

# Exploration of 5G Standards and Preliminary Findings on Essentiality

BY



# Introduction

As we create and consume ever greater amounts of data, telecommunication technology becomes increasingly important and integrated into our lives. The latest major wave of innovation, 5G technology, is poised to transform society with applications from remote surgery, to IoT, and autonomous vehicles.

But behind our data-saturated world and rapid pace of innovation is another story. The hidden story of how innovation is incentivized, rewarded, and commercialized through standard essential patents (SEPs) - and the emerging challenges in the system that supports them.

The preliminary report is the first of a series of analyses by GreyB that aims to bring greater transparency to the landscape of 5G standard essential patents. The patent data is large, opaque, and highly technical. Our focus will be on making the data more accessible and comprehensive. The issues are nuanced and complicated. We hope that this report and the following reports enable the many stakeholders involved to have more effective discussion and make better decisions.

# 5G Standards

If you're already familiar with 5G standards and standard essential patents (SEPs), then you can skip this section. If not, please take a moment to familiarize yourself with some of the key terms and technical subject matter.

## Standards and Standard Essential Patents (SEPs)

Standards are documents that set forth technology specifications and requirements, that when followed, provide certainty that the processes, devices and systems adhering to them will perform reliably.

5G technology standards are very complicated documents. Essentially, they cover one or more of three different parts of a communications network:

- User Equipment (UE): the requirements necessary for handheld or consumer devices, such as smart phones, to operate on the network;
- Radio Access Network (RAN): the requirements for a base station to transfer signals between multiple UE and the core network;
- Core network: covers network infrastructure supporting UE and base stations.

Patents, which help protect the rights of the innovators who contribute to building the standard, may be declared as potentially essential and relevant to the standard. These are known as SEPs. Declaration does not require verification. Verifying that a patent is essential to a particular standard is a complex task requiring significant time from experts in the field.

## Governing bodies

### International Telecommunications Union

The International Telecommunications Union (ITU) is the global organization responsible for worldwide standardization of telecommunications. The ITU Radiocommunication Sector has responsibility for governing the worldwide use of the radio-frequency spectrum and satellite orbit resources to make certain this spectrum is used effectively. The ITU-R has defined three main types of uses of 5G in its document ["Framework and overall objectives of the future development of IMT for 2020 and beyond"](#)

1. Enhanced Mobile Broadband (eMBB): much faster data speeds and capacity allowing for fixed wireless internet access (direct wireless transmission from cell tower or small cell to home) and increased connection speeds for mobile
2. Ultra-Reliable Low Latency Communications (URLLC): benefits to areas such as IoT, remote surgery and autonomous/connected vehicles through real-time control, safer transport networks and low latency communications
3. Massive Machine Type Communications (mMTC): benefits to IoT, allowing connection to billions of devices.

# ETSI

ETSI is the European Telecommunications Standards Institute, a non-profit standard setting organization (SSO) tasked by the ITU (International Telecommunication Union) with setting 5G technology standards.

ETSI invests significant sums of money and resources in the preparation, adoption, and application of standards. In addition, ETSI takes fair and reasonable measures to ensure that the essential patents that hold technologies with standards and technical specifications are available for potential and interested parties in accordance with fair and reasonable terms.

The first 5G related specifications were kicked off by the 3G Partnership Project (3GPP) in March 2016 to develop New Radio Technology to meet the ITU-R 5G requirements. These specifications were released by 3GPP. ETSI has been responsible for developing these and more than 500 additional specifications related to the New Radio Technology.<sup>1 2</sup>

Between then and December 31, 2019 more than 500 specifications related to 5G technology have been introduced by the standard body. Developing this technology requires significant R&D investment which, in addition to a cost, is a significant risk. These and future companies who contribute to 5G depend on two things to recoup their investment: royalties from standard essential patents and successful commercialization of their technology. Both of these are directly tied to standards.

Standards organizations require members to disclose patents that may be considered essential and grant licenses to their patents and pending patent applications. Licensing activities should follow the obligation of F/RAND which stands for to be on terms that are fair, reasonable, and non-discriminatory.

1 - [https://www.3gpp.org/ftp/tsg\\_ran/TSG\\_RAN/TSGR\\_71/Docs/RP-160671.zip](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_71/Docs/RP-160671.zip)

2 - [https://www.3gpp.org/news-events/1929-nsa\\_nr\\_5g](https://www.3gpp.org/news-events/1929-nsa_nr_5g)

# The role of standards in innovation

Standards benefit businesses, policy makers, and society in general.

- They promote innovation in the market through rewarding R&D
- Help to commercialize the technology and bring products to market faster
- Ensure and define interoperability and interchangeability which gives manufacturers and consumers more choice
- Encourage improvement and competition in the market
- Help protect consumer safety<sup>1</sup>

They balance cooperation and competition among innovative companies such that the net benefit is greater than the sum of their individual parts.

Manufacturers who implement standardized technology get an even playing field - a blueprint from which they can all build from at a predictable cost. This encourages more companies to participate in a market and innovate around the core technology.

Standards provide the ground rules for different devices, systems and processes to work together. Interoperable and interchangeable products gives consumers more choice and that encourages market pressure towards better, safer, and cheaper products.<sup>2</sup>

Finally, standards provide policymakers with well-documented baselines and rules for implementation which helps them to understand the implications of new technology and take action to protect consumer, business, societal interests.<sup>3</sup>



The National Electrical Code in place in the United States is the result of standardization efforts for electric lamps (lightbulbs) and brought about more convenience, lower prices and greater safety for consumers.<sup>4</sup>



Open standards, such as Ethernet, TCP/IP, and HTML allowed computers to talk to one another, allowing for interoperability and ease of digital communications. This led to the creation of massive growth and new industries.<sup>5</sup>

1 - [https://ec.europa.eu/growth/single-market/european-standards/policy/benefits\\_en](https://ec.europa.eu/growth/single-market/european-standards/policy/benefits_en)

2 - <https://www.bsigroup.com/en-GB/standards/Information-about-standards/standards-and-new-business-areas/>

3 - <https://www.etsi.org/standards/why-standards>

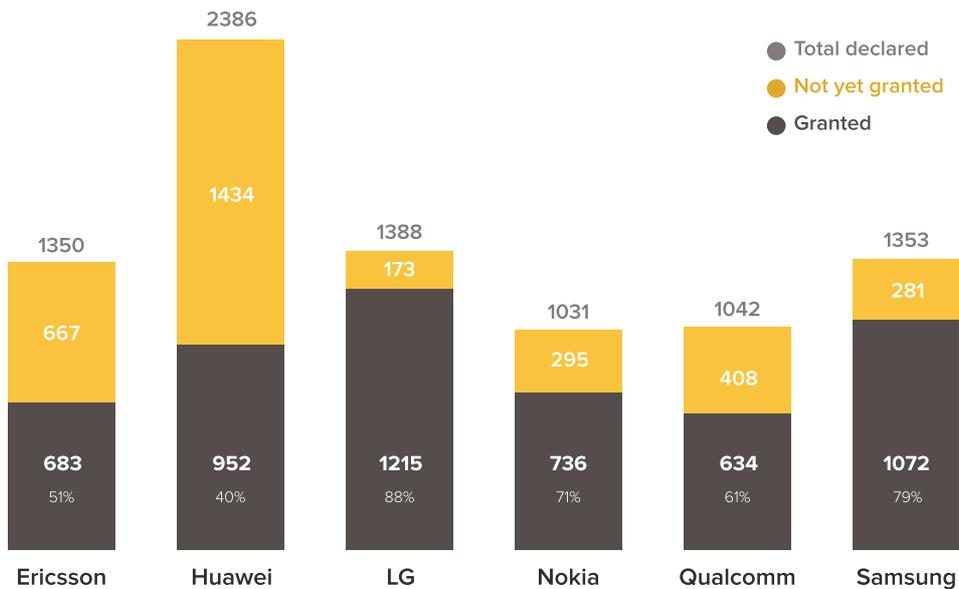
4 - <https://www.standardslearn.org/lessons.aspx?key=26&okey=5>

5 - <https://ripple.com/insights/a-brief-history-of-standards/>

# The state of 5G SEPs

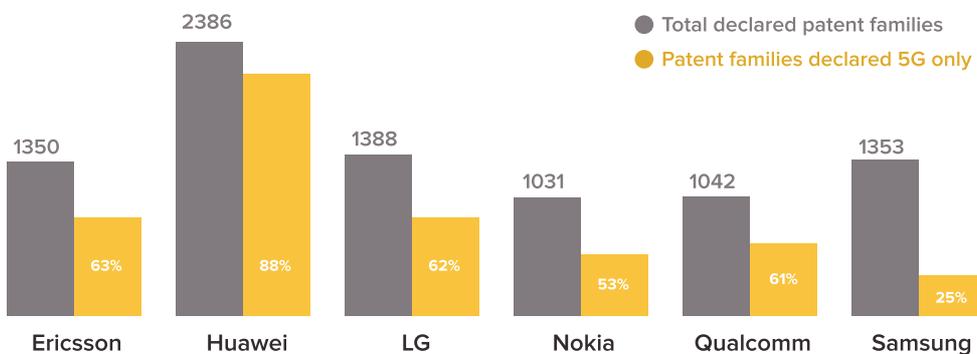
5G is expected to create or enable entirely new industries, greatly benefiting society. Potential applications range from medical applications like remote surgery to automotive such as self-driving. Internet of Things (IoT) in particular is expected to be transformed by 5G. According to ETSI, 12,002 patent families have been declared as of March 19, 2019.

## Who are the players?



While we don't yet know what products and markets will emerge, we do know who the main players are in developing this technology. To determine this, we took the 12,002 patents declared to ETSI and limited that to families that included at least one alive and granted patent as of December 31, 2019. After cleaning and analyzing the assignee data we found that six companies hold the majority, 71%, of the declared standard essential patents families. The remaining 29%, are held by approximately 65 entities.

## How many patents are declared to 5G only?



While examining the data we found that many patents were declared not only to 5G standards but also to previous standards as well. It is perhaps not surprising to note that companies with more published applications also have a greater number of 5G only declarations.

# The problem with standards

Standards are meant to incentivize and reward the technology creators while making that technology widely available to the manufacturers who implement and sell products.

When the implementors and SEP holders negotiate licensing terms, the process of determining royalty rates and essentiality is fraught with disputes and challenges. The reality today is that determining royalty rate or royalty share involves significant time, effort, and resources. In theory, these problems can be greatly mitigated by understanding the landscape of SEP declared patents. In practice, however, correctly determining essentiality requires significant time and effort. Even then, determining how to calculate royalties and interpret SEPs in an accurate and transparent way is difficult.

While we've attempted to give an overview of the issues here, but by no means capture the full breadth, depth, and nuance of each of these issues. These topics are the subject of many on-going discussions and deserve healthy debate. The issue that this series of reports will focus on is understanding the landscape of SEP patents and essentiality.

## Why all the confusion?

Theoretically, clear and defined licensing rates make the system more efficient because innovators and manufacturers alike don't need to negotiate or litigate again and again over cost and access to the standardized technology. In practice, this isn't happening.

To understand why, we need to take a closer look at the process of declaring SEPs and the system of incentives built around them. First, SEPs are self-declared and SEP holders are required to declare all patents that might be essential or risk loss of enforceability later on. Royalty share is calculated based on how many SEPs you own relative to the total pool. So there's a natural incentive to increase your share by having more of your patents considered SEP or reducing the number of SEPs that other's have.

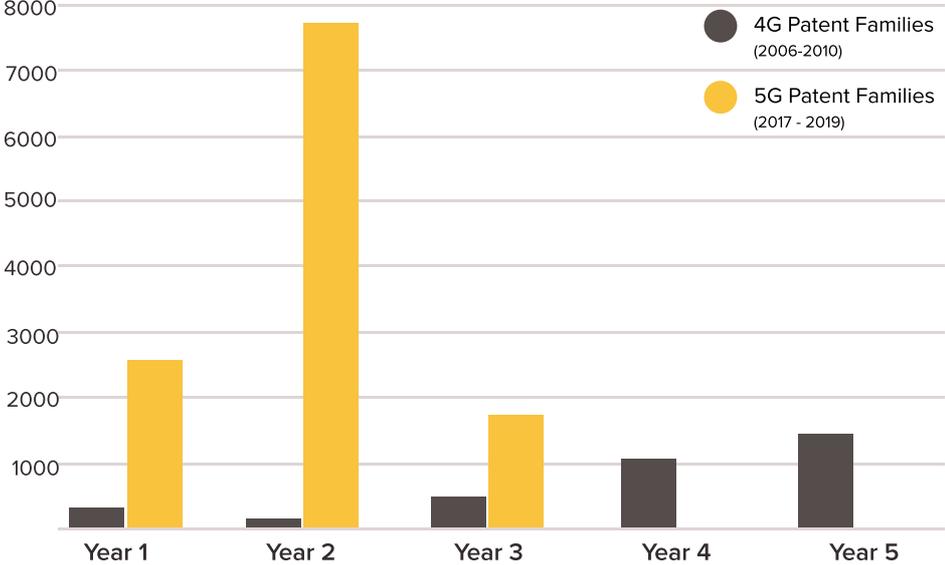
In addition, SEP holders are required to declare all patents that might be essential or risk loss of enforceability later on.

As a result, there is a strong incentive - even pressure - to over-declare patents as SEPs now and then dispute them later.



**1 in 4 SEPs are considered core**  
according to our analysis to date.

# First 5 years of SEP Declarations - 4G compared to 5G



# Increasing data transparency

At GreyB, we believe that transparent patent data promotes innovation. Specifically, the SEP system is plagued by a classic tragedy of the commons which can be solved by clear and ready access to information. Ideally, innovators would get well-deserved royalties for their contributions without diverting significant time, effort, and resources away from R&D towards essentiality research and disputes.

To the extent possible, we hope to encourage more objective measures that can facilitate better subjective decision making for all parties - policymakers, innovators, manufacturers, judges and jurors. Determining essentiality is, ultimately, subjective and vulnerable to human error. By centralizing the technical evaluation 80% of the work can be done upfront, leaving stakeholders to focus their time and effort on the remaining 20%.

So, we teamed up with Amplified to create a free and open resource for understanding the patents related to 5G. We consider our work a living document and invite comments and criticism from all interested parties.

## Problems and pitfalls

Reviewing historical work done in this field we've identified the following pitfalls which we seek to avoid:

- Extrapolating conclusions done from a small sample size
- Using proxies from 4G and projecting those onto 5G
- Taking declared numbers at face-value
- Implicitly framing all patents as equal by focusing on patent quantity only without accounting for quality

The complex nature of patent data analysis simply makes it impossible to address these issues completely so unfortunately it may be impossible to avoid all of these in entirety. However, it is our goal to create a reliable report and therefore we believe it is critical to acknowledge and account for them transparently and to the best of our ability. Our methodology is detailed in the appendix and we invite corrections, additions, criticism, and contributions.

*"The key ingredient needed for the prisoner's dilemma to work its destructive magic is a lack of transparency between the parties involved,"*

Siino writes. The article goes on to discuss how the lack of transparency in patent licensing transactions is disrupting the the patent marketplace, and threatens

*"to break licensing's virtuous circle of innovation leading to commercialisation, which in turn funds more innovation." <sup>1</sup>*

## Our analysis so far

### Expert review

Years of human expertise and effort spent tediously analyzing each patent family and their file histories in light of the standards specifications.

**6,402**

5G declared patent families and their file histories analyzed

**500+**

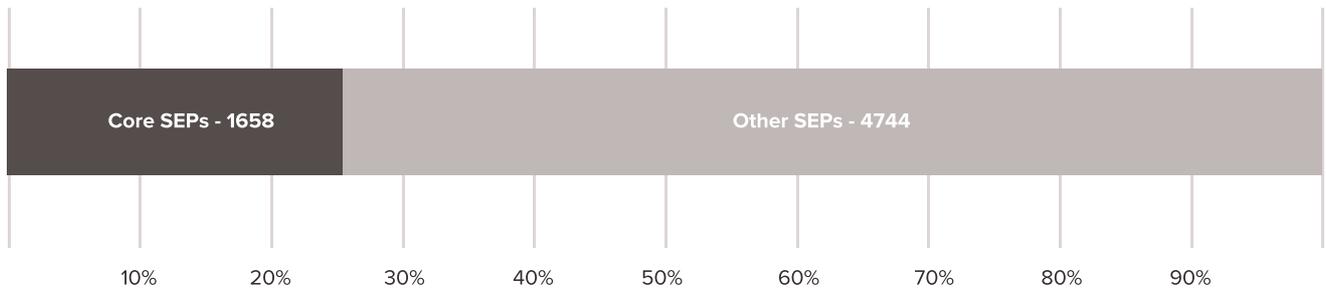
documents covering the each detailed technical specification

1 - <https://www.ipwatchdog.com/2017/09/10/escaping-prisoners-dilemma-transparency-patent-licensing/id=87812/>

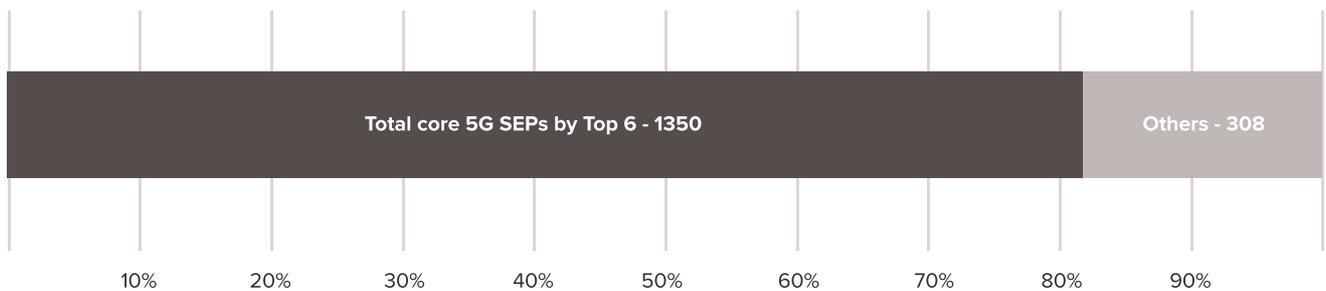
# Preliminary findings on essentiality

## Ratio of total core SEPs vs. non-core SEPs

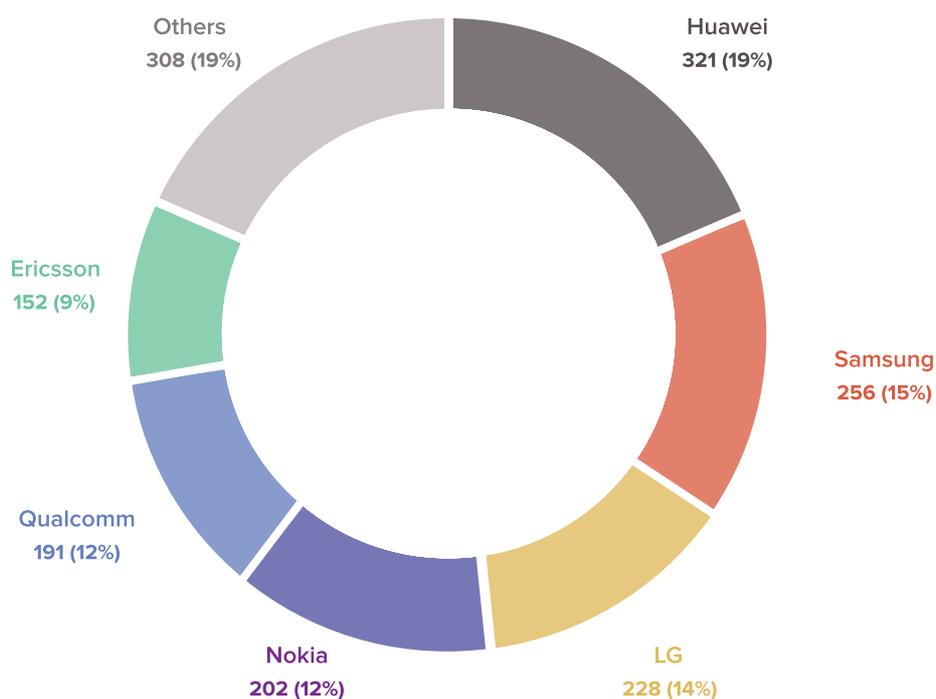
- 12,002 Patent Families declared to ETSI as of March 19, 2019
- 6,402 of these 12,002 families with a granted, alive patent as of December 31, 2019
- 1,658 of these 6,402 families determined as core essential SEPs Core



## Ownership breakdown of reviewed core SEPs

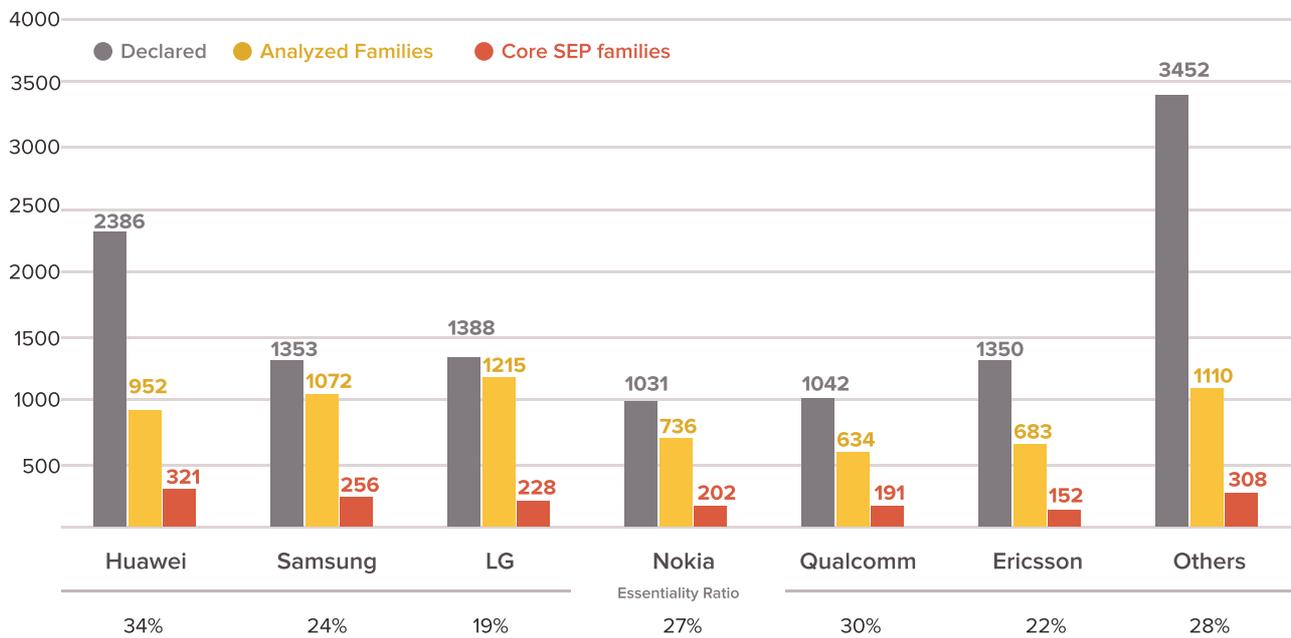


## Distribution of core SEPs with live granted patent families



# Preliminary findings on essentiality (con't)

## Essentiality ratio of top companies' core SEPs



## Who is this report for?

Anyone who owns or has played a hand in creating the technology covered by these standards.

Implementers who seek to commercialize this technology and need to license on SEPs.

Policymakers who seek to protect today's innovations while encouraging tomorrow's.

Legal professionals, judges and courts, who need evidence of essentiality and a clear methodology to help them resolve licensing disputes.

## Who are we?



GreyB is the world's leading technology research and intelligence company. We perform custom analysis on information including patents, scientific papers, market reports, and news to drive business insights. We innovate and combine machine learning & human intelligence to translate your high value opportunities into a win or help you with efficient risk mitigation in the changing landscape of the industry.



**Muzammil Hassan**

Manager at GreyB



**Aman Kumar**

Team Lead at GreyB

# Methodology

## What data was covered?

The data covered was all patents from the ETSI website 5G declaration list March 2019 version. This covers any patent or patent application declared to the ETSI 5G standard. Essentiality evaluation involves significant time and effort so there is a lag between release date of our report and data covered. We'll issue updates as we continue to analyze the data.

## How did we analyze the data?

- All patents declared to relevant 5G specifications and projects were selected resulting in 63,985 individual patent documents (granted patents, published patent applications, and non-public patent applications)
- ~500 Non-public patent documents, unavailable for inspection, were removed
- The remaining ~63,500 patent documents were grouped into 12,002 patent families.
- 6,402 of the 12,002 patent families with a granted patent having live legal status as of 31st December 2019 were kept, the rest were removed
- We determined our understanding of each of the 6,402 patent families by reading the claims and related embodiments from these granted patents and checked the correspondence history and documentation at the patent office to understand each patent.
- We determined essentiality for each patent family as a Core SEP or not by checking any specifications declared to be relevant by the patent holder to the SEP and compared the specific sections of these to compare overlap of the patent claims with those sections. If partial or no overlap was found, we then broadened our comparison to the wider group of all other specifications to repeat this process.