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APPLYING PATENT INTELLIGENCE TO EXPLORE THE TECHNOLOGY EVOLUTION

Abstract:

Voice data transmission is an important revenue source for mobile communications operators. VoLTE is the technology driver of the growth for 4G LTE voice data transmission. The first wave of VoLTE-enabled devices became commercially available between 2014 and 2016. To understand the global development of VoLTE technology, this study examines VoLTE patent portfolios and identifies area for VoLTE patent applications and commercialization. We recommend that mobile communications companies establish a competitive advantage with VoLTE technology leadership prior to the year 2018. All manufacturers should act expeditiously to develop patent protection for the next generation of voice communications technology. This research provides mobile-telecom service providers, mobile network operators, and terminal equipment manufacturers with an understanding of the VoLTE technology frontier and the competitive status of emerging innovations.

Keywords:

Signal processing, Patent intelligence, Patent map

JEL Classification: O32, O34

1 Introduction

LTE was established by the 3rd Generation Partnership Project (3GPP) and features two characteristics. First, the protocol has data upload rates of up to 75Mbps, with download rates of up to 300Mbps. Those are far superior to any 3G mobile communications systems. Second, LTE is an all-Internet-protocol based network, in which data transmission occurs through packet exchange. The Internetsimplifies network architectures and reduces operating costs (Astely, et al., 2009). However, prior to Voice-over-LTE (VoLTE), LTE networks were incapable of transmitting voice signals. Four common solutions were used to resolve these issues includingCircuit Switched fallback (CSFB), Simultaneous Voice and LTE (SVLTE), VoLTE and Over-the-top (OTT) (Manzer, 2012). CSFB and SVLTE use circuit switch networks to transmit voice calls and were widely used as a transition program prior to the formal adoption of VoLTE. On the other hand, OTT services such as Skype and Google Talk better enabled the transmission of voice data over an all-IP network environment. These type of services are usually provided by a third party rather than directly by network service providers. Although the sound quality is usually limited, the low-price or even free usage has had a significant impact on consumer adaption. Thus, in the long run, telecom operators using CSFB and SVLTE will eventually adopt 4G VoLTE voice communications services as the ultimate solution in direct competition with OTT service providers. According to a Global mobile Suppliers Association (GSA) report from January 7, 2015, a total of 80 operators in 42 countries have invested in VoLTE deployment trials, while 14 operators in seven countries have officially launched commercial VoLTE services (Global mobile Suppliers Association, 2015)

Voice transmission is a key income source for mobile communications operators, and the emergence and acceptance of VoLTE will influence the growth of 4G LTE. The first wave of commercially available VoLTE services will run from 2014 to 2016. To understand the global development of VoLTE, this study analyzes secondary source information using patent mapping and patent trend indicators. In addition to assessing overall technology trends in VoLTE, this study investigates VoLTE patent portfolios. The research results provide insights to the development of VoLTE-related competing technologies and identifies future directions of technology development.

2 Literature Review

2.1 Patent Technology Life Cycle

Patent maps are a visualization of patent analysis results which visually depict complex patent information. Patent maps are divided into two categories: quantitative and qualitative. The former presents trend charts and numerical diagrams, while the later

presents matrices for statistical analysis and data mining (WIPS, 2003). This study uses quantitative analysis to depict the overall VoLTE technical development trends. Matrices of patent data are need to categorize and segment VoLTE technologies. Patent indicator calculations are investigate the development status of each VoLTE technical domain. This study further uses S-curves to predict patent growth trend and to determine global VoLTE technology and commercialization developments at various life cycle stages. The patent trends are compared to provide insight into the gap between technical development and commercialization. Many models are used to track exponential growth (e.g., animal populations or technical performance), but growth trends are limited by negative environmental factors. The development often matures or achieves equilibrium (Meyer, Yung, & Ausubel, 1999). Therefore, S-curves are often used to predict the life cycles of a given technology. S-curves are calculated based on saturation, midpoint and growth rate according to the following equation (Loglet Lab, 2015):

$$p(t)=\frac{k}{1+e^{\left[\frac{\ln(81)}{-a}(t-b)\right]}}$$

where k is the saturation value which determines the upper limit of the range of overall growth, a is the growth rate $\frac{\ln(81)}{-a}$ which indicates the time needed for the saturation value to increase from 10% to 90%. The value b is the inflection point, where p(t) achieves a saturation value of 50% at time t, at which point growth slows and matches life cycle maturity.

2.2 Evolution of Voice Services over LTE

VoLTE was developed in 2010 by Global Systems for the Mobile Communications Association and was included in the 3GPP criteria (GSMA, 2015). VoLTE uses IMS for IP voice transmission, reducing the need for 2G/3G circuit switching networks. VoLTE networks are about three times faster than 3G UMTS and about six times faster than 2G GSM (Elkin, 2014), thus VoLTE provides additional network capacity for improved service, including HD Voice and other services. To use VoLTE for voice communications, telecom providers must deploy IMS. According to Spirent, VoLTE architectures include the following elements: LTE user equipment which supports 4G LTE smartphones, tablet computers and other terminal equipment Evolved Node B is used to link the UE and LTE network hardware for transmission scheduling; a serving gateway (SGW) for data packet transmission scheduling and delivery; a packet data network (PDN) including IMS and internet, with evolved packet cores with different gateways responsible for processing data transmission through the network; a Mobility Management Entity (MME) responsible for providing UE services, node selection and roaming restrictions; a Home Subscriber Server (HSS) to store customer information; a Policy and Charging Control (PCRF) responsible for policy and decision-making, including service quality and payment

decisions; an Authentication Authorization and Accounting (AAA) protocol to perform customer authentication, authorization and billing, including implementing customer service to control prices and quality service levels; an Application Server (AS) responsible for managing applications and services; a Call Session Control Function (CSCF) responsible for establishing, monitoring, supporting and releasing a variety of multimedia functions, and for dealing with Session Initiation Protocol signal data in the IMS system (Spirent, 2014; Kottapalli, 2011; Hart & Brown, 2013).

3 Applying Patent Intelligence to Explore Volte Evolution

This study uses patent analysis to assess global VolTE technology trends and related patent portfolios. Thomson Innovation provided the patent search results and patent mapping tools. Thomson Innovation collects patent information from multiple patent offices worldwide and reorganizes the information in terms of patent advantage, usage and novelty.

3.1 VoLTE Patent Search

This study uses Voice over Long-term-Evolution and its various acronyms for keyword searches in the title, abstract and claims of patents filed prior to December 31, 2014. The search was restricted to the 3rd level subclass International Patent Classifications related to LTE (National Applied Research Laboratories, 2013). The search results included 194 patents, four of which were excluded for irrelevance, leaving a total of 190 confirmed patents for subsequent analysis.

3.2 Patent Maps Analysis

Figure 1 shows the global distribution of VoLTE-related patents, with the five top patent holder being the US, followed by Korea, China, the EU and Japan. These five countries are not only key patent holders for VoLTE, but are also key VoLTE markets. In 2012, Korea and the US were among the first to roll out VoLTE commercialization followed by Japan in 2014. In the EU, German, Denmark and Romania launched commercial VoLTE services, while Italy, the UK, France and Spain are expected to launch such services in the near future (Global mobile Suppliers Association, 2015). In China, China Mobile is expected to launch VoLTE commercial services by the end of 2015 (c114, 2015).

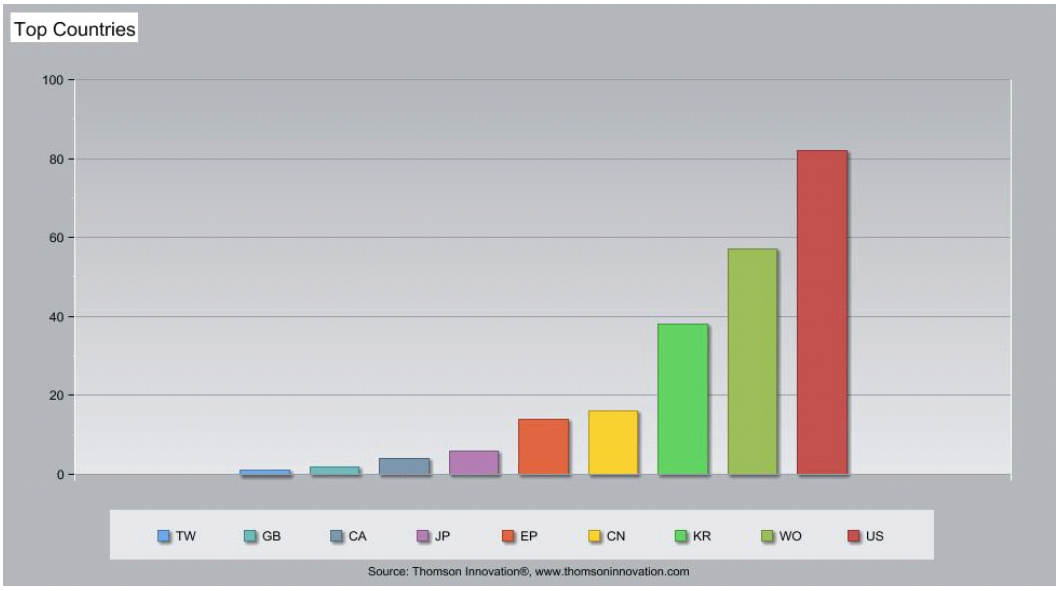

Fig.1 Top countries for VoLTE patents

3.3 Volte Technology and Commercialization Life Cycle

Based on the VoLTE commercialization status as shown in Section Introduction, this study uses Loglet Lab 3.0 to forecast the VoLTE technology and commercialization life cycle. Figure 2 shows the S-curve for the predicted results, indicating that there is a gap of about a year between VoLTE patent publishing and commercialization. The current number of patents has yet to reach 50% of the saturation value, indicating that VoLTE has considerable room for growth both in terms of the number of patents and commercial operators.

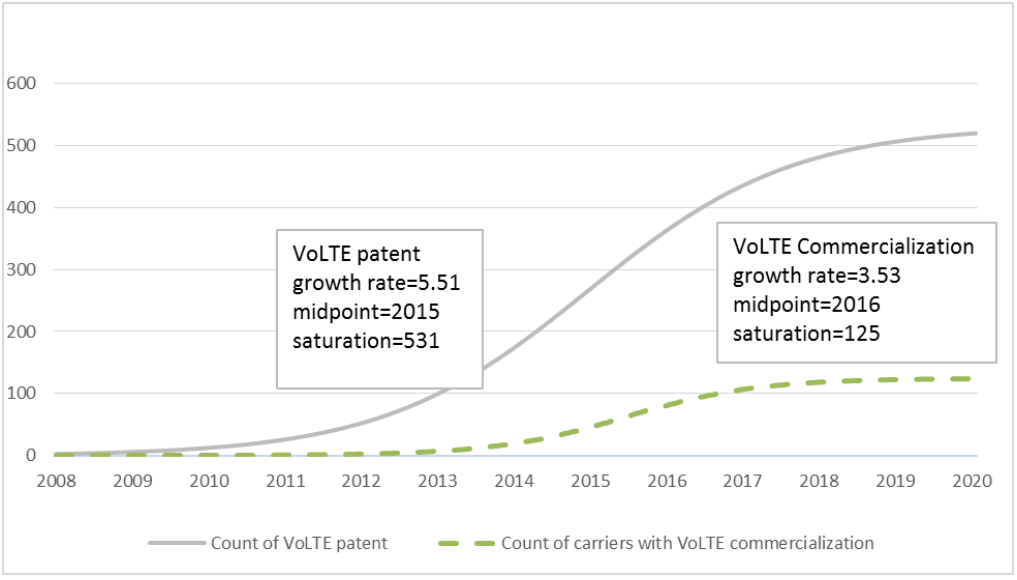

Fig.2 VoLTE S curve

4 Conclusions

VoLTE is the ultimate solution for high-quality LTE voice transmission, and is driving the development of the mobile communications industry. This study uses patent analysis to investigate VoLTE technical development trends and the technical position of related patent holders. Patent mapping techniques are used to assess overall VoLTE technical trends and to identify key countries and regions in terms of patent holdings, and uses S-curves to predict the VoLTE technical and commercialization lifecycles. Analysis results show an overall growth trend in VoLTE patent application numbers, led by the US, Korea, and China. Analysis of the patent holding structures in these countries and regions suggests a correlation between patent holding by local telecom operators and VoLTE commercialization, suggesting local operator support is a key factor in promoting VoLTE commercialization. Comparison of technical and commercialization lifecycles suggests that basic patent applications will peak in 2017 and saturate, while patents in 2017 and 2018 will largely focus on specific applications. By 2018, all manufacturer R&D should be refocused on the next generation of voice communications technologies. This research provides mobile-telecom service providers, mobile network operators, and terminal equipment manufacturers with an understanding of the VoLTE technology frontier and the competitive status of emerging innovations.

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