

# PROCESSOR QUARTERLY MARKET MONITOR

Computing Service - December 2020

*With SMIC and UniSoC, China is finding new paths to self-sufficiency in the dynamic APU market.*

## WHAT ABOUT THE PROCESSOR QUARTERLY MARKET MONITOR?

### A full package:

The Processor Quarterly Market Monitor includes the following deliverables:

- Excel database with quarterly update on historical and forecast data
- PDF slide deck with graphs and comments/analysis covering expected evolutions
- **Direct access to a Yole Développement analyst for one year, providing an opportunity for on-demand Q&A and discussions regarding trends, analyses, forecasts, and breaking news**

### Frequency:

Receive every quarter the updated Quarterly Market Monitor documents

### Monitored applications:

- Smartphone, tablet, smartwatch (available from Q1 2020)
- Smart speaker, AR/VR, TV, ultralight PC (available from Q2 2020)
- Automotive infotainment (available from Q3 2020)
- CPU, GPU, NPU starting Q1-2021
- FPGA starting Q2-2021

Get the sample of the monitor on [www.i-Micronews.com](http://www.i-Micronews.com)

## THE PROCESSOR LANDSCAPE IS REORGANIZING AMIDST GLOBAL TRADE DISPUTES AND DESIGNER INNOVATIONS

The recent SMIC IPO and positioning to gain APU foundry share has signaled the beginning of a global restructuring of processor design and manufacturing. Additionally, UniSoC is gaining steam and market share in the mid-tier phone segments, and looking to break into the high-end.

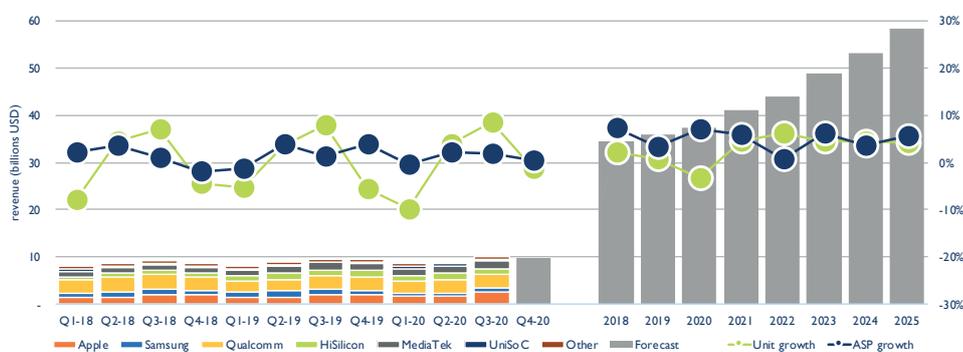
The application processor is the central chip for managing and executing the many functions of which modern “smart” devices are capable. In fact, as more consumer devices become always-on and always-connected, the APU becomes an attractive alternative to its traditionally more power-hungry x86-based counterparts. Within the smartphone segment alone, 2019 saw ~\$36B of revenue for application processors, making up 6% of total Semi revenue for that year. Among the emerging applications that are dependent on application processors are wearables, connected home, AR/VR, and ultralight PCs. Though not as

large as the smartphone market, these are the areas that are seeing real growth.

For reasons of optimum user experience and improved data security, chip designers and software developers are moving more and more processing functions out of the cloud to the edge. The edge is where the application processor is key, whether in mobile, IoT, connected home, or the many other various consumer devices.

In the high-end laptop segment, Apple has decided to shift the MacBook processor to in-house silicon, announcing the impressive M1 SoC. Built on TSMC’s N5, this chip is a departure from x86 architecture, which if successful, could signal the start of a larger shift towards APUs in more segments. This holds serious implications for the CPU and GPU markets, which this monitor will cover starting in Q1 of 2021.

### Application processor market dynamics per quarter



- Near term: seasonally weak Q1-20 and COVID-19 impacts are overlapped to place H1-20 revenue just 3% above H1-19. Production volume outpaced demand, keeping system builds afloat. Assuming a return to pre-COVID trajectories in mid-2021.
- Long term: Following the bounce back of demand in 2021, expecting modest unit and ASP growth to combine for growing APU revenues, nearing \$50B by 2023

"APU Market Revenue" is APU designers' revenue for end-systems tracked in this monitor: Smartphone, Tablet, APU-based Notebook, Smartwatch, Smart speaker, Smart TV, AR, VR, and Automotive Infotainment

(Yole Développement, December 2020)

## WHAT TO EXPECT FROM YOLE DÉVELOPPEMENT'S PROCESSOR QUARTERLY MARKET MONITOR?

The Quarterly Market Monitor examines and forecasts the application processor segment of the semiconductor industry, as dissected across multiple dimensions. The monitor tracks processor revenue, units, and wafer volumes at both fabless chip designers and at the foundries themselves, sliced across various relevant parameters including process node, end-product segment, core and IP type, etc. Subscribers to this product will become knowledgeable on

details of the processor landscape and where to expect inflections in the market.

The monitor will also examine the reported financials of players within the ecosystem. Through this examination, the Quarterly Market Monitor will provide estimates of the amounts of revenue, margin, and capital expenditure (Capex) attributable to processors for key designers and manufacturers.

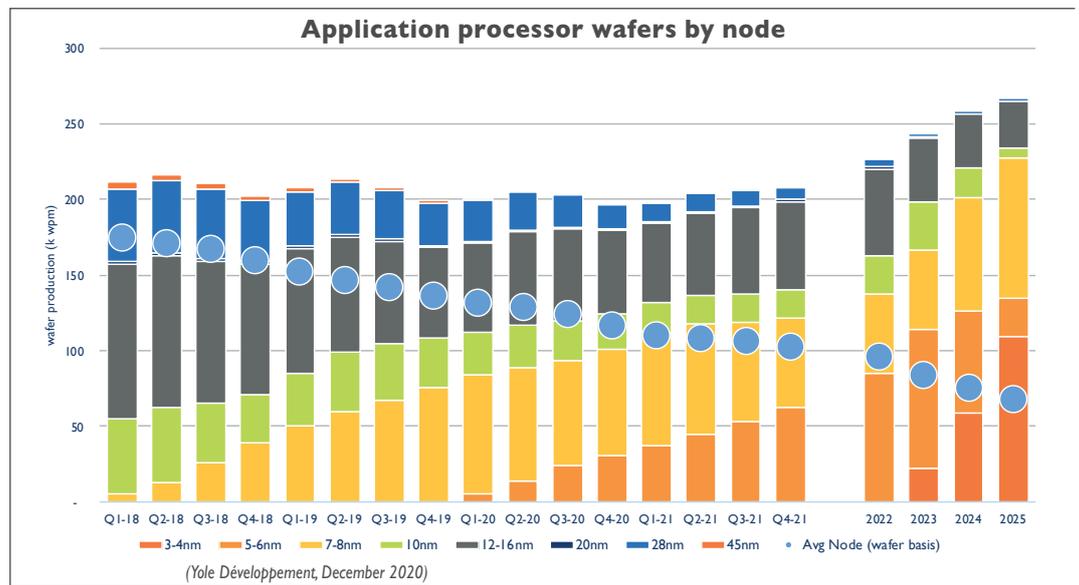
Yole Développement's (Yole) Processor Quarterly Market Monitor will address the pressing questions facing this industry, including:

- Which logic nodes are critical for processors over the next 12-24 months?
- What are the price and cost trends within the multiple tiers of the smartphone market?
- How many 10nm/7nm/5nm/3nm wafer starts are needed to satisfy the demands of the processor market for the next 5 years? Who will have the necessary capacity to deliver for OEMs ?
- When will 5nm become a mainstream node for processors?
- What implications do any delays of a process node carry to the processor market?
- How do the trends in luxury and high-end smartphones drive behavior in the designers and manufacturers of processors?
- How do the performance trends of end-products translate into market trends of processors?
- Which end device segment is driving revenue, unit, and wafer growth for processors?
- How will new functionalities in embedded neural

networks impact the wafer volume requirements for processor manufacturing ?

- How much capital expenditure for wafer fabrication equipment will be required to support the processor forecast
- What weight do key assumptions drive within the market forecast ? What is the range of market possibilities for a given range of adjustment within base assumptions ?

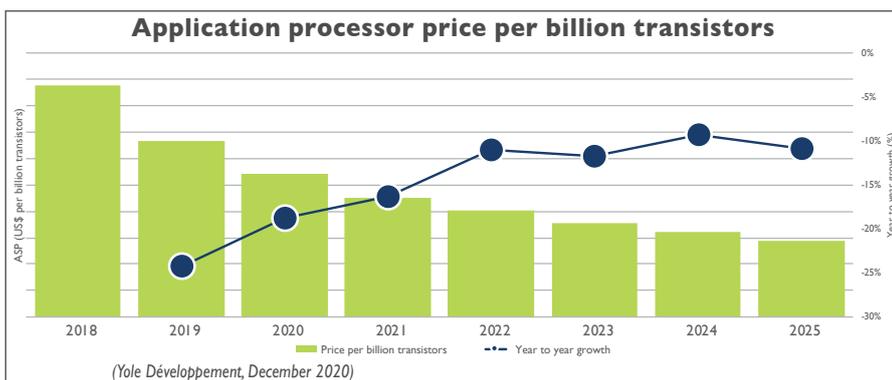
Underpinning the monitor are complex databases that track processors and their respective end-products, aggregated from highly detailed device and component teardowns. An internal Yole model supports the monitor, which employs extensive data analysis on the historical processor and device datasets to understand and forecast the tendencies of segment designers and OEMs on key parameters such as transistor count and density, speed, and processor core count to derive die size, wafer volume, cost, and performance. These insights are integrated with information gathered from across the Yole network and expert interviews to create a robust market forecast, unique for Yole and its customers.



### WHAT IS NEXT FOR PROCESSORS?

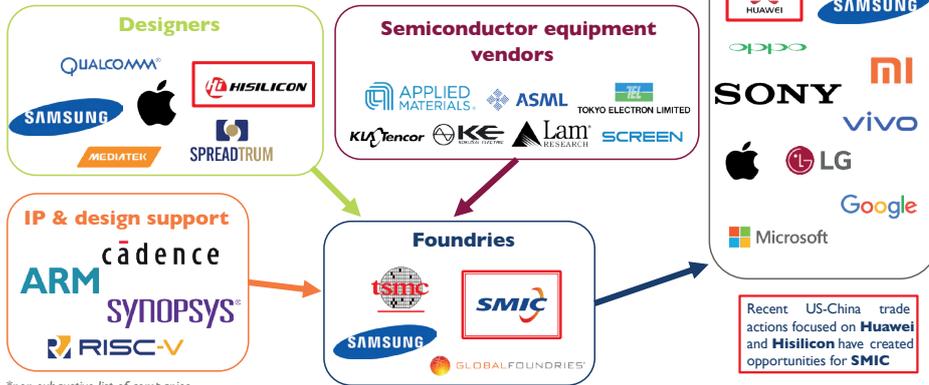
The long-term trend within the application processor industry is for OEMs to seek differentiation and demand increasing processing power for end-products, while living within the power and BOM constraints of high mobility. Similarly in the microprocessor space, the system designers seek to deploy ever-increasing computing capabilities at ever-increasing efficiencies. In some

cases, this calls for new hardware and software as in AI training and inference. Designers, IP licensers, and manufacturers partner to meet those demands by adding capabilities to the traditional areas of computing and graphics, as well as the emerging focus of innovation in neural network processing, deep learning, and artificial intelligence. In fact, artificial intelligence enablement (through stand-alone or embedded AI accelerators) is the newest differentiator for processor designers and OEMs. Packing ever-increasing computational capabilities into semiconductor devices has long been the trend for the whole of computing industry history. The next decade of processors will be no different. However, we are witnessing a slowdown in the rate of cost decline for a unit of computing capability, and therefore processor designers will have a choice to make: continue computational improvements at historical levels and accept the increasing costs, or adjust their innovation to match the rate of cost decline and live within historical BOM and margin bands. We expect the



### Application processor 2020 ecosystem\*

The **Fables / Foundry** business model succeeds by sharing risk, but interesting market dynamics exist in both designer and foundry realms.



\*non-exhaustive list of companies

(Yole Développement, December 2020)

decision designers make will depend on the specifics of their target markets. The dynamics of players within this industry is continuing to

evolve, and a quarterly market monitor is a critical tool for those looking for the advantage of insight.

#### KEY FEATURES OF THE MONITOR

- Direct access to the analyst
- Quarterly data update
- Market forecast through 2025, in \$US, units
- ASP analysis, per market segment
- Die size trend, per market segment
- Key process-technology mix
- Supplier market share (Samsung, Apple, Qualcomm, Hisilicon, Mediatek, UniSoC) in terms of units and \$US
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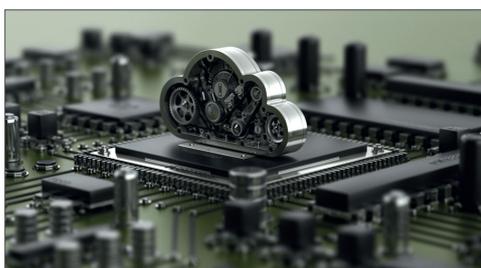
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#### RELATED REPORTS, MONITORS & TRACKS



- (x)PU: High-End CPU and GPU for Datacenter Applications 2020
- Cameras and Computing for Surveillance and Security 2020
- NAND & DRAM Quarterly Market Monitors
- Advanced Packaging Quarterly Market Monitor
- Teardown Tracks - by System Plus Consulting

More information and details about our offers and bundles opportunities on [www.i-micronews.com](http://www.i-micronews.com)

#### COMPANIES MONITORED IN THE PRODUCT (non exhaustive list)

Apple, Broadcom, Arm, Global Foundries, Google, HiSilicon, HTC, Huawei, Lenovo, LG, MediaTek, Meizu, OPPO, Qualcomm, Samsung, SMIC, Sony, Spreadtrum, TSMC, UMC, UniSOC, Vivo, Xiaomi, XMC, ZTE



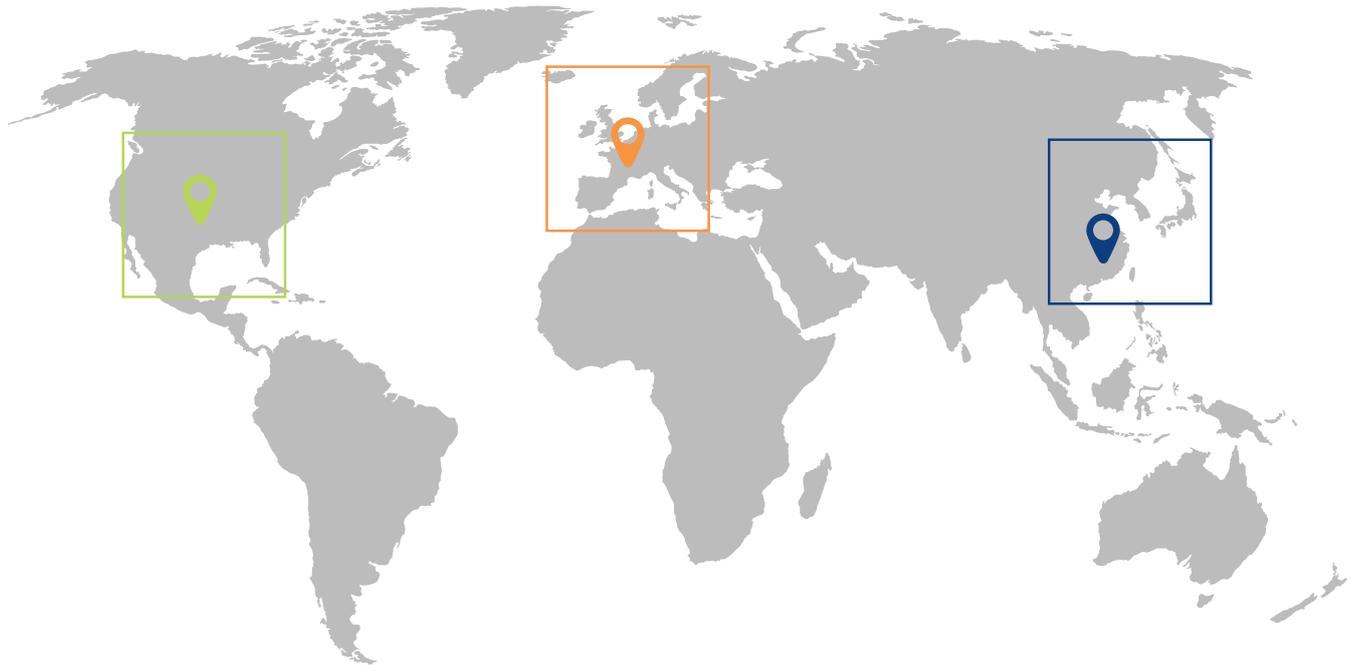
#### AUTHORS

**John Lorenz** is a Technology and Market Analyst within the Computing & Software division at Yole Développement (Yole), part of Yole Group of Companies. John is engaged in the development of market and technology monitors for the logic segment of advanced semiconductors, with an initial focus on processors. Prior to joining Yole, John held various technical and strategic roles at Micron Technology. On the engineering side, his roles included thin film process development and manufacturing integration on DRAM, NAND, and emerging memory technologies and industrial engineering / factory physics for the R&D fab. On the strategic side, John ran the memory industry supply & capex model for corporate strategy / market intelligence, and established the industry front-end costing model within strategic finance. John has a Bachelor of Science degree in Mechanical Engineering from the University of Illinois Urbana-Champaign (USA), with a focus on MEMS devices.



**Tom Hackenberg** is a Principal Analyst for Computing and Software in the Semiconductor, Memory and Computing Division at Yole Développement (Yole). Tom is engaged in developing processor market monitors and research into related technology trends. He is currently focused on low and ultralow power. Tom is an industry leading expert with more than a decade's experience reporting on markets for semiconductor processors. Tom is also well-versed in related technology trends including IoT, heterogeneous processing, chiplets, AI and edge computing. Tom holds a BSECE from the University of Texas at Austin.

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## ABOUT YOLE DEVELOPPEMENT

Founded in 1998, Yole Développement (Yole) has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services, reverse engineering and reverse costing services and well as IP and patent analysis. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole group of companies has expanded to include more than 120 collaborators worldwide covering MEMS and image sensors, Compound semiconductors, RF Electronics, Solid-state lighting, Displays, Software, Optoelectronics, Microfluidics & Medical, Advanced Packaging, Manufacturing, Power Electronics, Batteries & Energy Management and Memory.

The “More than Moore” market research, technology and strategy consulting company Yole Développement, along with its partners System Plus Consulting, PISEO and Blumorpho, supports industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to grow their business.

### CONSULTING AND ANALYSIS

- Market data & research, marketing analysis
- Technology analysis
- Strategy consulting
- Reverse engineering & costing
- Patent analysis
- Design and characterization of innovative optical systems
- Financial services (due diligence, M&A with our partner)

*More information on [www.yole.fr](http://www.yole.fr)*

### MEDIA & EVENTS

- i-Micronews.com website, application & related e-newsletter
- Communication & webcast services
- Events: TechDays, forums...

*More information on [www.i-Micronews.com](http://www.i-Micronews.com)*

### REPORTS & MONITORS

- Market & technology reports
- Market, reverse technology and patent quarterly monitors
- Patent investigation and patent infringement risk analysis
- Structure, process and cost analysis and teardowns
- Cost simulation tool

*More information on [www.i-micronews.com/reports](http://www.i-micronews.com/reports)*

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- Public Relations: Sandrine Leroy ([sandrine.leroy@yole.fr](mailto:sandrine.leroy@yole.fr))

Definitions: **“Acceptance”**: Action by which the Buyer accepts these General Terms and Conditions of Sale in their entirety. It is done by signing the purchase order which states “I hereby accept Yole Développement’s General 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) placing an order pursuant to these General Terms and Conditions of Sale, with the exclusion of any individual consumer acting for his/her sole personal interest.

**“Seller”**: Headquartered in Villeurbanne (France), Yole Développement provides marketing, technology and strategy consulting, media and corporate finance services, reverse engineering/costing services as well as IP and patent analysis. With dedicated teams of technology & market analysts, Yole Développement operates worldwide with the key industrial companies, R&D institutes and investors to help them understand the market and technology trends.

**“Contracting Parties”** or **“Parties”**: The Seller on the one hand and the Buyer on the other hand.

**“Intellectual Property Rights”** (“IPR”) means any rights held by the Seller in its Products, including any patents, trademarks, registered models, designs, copyrights, inventions, commercial secrets and know-how, technical information, company or trading names and any other intellectual property rights or similar in any part of the world, notwithstanding the fact that they have been registered or not and including any pending registration of one of the above mentioned rights.

**“Products”**  
Our products can be bought either on a unit basis or as a bundled offer (i.e. subscription for a period of 12 calendar months).

**“Report”**  
Reports are established in PowerPoint and delivered in a PDF format with an additional Excel file. 30 min of Q&A session with an analyst/author can be included for all purchased reports (except the ones bought as a one user license). More time can be allocated on a fee basis.

**“Monitor”**  
Monitors are established and delivered in Excel. An additional PDF can also be added. Q&A with an Analyst is possible for each monitor (except where specified otherwise). Frequency of the release vary according to the monitor or service (quarterly and monthly). All monitor products are eligible for a Corporate License.

**“Tracks”**  
Yearly subscription to access a web-based interactive portal to view features and specs of a device or component based on a complete turnaround process.

**“License”**  
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• One User License: The report is intended for only one identified user at the Company purchasing the report - Sharing is strictly forbidden  
• Multi-User License: The report can be shared by an identified user at the Company purchasing the report with an unlimited number of employees of said Company, working in the country where the identified user is based. No rights are granted to any employees of any Subsidiaries or Joint Ventures of the Company.  
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## 1. SCOPE

1.1 Both Contracting Parties undertake to comply with these General Terms and Conditions of Sale.  
**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, ARE DEEMED WHOLLY INAPPLICABLE TO ANY SALE MADE HEREUNDER, AND SHALL NOT BE BINDING IN ANY WAY ON THE SELLER.**

1.2 These General Terms and Conditions of Sale shall be deemed valid and enforceable between the Contracting Parties after acceptance of an order from the Buyer by the Seller pursuant to Article 1.3 below. For such purpose, the Buyer, when signing the purchase order which mentions “I hereby accept Yole Développement’s Terms and Conditions of Sale” is deemed to have fully and unequivocally accepted these Terms and Conditions of Sale.

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. In the absence of any confirmation in writing, no order shall be deemed to have been accepted.

## 2. MAILING OF THE PRODUCTS

- 2.1 Products are sent by email to the Buyer after Seller’s confirmation:
  - Within a few days from the Seller’s confirmation of the order for Products already released and paid; 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 The Seller shall by no means be responsible for any delay pursuant to Article 2.1 above, in particular in cases where a new event or access to new contradictory information would require the Seller analyst to dedicate extra time to compute or compare the data in order to enable the Seller to deliver a high quality Product.
- 2.3 The mailing of the Product will occur only upon payment by the Buyer, in accordance with the conditions contained in Article 3 above.

2.4. The mailing is operated through electronic means either by email via the sales department or automatically online via an email/password. The Buyer is responsible for ensuring that the Buyers platform has the required capacities and authorisations to receive the Product(s) emailed by the Seller. If the Product’s electronic delivery format is defective, the Seller undertakes to replace it at no charge to the Buyer provided that the Seller 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 with 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 written notification from the Buyer to the Seller, even in case of delayed delivery. Any Product returned to the Seller without the Buyer providing prior notification to the Seller as required under Article 2.5 above shall remain at the Buyer’s risk. In no event shall the Seller incur any liability for Products erroneously ordered by the Buyer, or for any request from the Buyer to replace a Product previously ordered by a different Product.

## 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 deemed to be inclusive of all taxes applicable in the country where the Seller is based (except for France where VAT will be added). The prices are re-evaluated from time to time by the Seller. 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 Yole Développement, or made by credit card or by electronic transfer to the following account:  
HSBC, 1 place de la Bourse 69002 Lyon France  
Bank code: 30056  
Branch code: 00170  
Account n°: 0170 200 1565 87  
BIC or SWIFT code: CCFRFRPP  
IBAN: FR76 3005 6001 7001 7020 0156 587

To secure the payments due to the Seller, the Seller reserves the right to request down payments from the Buyer. In such case, the need for a down payment will be mentioned on the corresponding order.

3.3 Payment is due by the Buyer to the Seller within 30 days from invoice date, except as otherwise specifically agreed in writing by the Buyer and the Seller. If the Buyer fails to pay at the due date and fails to request and obtain from the Seller a payment extension, 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.

3.4 The Seller publications (reports, monitors, tracks...) are due for delivery only after receipt by the Seller of any payment due by the Buyer prior to delivery.

3.5 In the event of termination of the contract by the Seller attributable to Buyer misconduct during the contract, the Seller will have the right to invoice all work performed at the time of termination, 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 the choice of the Products purchased as well as for the use and interpretations the Buyer makes of the documents it purchases, of the results the Buyer obtains, and of the advice and acts the Buyer bases thereon .

4.2 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 a Product or the use of or the inability by the Buyer to use the Seller’s website, or any information provided on the website, or contained in a Product;
- b) Any claim attributable to errors, omissions or other inaccuracies in a Product or interpretations thereof.

4.3 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.

4.4 Any Product that the Seller sells may, upon prior notice to the Buyer from time to time be modified by Seller or substituted with a similar Product meeting the needs of the Buyer. Such modification shall not lead to any liability of the Seller, provided that the Seller ensures the substituted Product is similar to the Product initially ordered.

4.5 In the case where, after inspection, it is acknowledged that a Product contain defects, the Seller undertakes to replace the defective product to the extent reasonably feasible and without indemnification or compensation of any kind for labour costs, delays, loss caused or any other reason being due by the Buyer . This undertaking from the Seller shall be effective for a maximum of two months starting from the delivery date but shall not be applicable in the event of force majeure as described in Article 5 below.

4.6 The deadlines that the Seller is asked to provide for the mailing of a Product are given for information purposes only and are not guaranteed. If such deadlines are not met, this shall not, without the agreement of the Seller lead to any claim for damages or right of cancellation of one or more orders by the Buyer, except for non-acceptable delays exceeding [3] months from the stated deadline. In such case only i.e. only in the event of a delay exceeding (3) months from the stated deadline the Buyer shall be entitled to ask for a reimbursement of any down payment previously made to the Seller, to the exclusion of any other damages.

4.7 The Seller does not make any warranties, express or implied, including, without limitation, those of sale ability and fitness for a particular purpose, with respect to any 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 Products available, the Seller cannot guarantee that any Product will be free from infection.

## 5. FORCE MAJEURE

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, labour difficulties, epidemics, major health event (e.g. Corona virus), equipment failure, late deliveries by suppliers or other difficulties which are beyond the control, and not attributable to the fault of the Seller.

## 6. PROTECTION OF THE SELLER’S IPR

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 a Product, or any part of it to any other party other than employees of the Buyer Company (and only in the country of the Primary User for Multi-User Licenses). The Buyer shall have the right to use Products solely for its own internal information purposes. In particular, the Buyer shall therefore not use any Product for purposes such as:

- Information storage and retrieval systems;
- 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 a Product or any derivative thereof.

6.3 If the Buyer would like to use data coming from a Product for presentations, press announcements and any other projects, the Buyer needs to contact Yole Développement’s Public Relations Director (info@yole.fr) to get an official authorization and confirm that the data are up to date. In return the Seller will make sure to provide up-to-date data under a suitable public format.

6.4 The Buyer shall be solely responsible towards the Seller for any infringement of the obligation described in Article 6.3 above, whether such infringement originates from the Buyer’s employees or any person to whom the Buyer has sent the Products. Furthermore, the Buyer shall initiate and personally take care of any related proceedings in coordination with the Seller, and the Buyer shall bear the related financial consequences in their entirety.

6.5 The Buyer shall define within its Company an identified user who shall serve as a contact person for the License purchased by the Buyer. This person will be the recipient of each new report. This person shall also be responsible on behalf of the Buyer, for compliance with all copyrights and other obligations relating to the protection of the Seller’s IP rights and general compliance with the terms of the License purchased by the Company. In the context of Bundle and Annual Subscriptions, the contact person shall decide within the Buyer which person(s) shall be entitled to receive the protected link that will allow the Buyer to access the Products.

6.6 It is acknowledged and accepted by the Buyer that whether purchased in the form of Bundles or Annual Subscription, all unselected reports will be deemed cancelled and lost after a period of 12 month following acceptance of the corresponding order by the Seller in accordance with provisions of Article 1.3 above .

6.7 It is further acknowledged and agreed by the Buyer that any investor in the Buyer Company, any external consultant of the Buyer Company or any joint venture done with a third party in which the Buyer Company is involved , is not entitled to use a Product, without paying to the Seller the full price for a license to the required Product..

## 7. TERMINATION

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 incurred by the Seller, pursuant to such cancellation or postponement.

## 8. MISCELLANEOUS

8.1 All the provisions of these General Terms and Conditions of Sale are for the benefit of the Seller, but also for that of its licensors, resellers and agents. Each of them is entitled to assert and enforce these provisions against the Buyer.

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

8.2 The Seller may, from time to time, update these General Terms and Conditions of Sale, and the Buyer, shall be deemed to have accepted the latest version of such General Terms and Conditions of Sale, once they have been duly communicated to the Buyer by the Seller.

## 9. GOVERNING LAW AND JURISDICTION

- 9.1 Any dispute arising out or linked to these General Terms and Conditions of Sale or to any Licenses or Products purchased in application thereof shall be submitted to the French Commercial Court of Lyon, which shall have exclusive jurisdiction upon such issues.
- 9.2 French law (without reference to any applicable conflict of law provisions) shall apply to these General Terms and Conditions of sale and any agreement between the Buyer and the Seller made pursuant thereto.