

# MEMS & SENSORS FOR SMARTPHONES

TECHNOLOGY & MARKET REPORT - JULY 2010

**Total motion sensor market for mobile phone will reach \$1.19B in 2015, with a 25.3% CAGR**

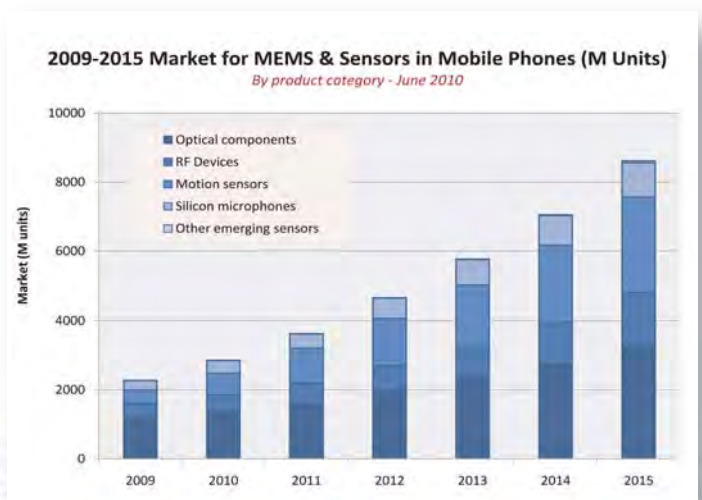
## MARKET TRENDS

Integration of MEMS components and sensors is not new to the mobile phone industry. For example, FBAR RF filters and silicon microphones have been integrated on our mobile phones since 2002. More recently, MEMS accelerometers have been established as a "must-have" feature for many smartphones and feature-phones. And other types of sensors, like CMOS image sensors, have experienced a large success in the recent years.

But the mobile phone market is changing extremely quickly. It appears that in 2010 we are at a turning point in the history of MEMS & sensors for handsets: **the market for MEMS & sensors will experience double digit growth, from \$3.55B in 2009 to \$7.91B in 2015.**

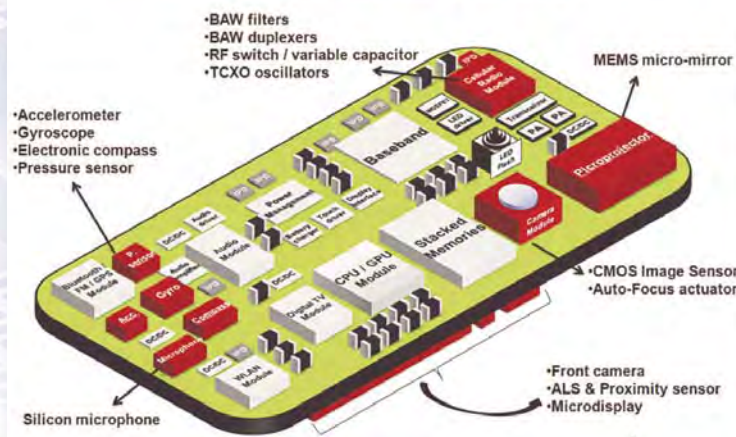
We have identified several factors explaining why MEMS & sensors will experience this tremendous growth over the next few years:

- Share of smartphones is rising faster than ever: 44% of the mobile phones will be smartphones in 2015. Success of smartphones is leading to an increasing amount of MEMS & sensors in mobile phones to provide new features/ services to end-users, to reduce cost through more integration or to improve hardware performance
- GPS integration is not limited to high-end phones anymore. Nearly one phone in three will incorporate GPS in 2010. This is an additional driver to integrate motion sensors : when combined with compass, accelerometers or gyroscopes, this enables new services to be deployed
- The RF part of cell phones is currently changing very quickly, with more and more multi-band multi-mode mobile phones. The incoming deployment of new standards (LTE network in particular) has a direct impact on RF components and will open new doors for online services using an increasing amount of sensors



## Simplified view of a smart-phone board

MEMS & Sensors in red (scope of this report)

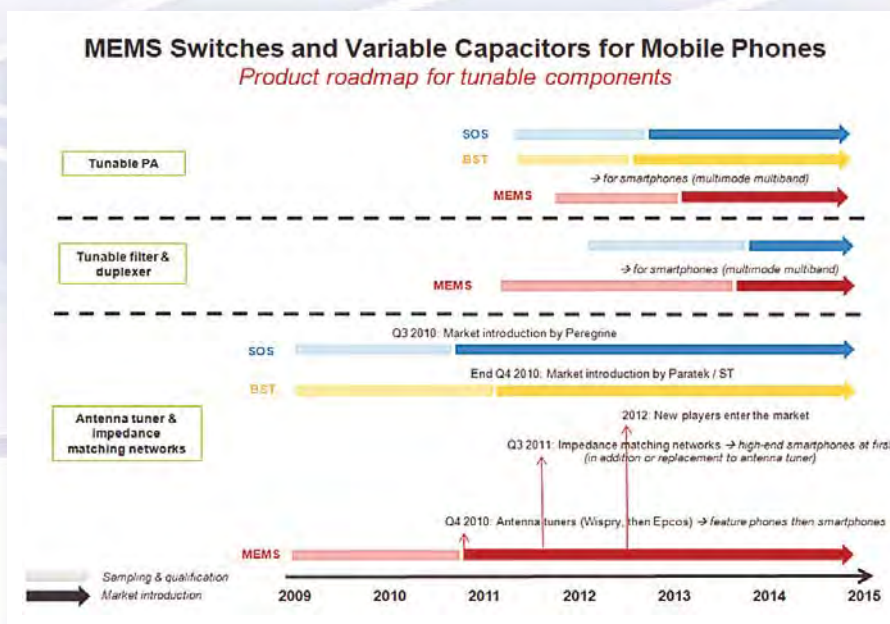


One striking illustration on how quickly things can happen in the mobile phone industry is the recent release of iPhone 4, the first mobile phone to integrate a MEMS gyroscope, followed a few days later by the announcement of InvenSense IPO. The gyroscope business is now expected to boom very quickly: we believe that the gyroscope market for mobile phones will be more than \$80M in 2010 already. We believe strongly that the impact of gyroscopes on the user experience will be as high as the accelerometer case. Only 3 years ago the first accelerometers were integrated on mobile phones, at a price level similar to gyroscopes today. Now accelerometers are viewed as commodity products in some platforms and their penetration should be above one third of cell phones in 2010. **Total motion sensor market for mobile phone will reach \$1.19B in 2015, with a 25.3% CAGR.**



Gyroscopes are not predicted to be the only "killer app" in handsets for the years to come. Many other significant changes are also expected:

- While the accelerometer and compass try to offer differentiating features, gyroscopes are now entering the mobile phone business, and efforts are also put on pressure sensors. Combo of motion sensors with an increasing processing part are now in development
- RF filters, variable capacitors and silicon MEMS oscillators should benefit from the changes occurring at the radio-front end level, from the increasing market for duplexers to the LTE impact on multi-mode phones.
- Silicon microphones are being accepted by the handset market. The cost benefit of ECM tends to decrease, and silicon microphones offer many other advantages. The emergence of dual-microphone solutions for ambient noise cancellation is going to push this business.
- Numerous innovative developments in the optical MEMS area are observed. Integrated picoprojectors could make the micromirror market take off, while new microdisplay concepts expect to widely decrease power consumption.
- CMOS image sensors are already a very big business. The battle is intense between the competitors to develop the next key features such as BSI, WLO, autofocus solutions or stabilization.
- Several other emerging sensors have been identified, with the potential to become new killer applications in 5 to 10 years: microspeakers, environmental sensors...



Such an attractive market brings with it intense competition between players. We can observe very quick changes in the supply chain since 2 years with the emergence of new players, the alliances between companies and regular fundraising / acquisitions, in particular when it comes to startups. IDMs such as ST Microelectronics have been established as business leaders, by offering reliable components, high level of customer support, an extensive product portfolio and huge price reduction.

However few fabless companies have been successful and several innovative fabless start-ups are expected to impact the market within a few years.

## REPORT OUTLINE

- **Worldwide market metrics:**
  - > 2009 – 2015 market (M units/\$M) & ASP (\$)
  - > 2009 market shares
- **150+ companies included in the report**
- **Report is a 330+ slides PowerPoint presentation**
- **Excel datasheet included**
- **20+ key devices are described:** ALS & proximity sensors, BAW filters & duplexers, CMOS image sensors,

CO2 & other gas sensors, Digital compass, Fingerprint sensors, Humidity sensors, Liquid sensors, MEMS accelerometers, MEMS autofocus, MEMS energy harvesting, MEMS gyroscopes, MEMS RFID, MEMS variable capacitors, Micro fuel cell, Microdisplays, Micromirrors, Microspeakers, Pressure sensors, Silicon MEMS oscillators, Silicon Microphones, Temperature sensors

## OBJECTIVES OF THE REPORT

- To provide **market data on MEMS & sensors for mobile phones: key market metrics & dynamics:**
  - > Unit shipments, revenues and average selling price by type of MEMS & sensors
  - > Market shares with detailed breakdown for each player
- To provide **application focus on key sensors that are changing the mobile phone industry: new features, technical roadmap, insight about future technology trends & challenges:**
  - > Packaging roadmaps (size of the sensors)
  - > Integration roadmaps (multi-sensors, integration of processing...)
- To provide a **deep understanding of MEMS & sensors value chain, infrastructure & players for the handset business:**
  - > Performance roadmaps with functionalities (e.g. for gyroscopes: from current devices used for stabilization, gaming and user interface to very low-drift gyroscopes used for true pedestrian navigation)
  - > Exhaustive list of players for each device under consideration
  - > Analysis on who are the key suppliers and emerging players to be considered
  - > What business model is the most successful and how will it evolve?

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## WHO SHOULD BUY THE REPORT

- **MEMS & sensor suppliers**
  - > Evaluate market potential of future technologies and products for new applicative markets
  - > Understand the differentiated value of your products and technologies in this market
  - > Identify new business opportunities and partners
  - > Monitor and benchmark your competitor's advancements
- **R&D centers**
  - > Evaluate market potential of future technologies and products for new applicative markets
  - > Identify the best candidates for technology transfer
- **MEMS & packaging foundries**
  - > Understand what are the applications that will drive the volumes in 2015
  - > Identify new business opportunities and prospects
- **Mixed-signal companies & ASIC manufacturers**
  - > Spot new opportunities and define diversification strategies
- **Mobile phone OEMs**
  - > Evaluate market potential of future technologies and products for new applicative markets
  - > Screen potential new suppliers for introducing disruptive features such as low-drift gyroscopes and IMUs, secondary microphones, MEMS oscillator, tunable RF components...
  - > Evaluate the benefits of using these new technologies in your end system
- **Network operators**
  - > Understand what will be the future services that can be offered by taking benefit on the new sensors
- **Financial & strategic investors**
  - > Understand the potential of new devices & MEMS technologies such as gyroscopes, RF switches, oscillators, speakers...
  - > Get the list of main key players & emerging start-ups of this industry

## COMPANY INDEX

3M, AgileRF, Aichi Steel, AKM, Akustica, Alces Technology, Alps Electric, Analog Devices, Apple, Aptina Imaging, Artificial Muscle, Asahi, Atmel, Audiopixels, Authentec, Auxitrol, Avago, Baolab, BEI Kimco Magnetics, Best Sound Electronics, Bluechiip, Bosch Sensortec, Btendo, Cambridge Mechatronics, Carnegie Mellon University, Cavendish Kinetics, CEA Leti, Ceradyne, ChipSensors, CSEM, Cypress, Dai Nippon Printing, Deep Di Semiconductor, DelfMEMS, Discera, Domintech, DXO, Epcos, Epson, Epson Toyocom, Fox Electronics, Fraunhofer IZM, Freescale, Fujitsu, G-TEK Scientific, Hamamatsu, HDK-hokuriku, Hillcrest Lab, Hiperscan, Honda/Stanford University, Honeywell, Hosiden, HT Micro, IBM, iC-Haus, ICT, IDT, IMEC, Infineon, Intersil, Invensense, Jyve, KDS, Kionix, Knowles Acoustics, Kyocera, Lawrence Livermore National Laboratory, Lemoptix, Lensvector, LG, Light Blue Optics, LightTuning / Egis Technology, Linear Technology, M2E power, Maradin Technologies, Maxim, Mcube, MEMSIC, Memsmart, Memsmertiz, Memstech, Micro infinity, Microflown Technologies, Microsemi, Microvision, Miradia, MIT, Mitsubishi, Mitsumi Electric, Mobius microsystem, Motorola, Movea, MTI Fuel Cell, Murata, MyFC, NDK, New Scale Technologies, Nippon Signal, Nokia, NPC, NTT Docomo, Nuvoton Technology, NXP, Olympus, Omnivision, Omron, Optotune, Opus Microsystems, Osram, Panasonic, Paratek, Pegreine SC, Pixart, Pixtronix, Polight, Powermat, Qualcomm, Qualtre, Rakon, RFMD, RIM, Rohm, Samsung, Sand9, Seiko Instruments, Senda Micro Technologies, Senodia, SenseAir, Sensirion, Sensor Platforms, SETi, Sharp, Siimpel, Silicon Clocks, Silicon Labs, SiTime, Siward, Skyworks, Sony, SonyEricsson, ST Microelectronics, Taiyo Yuden, Tessera, Texas Advanced Optoelectronic Solutions, Texas Instruments, Tohoku University, Toshiba, Triquint, TXC, Unipixel, Upek, Varioptic, Vasstek, Veratag, Virtus Advanced Sensors, Vishay, VTI, VTT, Wacoh, Wispry, Xiamen Hualian Electronics Company, Yamaha, Yishay Sensor, ZTE.

## BIO



### Laurent Robin:

Laurent is in charge of the MEMS & Sensors market research at Yole Developpement. He previously worked at image sensor company e2v Technologies (Grenoble, France). He holds a Physics Engineering degree from the National Institute of Applied Sciences in Toulouse, plus a

Master Degree in Technology & Innovation Management from EM Lyon Business School, France



### Jerome Baron:

Jerome is leading the MEMS & Advanced Packaging market research at Yole Developpement. He has been involved in the analysis of the CMOS image sensor industry at the sensor, packaging, assembly & test levels. He is also involved in the research linked to new equip-

ments and materials for image sensor manufacturing. He was granted a Master of Science degree in Nanotechnologies from the National Institute of Applied Sciences in Lyon, France

# ORDER FORM

PLEASE ENTER MY ORDER FOR «MEMS & SENSORS FOR SMARTPHONES» REPORT IN:

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\*For price in dollars please use the day's exchange rate

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\*All reports are delivered electronically in PowerPoint format (pdf file)

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Fax: +34 93 4011989

E-mail: [ifsa@sensorsportal.com](mailto:ifsa@sensorsportal.com)

### Contact:

Sergey Yurish at Tel.: +34 696067716

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## BILLING CONTACT

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## ABOUT YOLE DÉVELOPPEMENT

Beginning in 1998 with Yole Développement, we have grown to become a group of companies providing market research, technology analysis, strategy consulting, media in addition to finance services. With a solid focus on emerging applications using silicon and/or micro manufacturing Yole Développement group has expanded to include more than 40 associates worldwide covering MEMS and microfluidics, Advanced Packaging, Compound Semiconductors, Power Electronics, LED, and Photovoltaic. The group supports companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to develop their business.

### CONSULTING

- Market data, market research and marketing analysis
- Technology analysis
- Reverse engineering and reverse costing
- Strategy consulting
- Corporate Finance Advisory (M&A and fund raising)

### REPORTS

- Collection of market & technology reports
- Players & market databases
- Manufacturing cost simulation tools
- Component reverse engineering & costing analysis

### MEDIA

- Critical news, Bi-weekly: Micronews, the magazine
- In-depth analysis & Quarterly Technology Magazines:
- MEMS Trends- 3D Packaging - PV Manufacturing - Efficien'Si
- Online disruptive technologies website: [www.i-micronews.com](http://www.i-micronews.com)
- Exclusive Webcasts
- Live event with Market Briefings



# TERMS AND CONDITIONS OF SALE

Definitions: "Acceptance": Action by which the Buyer accepts the terms and conditions of sale in their entirety. It is done by ticking the box "I accept the conditions".

"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.

"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, 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.

"License": For the reports and databases, 3 different licenses are proposed. The buyer has to choose one license: 1. Single user license: the purchaser is the sole authorized user of the report 2. Multi-user, single site license: the report can be used by various users provided that the report is only use within the same company at same post address 3. Multi-user, multi-site license: the report can be used by various users within the same company or group and its subsidiaries (more than 50% share) at a global scale.

"Products": Depending on the purchase order, reports or database on MEMS, CSC, Optics/MOEMS, Nano, bio... to be bought either on a unit basis or as an annual subscription. (i.e. subscription for a period of 12 calendar months). The annual subscription to a package (i.e. a global discount based on the number of reports that the Buyer orders or accesses via the service, a global search service on line on I-micronews and a consulting approach), is defined in the order. Reports are established in PowerPoint and delivered on a PDF format and the database may include Excel files.

"Seller": Based in Lyon (France headquarters), Yole Développement is a market research and business development consultancy company, facilitating market access for advanced technology industrial projects. With more than 18 consultants, Yole works worldwide with the key industrial companies, R&D institutes and investors to help them understand the markets and technology trends.

1. Scope  
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.

1.2 This agreement becomes valid and enforceable between the Contracting Parties after clear and non-equivocal consent by any duly authorised person representing the Buyer. For these purposes,

the Buyer accepts these conditions of sales when ticking the box "I accept the conditions". This results in acceptance by the Buyer.

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 the 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 incases 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 meanseither by email via the sales department or automatically online via an email/password. 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.

2.4 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 nonconformity 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. .

2.5 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 Yole may offer a pre release discount for the companies willing to acquire in the future the specific report and agreeing on the fact that the report may be release later than the anticipated release date. In exchange to this uncertainty, the company will get a discount that can vary from 15% to 10%.

3.3 Payments due by the Buyer shall be sent by cheque payable to Yole Développement, credit card or by electronic transfer to the following account:

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To ensure the payments, 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.

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.

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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

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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.

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, labor difficulties, equipment failure, late deliveries by suppliers or other difficulties which are beyond the control, and not 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 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:

- 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 the Product.

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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.

6.5 In the context of annual subscriptions, the person of contact shall decide who within the Buyer, shall be entitled to access on line the reports on I-micronews.com. In this respect, the Seller will give the Buyer a maximum of 10 password, unless the multiple sites organisation of the Buyer requires more passwords. The Seller reserves the right to check from time to time the correct use of this password.

6.6 In the case of a multisite, multilicence, only the employee of the buyer can access the report or the employee of the companies in which the buyer have 100% shares. As a matter of fact the investor of a company, the joint venture done with a third party etc... can not access the report and should pay a full licence price.

7. Termination

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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

All the provisions of these Terms and Conditions are for the benefit of the Seller itself, but also for its licensors, employees and agents. Each of them is entitled to assert and enforce those provisions against the Buyer.

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 Lyon, 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.