., etc and also has a licensing agreement with Canon Inc.
- **Max Abecassis & Nissim Corp.**: Max Abecassis is the President & CEO of a patent holding company Nissim Corp. It has around 20 patents related to digital imaging and has been involved in 6 litigations. It also has licensing agreements with leading technology companies such as Acer, Fujitsu, HP, Hitachi, IBM, Lenovo, Microsoft, Mitsubishi, Panasonic, Sony and many more.
7 Kodak’s Digital Imaging Portfolio

Kodak is best known as a dominant manufacturer of film cameras and is also a pioneer in digital photography field. Its expertise in the field of camera manufacturing and digital image processing is evident by its relatively large patent portfolio in the image acquisition, image manipulation and image display sub-domain.

Kodak has a substantial portfolio in this field with 1191 patents, but only a small percentage of its patents are seminal (~2%) - lower than its peers in the industry. Also, many of the seminal patents belong to sub-domains (lens and aperture systems, content rework, etc.) which have low infringement detectability despite their importance and technological value. Kodak has some breakthrough technology patents which are very important and significant in the digital imaging landscape. However many of seminal patents are improvement and additions to pre-existing technology.

7.1 Kodak’s Patent Auction

By the late 1990’s, Kodak was mostly dependant on photographic films as the primary source of its revenue. Only after severe financial shocks and a waning film market did Kodak shift its focus to digital photography.

Kodak filed for bankruptcy in January 2012. As a part of its restructuring plan, Kodak focused on utilizing its patent portfolio, especially its digital imaging patents, as an additional means of revenue through their sale and/ or licensing. In June 2012, Kodak
announced to auction its digital imaging patent portfolio and expected to generate as much as $2.5 billion. There were multiple media reports that speculated that initial bids made by interested parties were just north of the $500 million mark. Later Kodak announced that it is continuing to explore alternatives and may form a separate licensing company to repay creditors in its bankruptcy case. However, in December 2012, Kodak announced that it has agreed to sell its digital imaging portfolio to a consortium of companies led by Intellectual Ventures and RPX Corporation for about USD 525 million. This group includes Google, Apple, Samsung, Facebook, Microsoft and other leading technology companies.

### 7.2 Comparative Analysis - Kodak & Other Players

This section (visual map in figure 10.) provides a comparative analysis of Kodak’s portfolio with respect to portfolio of major players in the digital imaging landscape and the complementary strength that Kodak’s patents would add to certain buyers. The map also includes companies such as Google and Apple, who are part of the consortium that successfully acquired rights of Kodak’s portfolio.

![Figure 10: Comparative Analysis of Kodak’s Portfolio with Major Players](image)

- Numbers in bracket indicate the percentage share of patents in the sub-domain.
- Size of circle is indicative of the number of patents
- Vertical position of the circle is indicative of the strength of the portfolio (seminal patents).
• In image acquisition, though Kodak has a large number of patents, it lacks in strength when compared to that of its competitors.
• In image storage, Kodak has the highest number of seminal patents, but lacks the volume it has in other sub-domains.
• In image manipulation and display, it has significant portfolio size, but the count of seminal patents is quite lower compared to other major players.
• In image networking and recognition, both the volume and strength is insignificant compared to other players in the domain. Even potential bidders in the auction have stronger patents than Kodak in these sub-domains.

**Kodak & Microsoft**
Microsoft has strong portfolio in the Image Recognition sub-category. But it has significantly lower number of patents in Lens Systems, Sensor and Filter, Camera Settings (Image Acquisition), Image Enhancement (Image Manipulation) and 2D Display (Image Display). Kodak has a sizeable portfolio in all these areas.

![Figure 11: Comparison: Kodak & Microsoft](image)

**Kodak & Apple**
Apple, a dominant player in the mobile devices segment, has been trying to strengthen its portfolio by buying patents relating to Smartphone technology from various companies. It has negligible digital imaging portfolio across various sub-categories and access to Kodak’s patents definitely adds value.
Google has a decent portfolio in the software domains (i.e. Image Networking and Recognition) but has very low protection on the hardware side (Image Acquisition, Storage, Manipulation & Display). Kodak’s patents in these domains would provide considerable strength to Google’s portfolio.
8 References

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