

# Analysis of Patents Declared as Essential to GSM as of June 6, 2007

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## Introduction

Fairfield Resources International has conducted a study, with financial support from a wireless equipment maker, of intellectual property related to GSM cellular technology. This technology is embodied in standards documents published by the Third Generation Partnership Project, accessible at [www.3gpp.org](http://www.3gpp.org). The aims of the study are to examine the nature of the technology covered by the intellectual property, the ownership of the intellectual property and the extent to which technical experts judge the intellectual property to be *technically essential* to implementing the standards. This report analyzes standards published and patents issued up to June 6, 2007. The methodology followed in this study is substantially the same as we used in our earlier paper, in which we reported on standards published and patents issued prior to February 2004 [Goodman, David J. & Myers, Robert A. 2005. 3G Cellular Standards and Patents, Proceedings of IEEE WirelessCom 2005, June 13-16, 2005, <http://www.frlicense.com/wireless2005-b.pdf>]. That study was recently extended to patents declared and issued as of [December 31, 2005](#). The only significant change in our process, apart from the cutoff date, is that for the present study we only reviewed patent families in which there is a declared issued US or EP patent or a declared US or EP application which has issued prior to June 6, 2007.

## Technology Categories

We selected the following categories with which to characterize the patents declared as essential to the WCDMA standards as being both descriptive of the major technical elements of the CDMA technology and being reasonably distinctive. In order to maintain continuity with our earlier studies of WCDMA essential patents, we have used the same categories to characterize the patents declared as essential to GSM (except that what was referred to as “CDMA” in the earlier study we now classify as “radio signals) although in a few instances a slightly different classification might be more illuminating. For example there is a higher proportion of “network” patents declared essential to GSM than to WCDMA. In a separate GSM study, it could be helpful to define a set of more specific categories that together comprise the “network” category originally defined in the WCDMA analysis. For the present study, where a patent might fall in more than one category, we chose the dominant one.

**Antenna.** Most of the antenna patents apply to base stations and or terminals with more than one antenna. The patents specify how to coordinate transmissions from multiple antennas and how to combine signals received on multiple antennas.

**Call management.** Procedures for establishing, maintaining, and breaking connections between devices in a phone call or a data session.

**Channel coding.** Wireless communications systems are vulnerable to transmission errors (the transmitter sends “one”, the receiver detects “zero”). Channel codes add redundancy (extra ones and zeros) so that the correct transmission can be detected by the receiver even if some of the ones and zeros have

been reversed.

**Circuits.** Electronic circuits for realizing functions specified in the standards.

**Data.** Techniques for communicating digital data (as distinct from voices or pictures). Many of the patents in this category apply generally to data transmission techniques, not necessarily cellular (even though they may have been devised as part of 3G cellular development and included in 3G standards).

**Facsimile.** Communicating standard telephone fax signals in a 3G network.

**Handover.** Transferring a communication from one antenna in the fixed part of the radio access network to another.

**Layer 2.** Certain cellular communications signals share the same channel with one another. Layer 2 protocols, especially media access control (MAC) establish rules for granting access to one signal at a time while the other signals wait their turn. Other Layer 2 protocols deal with signals that have not been received correctly. The receiver instructs the transmitter to send additional information that will enable it to detect the original signals correctly.

**Location.** In order to set up a communication with a mobile phone, the network has to know which base station the phone is in contact with. To make this possible, an inactive phone sometimes sends a registration message to the network. When the network has to set up a communication, it pages the phone at base stations near the one that received the latest registration message. The patents also disclose technology for determining the geographical coordinates of a phone (or other wireless device).

**Network.** Techniques for coordinating the operations of elements of a cellular telephone system's infrastructure, including base stations, switching centers, routers, and databases. This category also includes patents covering network management procedures for maintaining the long term health of a network and insuring that it meets quality objectives. The telephone industry sometimes refers to OA&M: operations, administration, and maintenance. Examples include fault location and provisioning (deciding where and when to replace old equipment or add new equipment to a growing network).

**Radio signals.** These patents cover the signals transmitted between terminals and base station. Many of them relate to CDMA codes (sequences of ones and zeros used to transmit each unit of information). Others present modulation techniques that transform the ones and zeros into radio signals to be transmitted at specified frequencies.

**Radio resources.** Efficiently managing transmitter power levels and bandwidth occupancy of the signals that share the same radio spectrum.

**Security.** Encryption of information to prevent eavesdropping. Authentication to ensure that only authorized users have access to networks.

**Source coding.** Compression techniques for representing speech and pictures as a sequence of numbers.

**Synchronization.** Base stations and terminals transmit sequences of ones and zeros, divided into data units, each containing a prescribed number of ones and zeros. Synchronization techniques enable a receiver to determine the beginning and end of each data unit within a continuous binary data stream.

**TDMA.** Time division multiple access. Signals sent to and from different terminals are transmitted at different times.

**Terminal.** Patents covering technologies located entirely or predominantly in subscriber equipment. Some of these patents cover SIM (subscriber identity modules). Others cover over the air programming of terminals.

## Process Followed

The lists of declared patents and patent applications compiled by ETSI (European Telecommunications Standards Institute) contains several thousand distinct entries. Each patent or application is published by either a national patent issuing office or the European Patent Office. However, the number of inventions is considerably smaller mainly because it is customary for inventors to patent a single invention in many different countries.

Moreover, the IPR declarations often include both a patent application and the issued patent.

A major task in our study was to select patents to evaluate. Among the unique patents and patent applications, the first selection criterion was to evaluate only issued patents. To do so, it was necessary to examine each declared application to determine whether the application eventually resulted in an issued patent. The study evaluated patents issued and declared as essential on or before June 6, 2007 to the extent this information is available. We have omitted from our final results any patents which expired during the course of our study as well as any patents judged essential by our experts which had been revoked or had otherwise lapsed.

To make the steps involved clearer, we provide the following high level picture of the process flow Fairfield followed in this study.

1. Establish Criteria and Priority for Patents to Review
  - EP/US declarations only
  - Active
  - Issued on or before 6-6-2007
2. Find Declared Patents and Standards on Standards Organization Sites
  - [www.etsi.org](http://www.etsi.org) [European Technical Standards Institute]
3. Search On-Line Patent Sites for Family Data
  - [www.delphion.com](http://www.delphion.com)
  - [www.espacenet.com](http://www.espacenet.com)
  - [www.uspto.gov/pair](http://www.uspto.gov/pair)
4. Find All Issued Declared Patent Applications Meeting Criteria
5. Remove Chaff
  - Duplicates
  - Expired or abandoned patents
6. Assign Patents to Appropriate Technology Category
  - Two categories per patent where appropriate
7. Review List for Obviously Non-essential Patents
  - Categorize them as “not essential”
8. Distribute Remaining Patents to Experts for Review
9. Expert Review
  - Review each and every independent claim
  - If necessary for clarification, review patent specification
  - Review section(s) of standard covered by independent claims

- Determine essentiality
10. Edit Reviews for Consistency.<sup>1</sup>
- Determine expiration date of essential patents

For initially reviewed *non-essential* patents

11. Find and Review All Issued Family Members for Essentiality
- Same jurisdiction as patent initially reviewed
  - Continuations
  - Divisionals
  - Other patents listed on cover page, i.e. “related patents”

12. Analyze Results and Prepare Report

In this project a total of 1074 patents were reviewed, with an average of approximately 1:10 spent on each patent. In some cases, the non-essential rationale was obvious to the reviewer, and therefore it was not fully elaborated. Often the short rationales are associated with the patents for which reviewers were sure of the assessment and longer rationales are associated with the patents where reviewers were less sure of the assessment. Hence the reviewer examined every point to convince himself or herself about the assessment. In some cases, in contrast, the method covered by the claims is *prima facie* not relevant to GSM – for example, all claims refer to spread spectrum techniques -- and, consequently, the rationale does not refer to any specific claims.

## Patent Families

Although widely used, the term “patent family” is not an accepted “term of the [patent] art” and is thus subject to misinterpretation due to different parties using it differently. Since an understanding of the concept is basic to our process, we provide the following overview of the topic, with links to related web sites.

There are four patent databases for identifying patent families, and each deals with these families differently.

- [World Patent Index \(WPI\)](#) - Derwent Information Ltd.
- [INPADOC](#) - EPIDOS, The European Patent Office
- [EDOC](#) - INPI, The French Patent & Trademark Office
- [CAS](#) - Chemical Abstracts Service

None of these databases provide a complete patent family. Since there are over 170 countries which grant patent protection and INPADOC, which covers the most countries, only covers 60 countries, these databases do not provide a comprehensive survey of patent

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<sup>1</sup>This consisted of polishing grammar and spelling, assuring that the rationale language is consistent with the reviewer’s assessment and removing irrelevant comments.

protection. Also, these databases do not necessarily provide complete coverage for the countries they do cover.”[<http://www.piug.org/patfam.php>].”

In our study, the operational definition we used is either the field “patent family” accessed on the [www.delphion.com](http://www.delphion.com) web site or the INPADOC family data provided by [www.espacenet.com](http://www.espacenet.com). The source of both for this data is INPADOC [International Patent Documentation Center], maintained by the European Patent Office. Since our study was limited to the US and the EP, the differences between the patent family data in these four databases was not judged to be material.

There are essentially four different kinds of members of a patent family.

**Counterpart patents and applications.** Since a patent is only enforceable in the jurisdiction in which it has been issued, inventors often file for patents in multiple countries. This is particularly common in fields like telecommunications where the invention may be practiced globally. In order to obtain coverage in a country, the initial patent application, including the claims, must be translated into the local language and the application must be examined and approved by the national patent office. Even though all counterpart patents (“family members”) are based on the same invention and the specifications differ only in translation nuances, negotiation with examiners and the process of translation may lead to significant differences between the different foreign counterparts. In our study, since both United States patents and European patents are written in English, there is no translation issue. We do not believe there is a significant risk from differences in claim language resulting from the examination process. The number of Japanese (and other major economy) patents declared to ETSI for which there is no EP or US counterpart is *de minimus*.

**Continuations and continuations-in-part.** “A *continuation* is a second application for the same invention claimed in a prior nonprovisional application and filed before the original prior application becomes abandoned or patented. The disclosure presented in the continuation must be the same as that of the original application; i.e., the continuation should not include anything which would constitute new matter if inserted in the original application. A *continuation-in-part* is an application filed during the lifetime of an earlier nonprovisional application, repeating some substantial portion or all of the earlier nonprovisional application and *adding matter not disclosed* in the said earlier nonprovisional application”. [US Manual of Patent Examination Procedure] Continuations and continuations-in-part are not permitted by the EPO or the JPO. United States inventors have the ability to “continue” a patent application by filing a new patent application which claims priority from the initial filing date but which has new claims which must, however, be based on the original specification which is ordinarily not changed [possibly except for typographical corrections]. The continuation application’s claims must be examined and approved as would an original patent application. A continuation may itself be continued. Inventors may file for a continuation to in effect obtain a further examination, (e.g., when they are unable to persuade the examiner regarding their position) or to adapt the initial claims to cover new products, services, or technologies. A continuation-in-part may also provide a mechanism for extending the life of a patent.

**Divisional patents.** “A later application for an independent or distinct invention, carved out of a pending application and disclosing and claiming only subject matter disclosed in the earlier or parent application, is known as a divisional application or "division." A divisional application is often filed as a result of a restriction requirement made by the examiner.” [US Manual of Patent Examination Procedure]. A common reason for such restrictions is the case in which the initial patent application is judged by the examiner to cover more than a single discrete invention. As in the case of continuations, the specification [“disclosure”] for all of the divisional patents is usually unchanged. Since divisional patent applications need not be contemporaneous with the original application, such applications offer another means to “tune” a patent’s claims to changing circumstances. Divisional patents are permitted by the EPO, and provide a kind of alternative to continuations where this is allowed by the patent office. Divisional applications are also available in Japan, for example, “when (a) the claims are rejected due to lack of unity of invention, (b) a part of the claims is rejected, (c) a desired amendment cannot be made due to restriction on amendment or (d) a pending application (insurance) is needed.” <http://www.taniabe.co.jp/e/infomation/main-patent023.html>

**Related patents.** “Related patent applications are those filed after an initial original application is filed but before it is issued as a patent and that involve similar or related technologies. For example, an inventor may come up with an improvement to technology disclosed in an earlier filed application. Instead of filing a new patent application for the improvement, the patent laws allow the inventor to supplement the earlier application by filing a continuation-in-part (CIP). A CIP is just one of the several types of related applications.” [David Radack, *Understanding “Related” US Patent Applications* <http://www.tms.org/pubs/journals/JOM/matters/matters-0406.html>]. The four different sources of patent family information do not follow a single procedure for linking family members. One linkage would be all patents claiming the same priority date. Another would be a series of patents with the same title and inventors but different priority dates. Yet another would be patents with the same title but different inventorship, as might be the case in a divisional patent. Different primary sources (INPADOC, EDOC) might not agree on all the “related” members of a family. In INPADOC, priority numbers and application numbers are used for establishing family links. The USPTO does not appear to have a hard and fast rule about what constitutes a “related patent” and a patent applicant may state in his application that it is related to other pending or issued patents. As a practical matter, we solved the problem of which member of a declared patent family to review by reviewing *all issued members in the same jurisdiction*<sup>2</sup> of a declared patent which was judged non-essential. Out of 152 such families, nine additional families were found to have at least one essential patent.

## Summary of results

The results we report below are for analyses of a single patent in each of 561 patent

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<sup>2</sup> If there was an issued EP patent, we reviewed all EP patents in that patent’s family; if not, and there was an issued US patent, we reviewed all US patents of that patent’s family.

families declared essential to GSM, GERAN or ARM following the methodology in our previous study, with the further modification that we restricted this study to families in which there was an issued US or EP patent. There were, in addition, 62 US or EP patents declared as essential which had already expired or lapsed or were obviously not relevant to GSM standards<sup>3</sup>. The source for the declarations is the web site of [ETSI](#), the European Telecommunications Standards Institute. For each of these patents, we have identified the technology claimed and the patent owner. A panel of technical experts has compared the technology in each patent with the specifications in Release 6.0 of the GSM standard and judged whether the patent is essential according to the ETSI definition:

*"ESSENTIAL" as applied to IPR means that it is not possible on technical (but not commercial) grounds, taking into account normal technical practice and the state of the art generally available at the time of standardization, to make, sell, lease, otherwise dispose of, repair, use or operate EQUIPMENT or METHODS which comply with a STANDARD without infringing that IPR.*

The following charts present the distributions of patent technologies and patent ownership of the 561 patent families selected for the study and the 158 families (27%) judged essential to GSM by the technical experts. We also relate these results with those in our most recent earlier report as noted above. The 158 families in which at least one family member was judged essential include nine families in which the patent initially reviewed was judged non-essential. In three of those nine families, three patents each were judged as essential. The charts below include families in which one or more patents were judged essential<sup>4</sup>.

In addition to asking our experts to judge whether or not a patent is technically essential to GSM we were also able to note which of the patents declared as essential to GSM had also been declared as essential to WCDMA and, using the data in our previous report, which of those patents had been judged essential to WCDMA: 182, or one-third of the patents declared as essential to GSM were also declared as essential to WCDMA. Of these, 26 were judged as essential to both GSM and WCDMA. We also categorized these by their primary technology field.

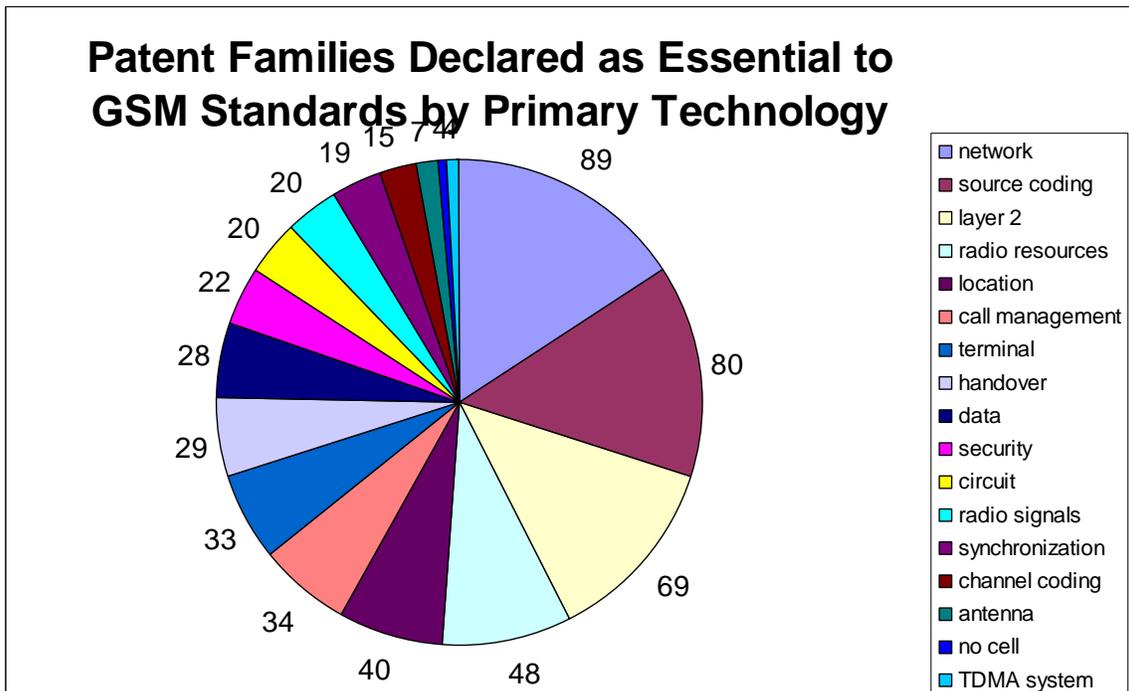
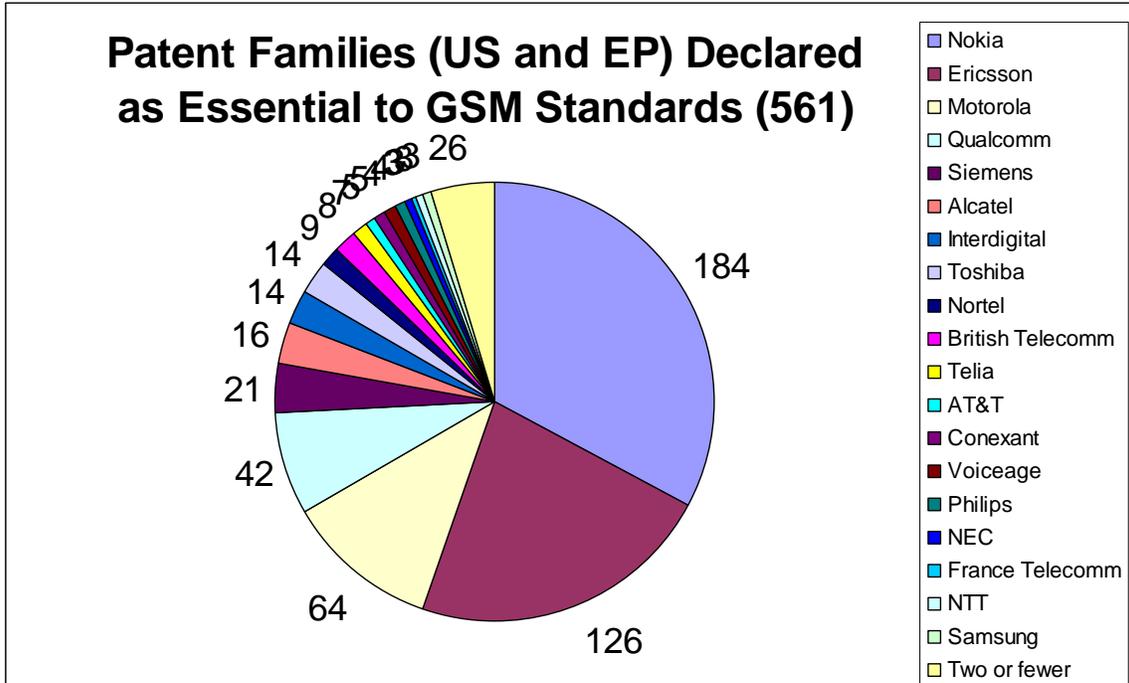
Finally, we have recorded the distribution of expiration dates for the patents our experts judged as essential to GSM.

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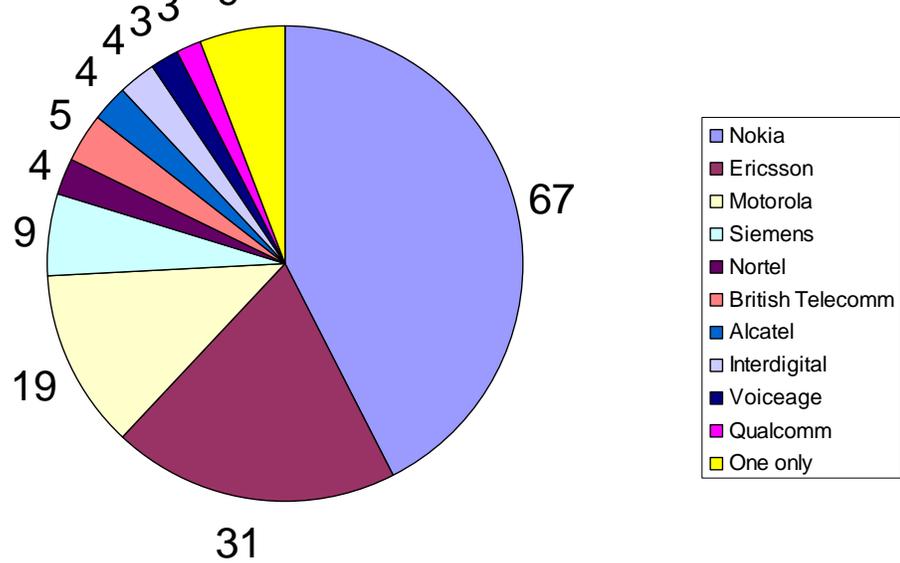
<sup>3</sup> There were a handful of cases for which the number of the patent declared to ETSI (or the number of a member of a declared patent's family) was obviously a typographical or transcription error. These were removed from our results.

<sup>4</sup> Note that if our experts found a patent to be essential, no further patents in that family were reviewed. Only for the families in the "continuation study" were all (US) members reviewed.

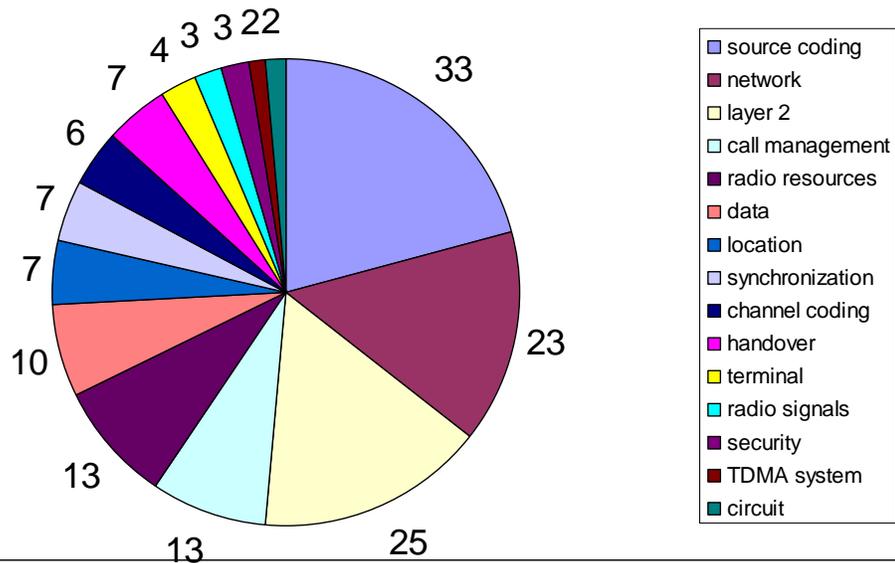
# Data



### Patent Families Judged as Essential to GSM Standards (158)

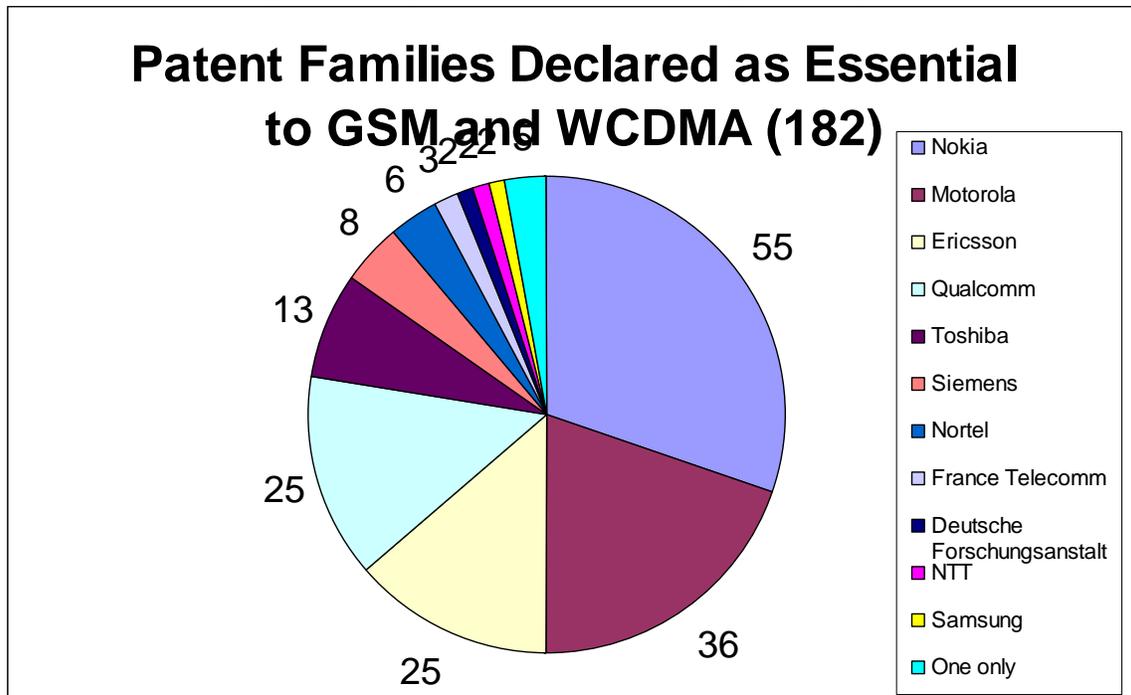


### Patent Families Judged Essential to GSM Standards by Primary Technology

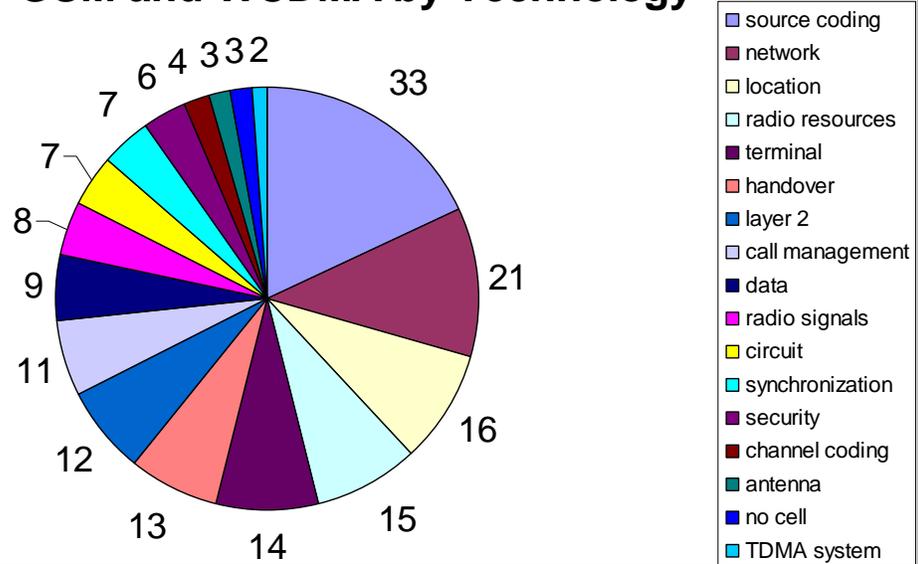


Expiration Year	Number of Essential Patents
2024	3
2023	4
2022	6
2021	11
2020	15
2019	21
2018	24
2017	18
2016	17
2015	17
2014	8
2013	2
2012	4
2011	2
2010	2
2009	1
2008	3

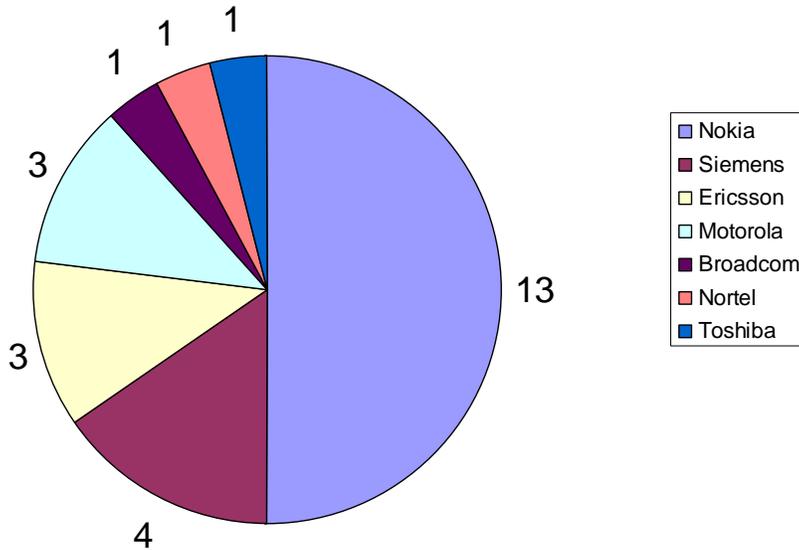
The following charts present the data for patents which were declared as essential to both WCDMA (from our previous report) and to GSM (in the present report).

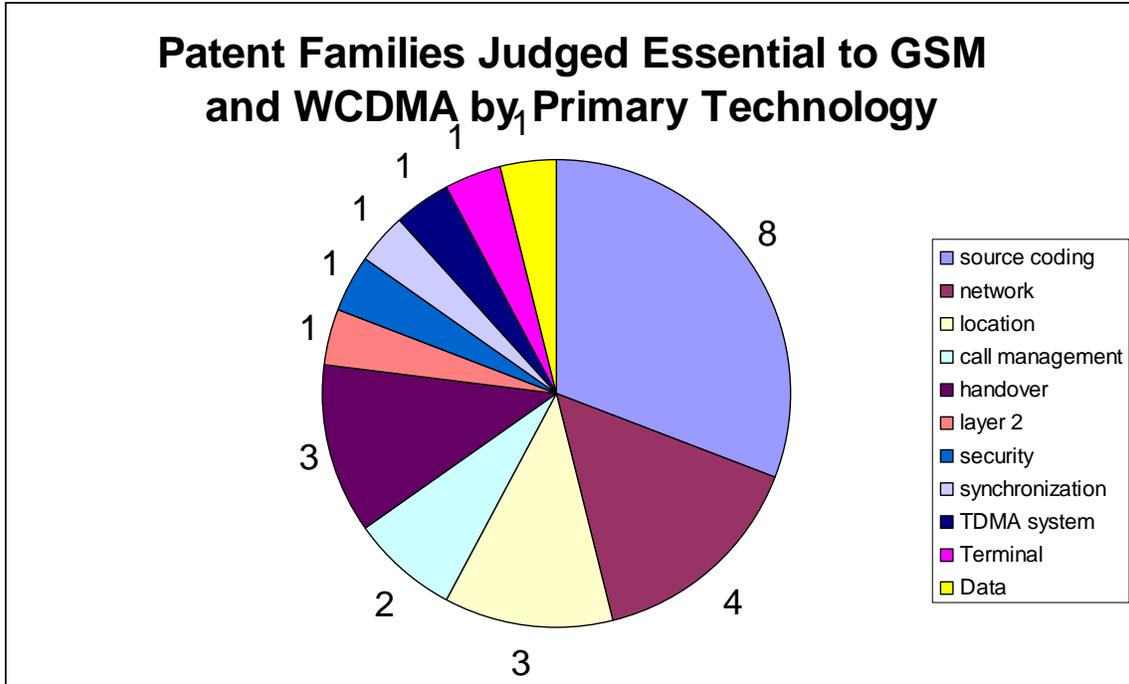


### Patent Families Declared as Essential to GSM and WCDMA by Technology



### Patent Families Judged Essential to GSM and WCDMA (26)





### Discussion of Results

In contrast with our WCDMA analysis, Nokia, Ericsson and Motorola are the primary patentees of patent families declared as essential to GSM. Qualcomm, with primary technical strength in CDMA technology has a smaller proportion of patents declared essential to GSM than to WCDMA. Note that although we have removed multiple essential members of the same patent family, even if we had counted all of these patents the leaders would not have changed. Approximately 10% of the declared US and EP patents and issued applications have expired. In view of the early establishment of the GSM standard, this is not surprising. Even so, only twelve of the patents judged essential will expire within the next five years. In contrast with WCDMA declared essential patents, the technologies of the GSM families declared essential as well as the patents declared as essential to both GSM and WCDMA are dominated by network and source coding, while in the WCDMA study declared patents that apply to “radio signals” are more prominent than in GSM. The reason is that GSM standards rely on TDMA (time division multiple access) for transmission of radio signals. TDMA was already a mature technology when GSM was standardized. On the other hand, GSM incorporated a large number of networking innovations, whereas WCDMA, while adopting much of the GSM networking technology, introduced innovations on the radio side. Meanwhile, source coding technology for decades has advanced steadily, largely in synchronism with Moore’s Law and both standards are set up to benefit from source coding advances as they become available.

As we stated in our earlier publication, the evaluations performed by the experts in this study are *preliminary technical* assessments. By contrast, determining the scope of a

patent and its commercial value can consume several days of effort by lawyers and engineers and weeks or months of adjudication by judges and juries. Therefore, as in our previous study, we suggest that the data be regarded as a statistical indication of the ownership and technology covered by patents that are essential to implementing the GSM standards. Our methodology, which includes reviews of different patents by different experts embodies controls across the large number of patents reviewed which assure the reliability of the analysis on an aggregate basis. We have further enhanced the validity of this study by reviewing all members of the family of a declared patent initially found to be non-essential, whether or not they were declared, thus providing a higher probability that at least one member of a declared family would be judged as essential. .