

# STMicroelectronics ToF Proximity Sensor & Flood Illuminator in the Apple iPhone X

Patent-to-Product Mapping - August 2018

*What are the main patented features of Apple iPhone X proximity sensor and flood illuminator?*



## REPORT OUTLINE

- STMicroelectronics ToF proximity sensor & flood illuminator in the Apple iPhone X
- Patent-to-product mapping
- August 2018
- Ref.: 18006
- PDF > 110 slides
- €6,490 for a multi-user license

## REPORT'S KEY FEATURES:

- **Link between key product features and patents** owned by STMicroelectronics, Lumentum, and Philips
- **Essential patent portfolio analysis** for STMicroelectronics, Lumentum, and Philips, related to **VCSEL and ToF sensors**. Includes:
  - Time evolution of patent publications, and countries of patent filings
  - Current legal status of patents
  - Citation network and competitive IP networks
- **Deep insight into technology data, including teardown analysis of:**
  - STMicroelectronics ToF sensor
  - Philips' VCSEL source
  - Lumentum's VCSEL array

## RELATED REPORTS

- [STMicroelectronics Time of Flight Proximity Sensor & Flood Illuminator in the Apple iPhone X, 2018](#) - System Plus Consulting
- [Lenovo Phab2Pro 3D ToF Camera, 2017](#) - System Plus Consulting
- [Apple iPhone X - Infrared Dot Projector, 2017](#) - System Plus Consulting
- [STMicroelectronics Time of Flight Proximity Sensor in the Apple iPhone 7 Plus, 2017](#) - System Plus Consulting
- [3D Imaging & Sensing, 2018](#) - Yole Développement

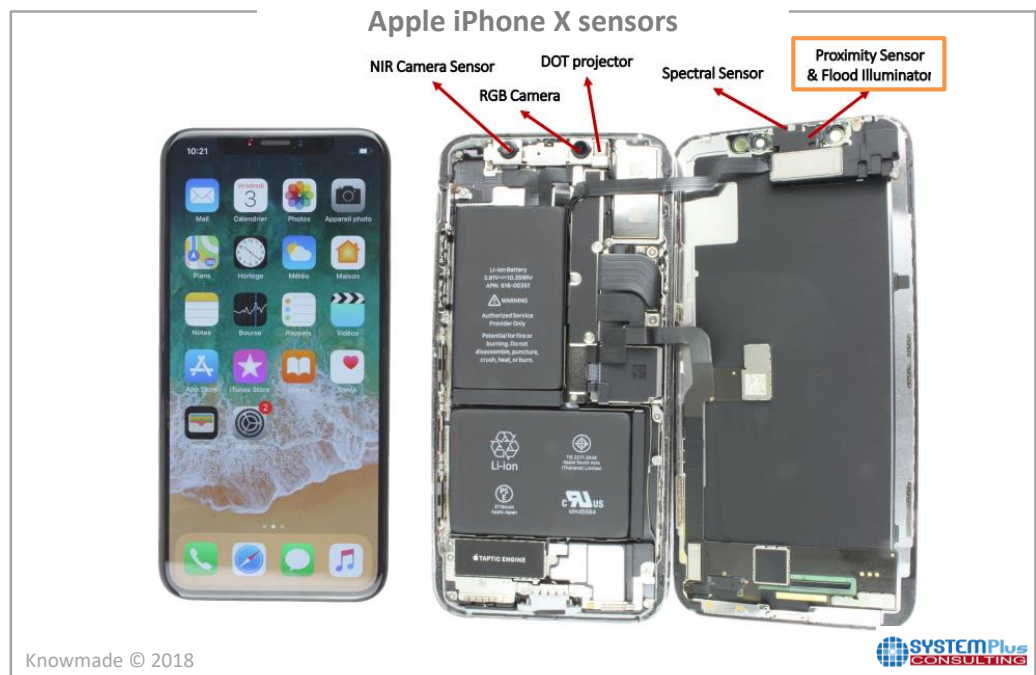
## Apple iPhone X: a trove of new tech sensors

Released in November 2017, the Apple iPhone X marks the 10<sup>th</sup> anniversary of the iPhone product line. With this new generation come several new technologies that make the iPhone X unique. Among the main new features we find are the screen design, OLED display, advanced true-depth camera, and optical array sensors (which enable facial ID). In addition to these new features, the iPhone X has an impressive number of sensors, especially those that are integrated into a small space at the top of the iPhone X screen. The sensor panel includes an infrared camera, flood illuminator, proximity sensor, and an ambient light sensor, along with a front camera, dot projector, speaker, and microphone. To achieve such a complex solution, Apple successfully built and managed a strong network comprised of many players.

The iPhone X's time of flight (ToF) proximity sensor and flood illuminator are good examples of this network's aptitude. Indeed, manufacturing these two devices required the work of three companies: STMicroelectronics, Philips, and Lumentum. In such a complex network, understanding each player's patented features, IP position, and strategy was critical.

With a CAGR of 82% from 2016 - 2023 (according to Yole Développement), the consumer market will drive the development of 3D imaging and sensing technologies. Today, the iPhone X's sensors are part of the first generation of imaging and sensing devices to be integrated in a cellphone, but many will follow. In this report, Knowmade and its partner, System Plus Consulting, join forces and provide key information for understanding the roles, dynamics, and IP strategies of the players involved in the manufacturing of the iPhone X's proximity sensor and flood illuminator.

Included in the same package, both components have been torn down and analyzed by System Plus Consulting, revealing their main characteristics. Based on this teardown analysis, Knowmade has identified the closest patents to these technologies and described the main proprietary features.



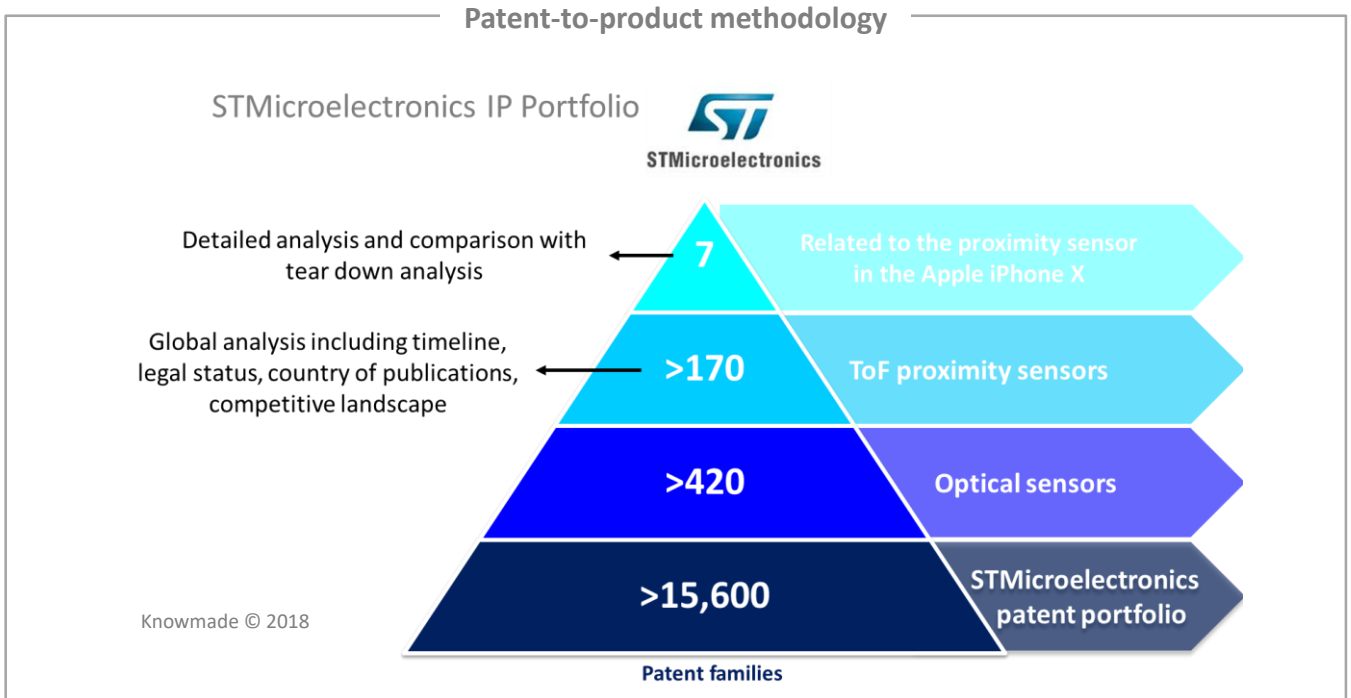
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### THIS REPORT'S METHODOLOGY

To reveal the main features of the Apple iPhone X's proximity sensor and flood illuminator, Knowmade has analyzed the patent portfolios of STMicroelectronics, Lumentum, and Philips. For each player, Knowmade has performed:

- A selection of **relevant and related patents**
- A **global IP analysis** in order to understand each player's **IP strategy and position**
- A **deep analysis** of patents related to the Apple iPhone X product



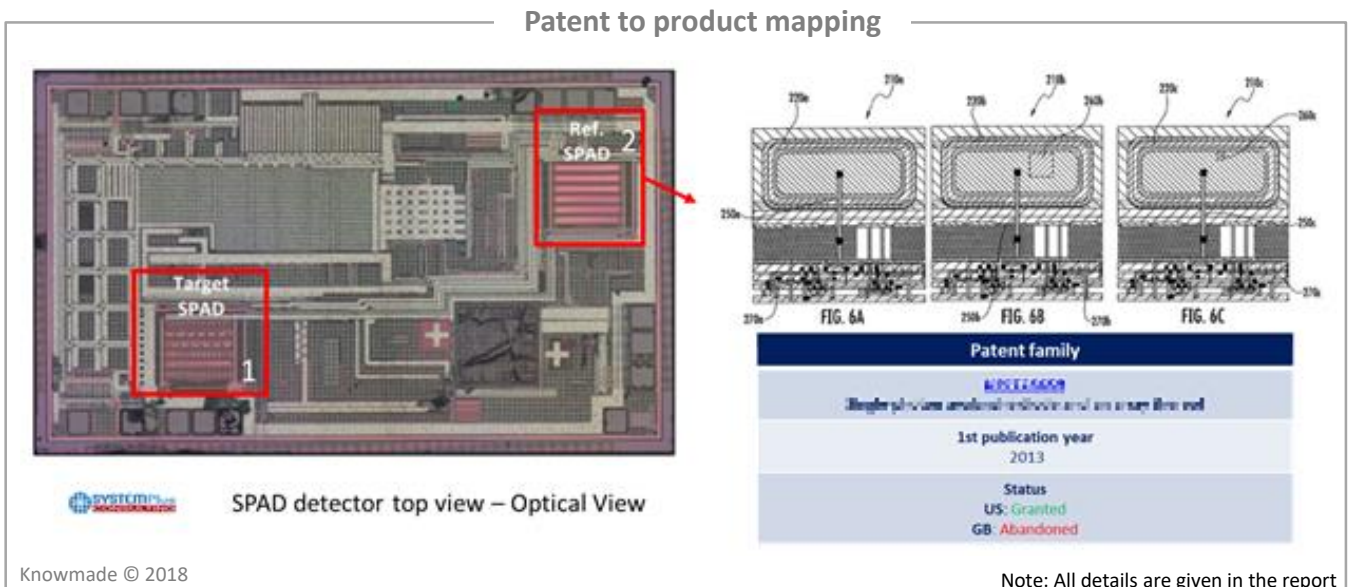
### THIS REPORT'S MAIN ASSETS

- Identify the IP players involved in manufacturing the Apple iPhone X's proximity sensor and flood illuminator
- Understand these players' strategy and position in the IP landscape

From STMicroelectronics' patent portfolio to Lumentum's VCSEL-focused portfolio, more than 500 inventions related to ToF sensors and VCSEL have been identified. A global IP analysis allows us to **understand the position of each player** by positioning their patents within their IP **competitive landscape** and highlighting their actual **IP dynamic regarding patent publication and geographic coverage**.

- Analyzing IP players' product-related patents

This report provides an **understanding of the key features asserted by the patents of STMicroelectronics, Lumentum, and Philips**. Each patent related to the Apple iPhone X's sensor is detailed. Main characteristics and their impact on the manufacturing process, device performance, cost, etc. are highlighted too.



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## ABOUT KNOWMADE

Specialized in the analysis of patents and scientific information, **Knowmade** provides technology intelligence and IP strategy consulting services. The company supports the business development of R&D organizations, industrial companies, and investors by offering them a deep understanding of their IP environment and technology trends.

**Knowmade** operates in the following industrial sectors: compound semiconductors, power electronics, RF & microwave technologies, LED/OLED lighting & display, photonics, memory, MEMS & sensors, manufacturing & advanced packaging, battery & energy management, biotechnology, pharmaceuticals, medical devices, medical imaging, and agri-food & environment.

**Knowmade's** experts provide prior art search, patent landscape analysis, scientific literature analysis, patent valuation, IP due diligence, and freedom-to-operate analysis. The company also delivers litigation/licensing support, technology scouting, and IP/technology observation. **Knowmade's** analysts combine their technical and patent expertise with powerful analytics tools and proprietary methodologies, delivering invaluable patent analyses and scientific reviews.

## ABOUT SYSTEM PLUS CONSULTING

Headquartered in Nantes, France, **System Plus Consulting** specializes in technology and cost analysis of electronic components and systems in the fields of integrated circuits, power devices and modules, MEMS and sensors, LED, image sensors, packaging (including wafer level), electronic boards, and systems. The company offers custom reverse costing analyses, standard reverse costing reports, and costing tools. These analyses are used by Purchasing departments to measure their suppliers' cost structure; R&D departments to confirm technological choices depending on their cost impact; and Benchmarking/Marketing departments to monitor products on the market.

# ORDER FORM

## STMicroelectronics ToF Proximity Sensor & Flood Illuminator in the Apple iPhone X

Patent-to-Product Mapping - August 2018

Ref.:KM18006

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### PRODUCT ORDER

€6,490 – Corporate license

€5,990 – Single-user license\*

For the price in dollars, please use the current day's exchange rate. French customers, please add 20% for VAT.

Upon payment receipt, all reports are delivered electronically in pdf format \*

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*I hereby accept Knowmade's Terms and Conditions of Sale*

**Signature:**

# TERMS AND CONDITIONS OF SALES

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“Acceptance”: Action by which the Buyer accepts the terms and conditions of sale in their entirety. It is done by signing the purchase order which mentions “I hereby accept Knowmade’s Terms and Conditions of Sale”.

“Buyer”: Any business user (i.e. any person acting in the course of its business activities, for its business needs) entering into the following general conditions to the exclusion of consumers acting in their personal interests.

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“Products”: Reports are established in PowerPoint and delivered on a PDF format and the database may include Excel files.

“Seller”: Based in Sophia Antipolis (France headquarters), Knowmade is a technology intelligence company specialized in the research and analysis of scientific and technical information. We provide patent landscapes and scientific state of the art with high added value to businesses and research laboratories. Our intelligence digests play a key role to define your innovation and development strategy.

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1.1 The Contracting Parties undertake to observe the following general conditions when agreed by the Buyer and the Seller. ANY ADDITIONAL, DIFFERENT, OR CONFLICTING TERMS AND CONDITIONS IN ANY OTHER DOCUMENTS ISSUED BY THE BUYER AT ANY TIME ARE HEREBY OBJECTED TO BY THE SELLER, SHALL BE WHOLLY INAPPLICABLE TO ANY SALE MADE HEREUNDER AND SHALL NOT BE BINDING IN ANY WAY ON THE SELLER.

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1.3 Orders are deemed to be accepted only upon written acceptance and confirmation by the Seller, within [7 days] from the date of order, to be sent either by email or to the Buyer’s address. In the absence of any confirmation in writing, orders shall be deemed to have been accepted.

## 2. Mailing of Products

2.1 Products are sent by email to the Buyer:

- within [1] month from the order for Products already released; or
- within a reasonable time for Products ordered prior to their effective release. In this case, the Seller shall use its best endeavours to inform the Buyer of an indicative release date and the evolution of the work in progress.

2.2 Some weeks prior to the release date the Seller can propose a pre-release discount to the Buyer.

The Seller shall by no means be responsible for any delay in respect of article 2.2 above, and including in cases where a new event or access to new contradictory information would require for the analyst extra time to compute or compare the data in order to enable the Seller to deliver a high quality Products.

2.3 The mailing of the Product will occur only upon payment by the Buyer, in accordance with the conditions contained in article 3.

2.4 The mailing is operated through electronic means either by email via the sales department. If the Product’s electronic delivery format is defective, the Seller undertakes to replace it at no charge to the Buyer provided that it is informed of the defective formatting within 90 days from the date of the original download or receipt of the Product.

2.5 The person receiving the Products on behalf of the Buyer shall immediately verify the quality of the Products and their conformity to the order. Any claim for apparent defects or for non-conformity shall be sent in writing to the Seller within 8 days of receipt of the Products. For this purpose, the Buyer agrees to produce sufficient evidence of such defects.

2.6 No return of Products shall be accepted without prior information to the Seller, even in case of delayed delivery. Any Product returned to the Seller without providing prior information to the Seller as required under article 2.5 shall remain at the Buyer’s risk.

## 3. Price, invoicing, and payment

3.1 Prices are given in the orders corresponding to each Product sold on a unit basis or corresponding to annual subscriptions. They are expressed to be inclusive of all taxes. The prices may be reevaluated from time to time. The effective price is deemed to be the one applicable at the time of the order.

3.2 Payments due by the Buyer shall be sent by cheque payable to Knowmade, PayPal, or by electronic transfer to the following account:

Banque Populaire Méditerranée, CAP 3000 Quartier du lac, 06700 St Laurent du Var

BIC or SWIFT code: CCBPFRPPMAR

IBAN: : FR76 1460 7003 6360 6214 5695 139

To ensure payment, the Seller reserves the right to request down payments from the Buyer. In this case, the need of down payments will be mentioned on the order.

3.3 Payment is due by the Buyer to the Seller within 30 days from invoice date, except in the case of a particular written agreement. If the Buyer fails to pay within this time and fails to contact the Seller, the latter shall be entitled to invoice interest in arrears based on the annual rate Refi of the «BCE» + 7 points, in accordance with article L. 441-6 of the French Commercial Code. Our publications (report, database, tool...) are delivered only after reception of the payment.

3.4 In the event of termination of the contract, or of misconduct, during the contract, the Seller will have the right to invoice at the stage in progress, and to take legal action for damages.

## 4. Liabilities

4.1 The Buyer or any other individual or legal person acting on its behalf, being a business user buying the Products for its business activities, shall be solely responsible for choosing the Products and for the use and interpretations he makes of the documents it purchases, of the results he obtains, and of the advice and acts it deduces thereof.

4.2 The Seller shall only be liable for (i) direct and (ii) foreseeable pecuniary loss, caused by the Products or arising from a material breach of this agreement

4.3 In no event shall the Seller be liable for:

a) damages of any kind, including without limitation, incidental or consequential damages (including, but not limited to, damages for loss of profits, business interruption and loss of programs or information) arising out of the use of or inability to use the Seller's website or the Products, or any information provided on the website, or in the Products;

b) any claim attributable to errors, omissions or other inaccuracies in the Product or interpretations thereof.

4.4 All the information contained in the Products has been obtained from sources believed to be reliable. The Seller does not warrant the accuracy, completeness adequacy or reliability of such information, which cannot be guaranteed to be free from errors.

4.5 All the Products that the Seller sells may, upon prior notice to the Buyer from time to time be modified by or substituted with similar Products meeting the needs of the Buyer. This modification shall not lead to the liability of the Seller, provided that the Seller ensures the substituted Product is similar to the Product initially ordered.

4.6 In the case where, after inspection, it is acknowledged that the Products contain defects, the Seller undertakes to replace the defective products as far as the supplies allow and without indemnities or compensation of any kind for labor costs, delays, loss caused or any other reason. The replacement is guaranteed for a maximum of two months starting from the delivery date. Any replacement is excluded for any event as set out in article 5 below.

4.7 The deadlines that the Seller is asked to state for the mailing of the Products are given for information only and are not guaranteed. If such deadlines are not met, it shall not lead to any damages or cancellation of the orders, except for non-acceptable delays exceeding [4] months from the stated deadline, without information from the Seller. In such case only, the Buyer shall be entitled to ask for a reimbursement of its first down payment to the exclusion of any further damages.

4.8 The Seller does not make any warranties, express or implied, including, without limitation, those of saleability and fitness for a particular purpose, with respect to the Products. Although the Seller shall take reasonable steps to screen Products for infection of viruses, worms, Trojan horses or other codes containing contaminating or destructive properties before making the Products available, the Seller cannot guarantee that any Product will be free from infection.

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The Seller shall not be liable for any delay in performance directly or indirectly caused by or resulting from acts of nature, fire, flood, accident, riot, war, government intervention, embargoes, strikes, labor difficulties, equipment failure, late deliveries by suppliers or other difficulties which are beyond the control, and not the fault of the Seller.

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6.1 All the IPR attached to the Products are and remain the property of the Seller and are protected under French and international copyright law and conventions.

6.2 The Buyer agreed not to disclose, copy, reproduce, redistribute, resell or publish the Product, or any part of it to any other party other than employees of its company. The Buyer shall have the right to use the Products solely for its own internal information purposes. In particular, the Buyer shall therefore not use the Product for purposes such as:

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- Recordings and re-transmittals over any network (including any local area network);
- use in any timesharing, service bureau, bulletin board or similar arrangement or public display;
- Posting any Product to any other online service (including bulletin boards or the Internet);
- Licensing, leasing, selling, offering for sale or assigning the Product.

6.3 The Buyer shall be solely responsible towards the Seller of all infringements of this obligation, whether this infringement comes from its employees or any person to whom the Buyer has sent the Products and shall personally take care of any related proceedings, and the Buyer shall bear related financial consequences in their entirety.

6.4 The Buyer shall define within its company point of contact for the needs of the contract. This person will be the recipient of each new report in PDF format. This person shall also be responsible for respect of the copyrights and will guaranty that the Products are not disseminated out of the company.

## 7. Termination

7.1 If the Buyer cancels the order in whole or in part or postpones the date of mailing, the Buyer shall indemnify the Seller for the entire costs that have been incurred as at the date of notification by the Buyer of such delay or cancellation. This may also apply for any other direct or indirect consequential loss that may be borne by the Seller, following this decision.

7.2 In the event of breach by one Party under these conditions or the order, the non-breaching Party may send a notification to the other by recorded delivery letter upon which, after a period of thirty (30) days without solving the problem, the non-breaching Party shall be entitled to terminate all the pending orders, without being liable for any compensation.

## 8. Miscellaneous

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Any notices under these Terms and Conditions shall be given in writing. They shall be effective upon receipt by the other Party.

The Seller may, from time to time, update these Terms and Conditions and the Buyer, is deemed to have accepted the latest version of these terms and conditions, provided they have been communicated to him in due time.

## 9. Governing law and jurisdiction

9.1 Any dispute arising out or linked to these Terms and Conditions or to any contract (orders) entered into in application of these Terms and Conditions shall be settled by the French Commercial Courts of Grasse, which shall have exclusive jurisdiction upon such issues.

9.2 French law shall govern the relation between the Buyer and the Seller, in accordance with these Terms and Conditions.