



RESEARCH & DEVELOPMENT AGREEMENT

Between

HUAWEI TECHNOLOGIES Italia S.r.l.
and

UNIVERSITA' DEGLI STUDI ROMA TRE
DIPARTIMENTO DI INGEGNERIA

Agreement No: HF2019045069



This Agreement is made and entered into as of the Effective Date

By and between

Huawei Technologies Italia S.r.l.,
having its registered office at Via Lorenteggio, 240, 20147 Milano MI, Italy
(hereinafter "Huawei")

and

UNIVERSITA' DEGLI STUDI ROMA TRE – **DIPARTIMENTO DI INGEGNERIA**, having its
registered office at **Via Vito Volterra 62**
00146 Roma
(hereinafter "Partner").

Huawei and Partner are each individually hereinafter also referred to as "Party" and,
collectively, as "Parties"

Preamble

WHEREAS, Huawei is a global telecommunication equipment supplier.

WHEREAS, Huawei now wishes to contract for and Partner is willing to carry out research
and development work as defined herein.

NOW, THEREFORE, in consideration of the promises and mutual covenants contained herein
and for other good and valuable consideration, the receipt and sufficiency of which is hereby
mutually acknowledged, Parties hereto agree as follows:

Part I: Technical and Commercial Provisions

Section 1 - Definitions

"Affiliate" shall mean entities that control, or are controlled by, or are under common control
with a Party. For the purposes of this definition, 'control' shall mean direct or indirect ownership
of at least fifty percent (50%) of the voting power, capital or other securities of controlled or
commonly controlled entity.

"Agreement" shall mean this research and development agreement.

"Background IPR" shall mean a) any IPR held, controlled or owned by any Party or its Affiliates,



in existence prior to the Effective Date, or b) the IPR generated by any of the Parties independently of this Agreement.

“Confidential Information” shall mean including, without limitation, all non-public information relating to business plans or practices, financial or technical matters, trade secrets, designs, know-how, inventions, operations, the marketing or promotion of product, business and information received from others that Discloser is obligated to treat as confidential and any other information received or acquired by Recipient from the Discloser in the course of exploring the possible Business Relationship. The Confidential Information shall be disclosed in written form and marked "CONFIDENTIAL", with the name of the Discloser and the date of disclosure. If the Confidential Information is initially disclosed orally, it shall be reduced to written form by the Discloser (including the date of the oral disclosure and name of the Discloser) and presented or mailed to the Recipient within fifteen (15) days of the first oral disclosure.

“Remuneration” shall mean the total amount of fees that shall be paid by Huawei to Partner described in Section 8 for all Development Work, Results and services.

“Deliverables” shall mean any and all deliverables, including but not limited to Technical Solutions, Technical Samples, described and itemized in the Annex 1 and/or Section 0.

“Delivery Date” shall mean the designated date by which corresponding Results must be delivered in order for the terms of this Agreement to be fulfilled.

“Development Work” shall mean the research and development work on **+/-90° scanning range planar array + dielectric lens system operating in the 26.5 – 29.5GHz frequency band** pursuant to the provisions of this Agreement and specified in more detail in Annex 1.

“Discloser” shall mean the Party disclosing Confidential Information to the other Party during the negotiation and performance of this Agreement and except as otherwise indicated in this Agreement, also includes all Affiliates of the Discloser.

“Effective Date” shall mean the latter date of signature of this Agreement.

“IPR” or “Intellectual Property Rights” shall mean any and all:

- I. patents, utility models, trademarks, trade names, domain names, designs, semiconductor topography rights,;
- II. rights to inventions, know-how, trade secrets, database rights and confidential technical and non-technical information;
- III. copyrights, author's rights, moral rights, mask work rights and rights of publicity;
- IV. other industrial, proprietary and intellectual property related rights of any kind whatsoever, whether registered or unregistered and including all applications and



rights to apply for and be granted, renewals or extensions of, and rights to claim priority from such rights and all similar or equivalent rights or forms of protection which subsist or will subsist now or in the future in any part of the world.

“Non-Disclosure Agreement” shall mean the Non-Disclosure Agreement entered into by the Parties dated on XXX with the agreement number of XXX.

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Please insert details of the NDA.

“Open Source License” shall mean any license that: (a) requires the licensor to permit reverse-engineering of the licensed software or other software incorporated into, derived from, or distributed with such licensed software, or (b) that requires the licensed software or other software incorporated into, derived from, or distributed with such licensed software (i) be distributed in source code form; or (ii) be distributed at no charge. Open Source Licenses include but not limited to: (a) GNU General Public License (GPL) or Lesser/Library GPL (LGPL), (b) The Artistic License (e.g., PERL), (c) the Mozilla Public License, (d) the Netscape Public License, (e) the Sun Community Source License (SCSL), (f) the Sun Industry Standards Source License (SISL), (g) the Apache Server license, (h) QT Free Edition License and (i) IBM Public License and (k) BSD (Berkley Software Distribution) License.

“Open Source Software” shall mean any source or object code that is subject to an Open Source License.

“Recipient” shall mean the Party receiving Confidential Information from the other Party during the negotiation and performance of this Agreement, and except as otherwise indicated in this Agreement, also includes all Affiliates of the Recipient.

“Results” shall means any tangible or intangible output of the Development Work, such as Deliverables, Technical Solutions, Technical Samples, data, knowledge or information, that is generated in the Development Work, whatever its form or nature, whether or not it can be protected, as well as any rights attached to it, including IPR.

“Results Evaluation” shall mean any and all tests Huawei deems necessary in order to establish the compliance of the Results with the Specification as defined in Section 4 -.

“Specification” shall mean exact written descriptions of related criteria specified in the Annex 1 and/or Section 5 - used to establish whether the Results meet any and all requirements hereunder.

“Staff” shall mean the employees of Partner specified in Section 3 - designated by Partner and qualified for the undertaking of the Development Work.

“Technical Solutions” shall mean the technologies and industry solutions developed by Partner in accordance with the terms and conditions of this Agreement.



"Technical Samples" shall mean the samples developed by Partner to carry out Technical Solutions. Such samples shall be **Phase Arrays Antenna Prototypes**.

"Use" means the direct or indirect utilisation of the Results, Development Work, the Deliverables and/or the IPR in further research activities other than those covered by the Agreement, or for developing, creating, making, providing and/or marketing and/or have a third party developing, creating, making, providing and/or marketing a product or process or service.

"Work Plan" shall mean the work schedule detailed in Section 0 herein.

"Work Place" shall mean the place where Partner conducts the Development Work.

Section 2 - Scope of Agreement, Obligations of the Partner

Subject to the terms and conditions herein, Partner shall carry out the research and **Development Work on +/-90° scanning range planar array + dielectric lens system operating in the 26.5 – 29.5GHz frequency band** as defined in Annex 1.

Partner shall perform its obligations of research and Development Work in a professional, workmanlike and state-of-the-art manner and shall ensure that the research and development meets technical, scientific and professional standards and that it is undertaken by appropriate personnel and carried out in accordance with this Agreement.

The Partner will comply with applicable laws and regulations including rules relating to fair trade and anti-corruption, support Huawei in the building of trust and integrity, reject any solicitation for bribes during daily business cooperation and make a complaint to Huawei's Business Control Department if there is any related misbehavior (via Complaint channel: E-mail: purchase_audit@huawei.com, TEL: +86-755-28786148 or Fax: +86-755-28789314).

Partner shall deliver the Results and the Deliverables to Huawei in accordance with the schedule laid down in Section 4 - and Section 5 -.

Unless otherwise requested by Huawei, Partner shall deliver answers **in thirty (30) days** upon the receipt of enquiries from Huawei regarding the Results by way of facsimile or e-mail.

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To be filled out for this specific project.

Section 3 - Staffing



Partner shall allocate professional and state-of-the-art qualified Staff to undertake the Development Work, as put forward in the Partner's Technical and Commercial Proposal (**Errore. L'origine riferimento non è stata trovata.**).

Each Party designates its contact person under Annex 1 who is in charge of the liaison and coordination work during the term of this Agreement:

Huawei shall be informed of any change of Staff fifteen (15) days in advance. In such cases, Partner shall designate other persons with at least equivalent proficiencies to undertake the Development Work.

Any Staff of Partner shall comply with EHS, security and other internal regulations and policies adopted and communicated to Partner by Huawei in respect of persons working at the premises of Huawei.

Section 4 - Work Plan

Partner shall carry out the Development Work in the Work Place according to the Work Plan specified below. Work Place shall be **Rome** or other sites or places agreed or approved by Huawei.

The Parties shall communicate with each other about the technical, managerial and other necessary information regarding the Development Work timely and accurately. Partner shall keep Huawei informed of the progress of the Development Work by sending written reports to Huawei monthly if not otherwise agreed in in the SOW. In the event that Partner foresees a delay in the Development Work, Partner shall promptly notify Huawei specifying (i) reasons of such delay; and (ii) its best estimated new schedule. In the event of any delay of more than thirty (30) days not resulting from Huawei's default, Huawei shall have the right to terminate this Agreement according to Clause 0 of this Agreement.

Huawei shall be entitled to make an audit and examination of the Development Work and its related documentations during the term of this Agreement, to which Partner shall provide necessary cooperation. Upon the receipt of the notice about problems discovered through the said audit and examination, Partner shall provide reasonable explanation and clarification of such problems. Huawei shall have the right to require Partner's reasonable measures to solve such problems.

During the term of this Agreement, Huawei shall have the right to inform Partner to change the Development Work and Work Plan according to altered requirements of this cooperation. Huawei shall provide a document specifying such changes, upon which Partner shall manage to conduct the amended Development Work according to the changed instructions. If such



changes results in additional fees of not more than 15% of the Remuneration stated in Clause 0, Parties shall agree to a new schedule and Partner shall conduct the changed Development Work without additional payment from Huawei. If the additional fees exceed 15% of the Remuneration stated in Clause 0, the Parties shall agree on an appropriate adjustment regarding additional fees and schedule.

For avoidance of doubt, the additional fees shall be calculated by the daily working fees of **four hundreds euro (400€)** per person multiplying the additional number of working days caused by such changes.

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Please fill out according this specific project

Section 5 - Delivery

Partner shall deliver all Results to Huawei's office in Segrate (MI), Italy or other sites as mutually agreed.

Partner shall deliver all Results and Deliverables latest at the end date of every stage specified in Section 4 -.

Partner agrees that it shall provide monthly report on its performance including without limitation performed Development Work and delivered Results, hours spent, current schedules, detailed expenses or costs and other necessary information for Huawei to inspect and get updated knowledge in connection with the Results. Reports have to be comprehensive enough for Huawei to gain sufficient insight into the concept and the structure of the Development Work and to enable Huawei to fully understand the Results obtained.

In the event that the delivery of the Results was delayed over thirty (30) days due to Partner's failure of performance, Huawei shall have the right to terminate this Agreement immediately by a written notice to Partner.

Section 6 - Results Evaluation

Huawei shall perform Results Evaluation according to the Specifications with the Results delivered on the site of Huawei or any other places selected or approved by Huawei, within thirty (30) days after receipt. Further details are described in Annex 1.

If the Results Evaluation reveal no errors, defects and non-conformities with the Specifications, Huawei shall provide Partner with a written acceptance certificate. In this case, Partner shall continue its Development Work in next stage.

If the Results Evaluation reveal errors, defects and/or non-conformities with the Specifications, Huawei shall send a written notice to Partner specifying such errors, defects and/or non-



conformities, upon the receipt of which Partner shall, at no additional charge from Huawei, take all reasonable measures to remedy such errors, defects and/or non-conformities or substitute delivery to Huawei within fifteen (15) days. Huawei shall then repeat Results Evaluation within thirty (30) days. If such further Acceptance Tests reveal no errors, defects and non-conformities, Huawei shall provide Partner with a written acceptance certificate. If such further Results Evaluation reveal any non-conformity, Huawei shall have the option to terminate the Agreement immediately by a written notice to Partner, or to inform Partner in written to correct such non-compliance and resubmit the corrected Deliverables to Huawei within fifteen (15) days.

Section 7 - Remuneration

For the performance of the Partner's obligations under this Agreement, Huawei shall pay Partner the total amount of **One hundred thirty thousand euro (130,000 €)** as Remuneration. Unless otherwise agreed in writing between the Parties, no additional fees shall be paid to Partner by Huawei.

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To be filled out according this specific project.

Huawei shall pay the Remuneration according to the payment schedule below:

Stage	Payment Term	Payment Amount (exc. VAT)
1	Contract Signature	26,000€
2	The Deliverables of the first stage has passed the corresponding Acceptance Tests.	19,500€
3	The Deliverables of the second stage has passed the corresponding Acceptance Tests.	32,500€
4	The Deliverables of the third stage has passed the corresponding Acceptance Tests.	52,000€

Except as otherwise specified by Huawei in writing, the prices under this Agreement are exclusive of any, value added or other taxes, levies, imposts, duties, charges or withholdings of any nature ("Taxes") arising out of any transaction contemplated by this Agreement and imposed against Partner and/or Huawei by the tax authority or by other governmental entity. Without prejudice to the above, both Parties shall be responsible for their own applicable taxes as required by applicable laws and rules in force. Partner shall show identification numbers of both Parties (**Huawei Technologies Italia Srl.**) on the invoices.

All payments shall be payable within **15 (fifteen)** calendar days upon receipt of a valid invoice issued by Partner (**AC15D**).



If payment is late, the Partner may claim late payment interests on the outstanding sums unless Huawei's failure to pay is due to Partner's failure to comply with its contractual obligations. The applicable interest rate shall be equal to the rate defined by Legislative Decree 231 of 9 October 2002.

Huawei shall pay Partner the Remuneration by bank transfer to following bank account:

Beneficiary Name: Universita degli Studi ROMA TRE – Dipartimento di Ingegneria

Bank Name: Banco BPM Società per Azioni

Swift Number: BAPPIT22

Bank Address: Viale Europa, 115

Account Number: 000000300003

IBAN: IT16Z0503403207000000300003

Any notice for changing the information of the Partners bank account will take effect upon receipt by Huawei and provided it is signed by a duly Authorized Representative of the Partner or any other person so authorized in writing by the Partner.

Section 8 - Ownership of Intellectual Property Rights

Each Party shall retain all rights in its own Background IPR.

All IPR embodied in the Results or otherwise generated in the performance of this Agreement, shall be exclusively owned by Huawei.

The Partner warrants to disclose, fully and promptly, and only to Huawei, all ideas, methods, plans, improvements or patentable inventions of any kind which are made or discovered, in whole or in part, by the Partner during the performance of the Development Work that result from any aid, support, or assistance by Huawei or that are created solely during Partners performance under this Agreement.

The Partner hereby assigns to Huawei any and all rights, title, and ownership interests that it or its employees may acquire in or to any invention, discovery, concept or idea within the Results protected or protectable by copyright, trademark, patent or design protection under this Agreement to the extent that applicable law permits. Huawei hereby accepts such assignment. Additionally Partner will unrequested and promptly execute and provide Huawei with a specific written assignment. In the foregoing assignment the Partner shall explicitly mention the Agreement No. of this Agreement and attach a copy of this Agreement.

For the avoidance of any doubt, and unless not otherwise specified within this Agreement or the written assignment or another document in textform (email), the assignment of technical



inventions is deemed to be effective on the day of "filing of the patent application or similar right application" at any competent authority.

Partner hereby grants Huawei and its Affiliates a free of charge, perpetual, world-wide and non-exclusive license to Use its Background IPR as necessary for the purpose of carrying out or using or utilizing or implementing the Results, Development Work and Deliverables under this Agreement. Such license includes the right to amend the Results, Development Work or Deliverables and to use, utilize or implement these in amended form.

Upon the request of Huawei, Partner shall compose and deliver descriptive and explanatory technical statements regarding the Results and Partner will provide reasonable support to Huawei in the filing and defense of patent rights based on technical inventions invented by the Partners' employees during the fulfillment of this Agreement. Partner shall contractually bind the employees to provide free of charge assistance to Huawei and its legal successor for getting each such patent granted, which assistance includes in particular but is not limited to giving statements, signing assignments and declarations and fulfilling other requirements as needed before authorities such as patent offices. Partner shall maintain personal contact information (addresses) of the inventors (inventing employees), shall forward documents to inventors and shall use best efforts to ensure direct contact between inventor and Huawei if required for filing patent applications or supporting the granting of patents based on inventions granted.

Huawei grants to Partner an irrevocable, non-exclusive, non-transferable and non-sublicensable, royalty-free right to use the Results and any IPR generated in the performance of this Agreement solely for non-commercial internal research and development (not including third-party research and development) and the purposes of teaching and other academic uses.

Subject that applications, and/or registrations of intellectual property rights are not impaired, the Partner shall have the right to publish the Results or any portion thereof in dissertations or thesis, academic periodicals or other academic media upon the prior written approval from Huawei, which approval shall not be unreasonably withheld.

Any publication of Results of the work directly related to the Agreement by the University shall be subject to prior written consent of The Company. Such consent shall not be unreasonably withheld and will be provided by the Company not later than thirty (30) calendar days form the receipt of such request. Notwithstanding the foregoing, the Company shall be entitled to require the University to delay the proposed publication for a maximum of sixty (60) calendar days after receipt of its request of publication if, in the Company's reasonable opinion, that delay is necessary in order to protect the Company's Confidential Information, or to seek patent or similar protection for any of the Company's Background IPR and / or IPRs embodied in the Results that is to be published.



Section 9 - Survival

Section 8 -, Section 9 -, Section 10 -, Section 12 -, Section 13 -, Section 14 -, and Section 16 - herein shall survive any expiration or termination of this Agreement has.

Part II: General Provisions

Section 10 - Confidentiality

Confidential Information shall not include any information, however designated, that:

- I. is or subsequently becomes publicly available through no wrongful act of the Recipient; is already known to the Recipient at the time of disclosure;
- II. is rightfully received by the Recipient from a third party without restriction on disclosure and without breach of this Agreement;
- III. is independently developed by Recipient and without the use of any of the Confidential Information.

The Parties shall strictly perform confidentiality obligations specified in the Non-Disclosure Agreement.

Unless otherwise agreed, neither Party shall in any manner disclose to any third party or publicly disclose or make public reference about the facts that the Parties (i) are discussing or intend to initiate discussions on the subject matter hereof or the possibilities to enter into any business or other relationship; or (ii) have or have entered into or are contemplating to enter into or have terminated any business or other relationship.

All technical and commercial information provided to Recipient by Discloser during the negotiation and performance of this Agreement, including but not limited to the content of this Agreement, the existence of this Agreement, Results shall be treated as the Confidential Information defined in the Non-Disclosure Agreement signed by Parties.

Recipient shall strictly refrain from disclosing any Confidential Information to any third parties without prior written consent of Discloser. Partner shall strictly refrain from disclosing the content of this Agreement, the existence of this Agreement, the whole or part of the Results to any third parties without prior written consent of Huawei. Recipient shall use Confidential Information only for the purpose of performing this Agreement. Recipient shall use reasonable care, but in no event less than the same degree of care that it uses to protect its own confidential and proprietary information of similar importance, to prevent the unauthorized use, disclosure, publication and dissemination of Confidential Information. Recipient shall



refrain from disassemble, decompile, decrypt or otherwise reverse engineering Confidential Information.

Upon the reception of the final written acceptance certificate and relevant fees from Huawei, Partner shall immediately destroy or return all originals, copies, reproductions and summaries of Results controlled or possessed by Partner.

Upon any termination or expiration of this Agreement, Recipient shall promptly return or destroy all originals, copies, reproductions and summaries of all Confidential Information disclosed by Discloser.

Section 11 - Open Source License Compliance

Without prior written consent of Huawei, the Results shall not embody any Open Source Software.

Subject to Section 0, the Partner shall, latest 3 (three) months before delivery is due according to this Agreement, provide Huawei a list of any and all of the Open Source Software contained in Results according to **Errore. L'origine riferimento non è stata trovata.**

The Partner represents and warrants that the list in **Errore. L'origine riferimento non è stata trovata.** provided by the Partner according to Section 0 is accurate and exhaustive, and that the Partner shall have fully complied with respective Open Source License for Open Source Software used in Results before the final stage Delivery Date in accordance with the Agreement. Subject to applicable Open Source License, upon request by Huawei, the Partner shall provide Huawei source code of related Open Source Software without any charge.

In the event that the Partner fails to perform its obligations in Section 11 -, or its performance fails to satisfy the terms of Section 11 -, the Partner shall reimburse Huawei any loss or damage or liability suffered by Huawei due to such breach.

Section 12 - Infringement of IPR

Partner represents and warrants that Results or any part thereof shall not infringe any third party's IPR, and will be free from defects that are resulted from malfunctions or illicit code, including but not limited to computer viruses, trojan horses, backdoor, self-destruction mechanisms, copy protection schemes.



Partner shall at its expense defend, fully indemnify and hold harmless Huawei and its employees, customers or agents from and against any and all damages, costs, expenses (including reasonable attorney fees), and liabilities awarded in any action brought against Huawei or any customer of Huawei, based on allegation that Results or other information provided by Partner under this Agreement or any portion thereof infringe any IPR of any third party, provided that Huawei (i) promptly notifies Partner in writing of the claim; (ii) gives Partner necessary information which Huawei or Huawei's customer has learnt in relation to the claim; (iii) reasonably co-operates with and assists Partner in defending the claim at Partner's expense; and (iv) gives Partner sole authority to control or settle the claim.

In the event that the Use of Results or any portion thereof are likely to be prohibited or enjoined, Partner shall, at its own expense, either (i) procure for Huawei the right to continue using Results so that it is non-infringing; or (ii) modify or replace such infringing Results or part thereof so as to avoid the infringement, without prejudice to the representations and warranties in this Agreement in relation to all or any part of Results, and without diminishing or curtailing in any material respect of the performance or functionality of Results as described in Specifications.

In the event that Partner by its reasonable judgement is not able to exercise any of the options set out at foregoing Sections 0(i) or 13.3(ii) within reasonable time, then Partner shall immediately refund to Huawei the amount in proportion to what have been paid by Huawei under this Agreement.

Section 13 - Force Majeure

Either Party shall be excused for failures or delays in performance caused by war, strikes, lockouts, earthquakes, floods, fire, explosions, or such catastrophes or events as are beyond reasonable control or without the material fault of such Party.

Any Party claiming such excuse for failure or delay in performance due to the above causes shall give prompt notice thereof to the other Party attaching necessary proof material, and neither Party shall be considered in breach of this Agreement or in default of its obligations hereunder because it fails to perform or observe any or all of the terms of this Agreement resulting directly or indirectly from such causes.

This provision shall not, however, release such Party from using its best efforts to avoid or remove all such causes and such Party shall continue performance hereunder with the utmost dispatch whenever such causes are removed.

In the event that the period of excused performance continues for ninety (90) days, this



Agreement may be terminated by the affected Party with written notice to the other Party.

For avoidance of doubt, any disclosure by third parties of any technology to be developed or being developed by Partner not due to any default of the Parties shall be included in force majeure events, in which case each Party shall be entitled to terminate this Agreement. In such events, Huawei shall neither be obligated to pay any fees which shall be paid to Partner without such events, nor be liable to return any Deliverables that have been delivered to Huawei by Partner.

Section 14 - Liabilities and Insurances

The total liability of Huawei under this Agreement for any and all cumulated claims, whether based on Agreement, tort (including negligence), infringement of third party intellectual property rights, property damage or otherwise, resulting from Huawei's performance of this Agreement, including any liquidated damages shall not exceed 100% (onehundred percent) of the Remuneration amount duly paid off within 12 months before the dispute arises.

Notwithstanding any other provision in this Agreement, neither Huawei or its agents, or its subcontractors shall be liable to the Partner, its agents and subcontractors, for any indirect, incidental, consequential losses, loss of profit or revenues, loss of goodwill or reputation, loss of opportunity, loss of data or information, arising out of any performance of this Agreement, regardless of whether such losses or damages are based on tort, warranty, or any other legal theory, even if Huawei is advised of the possibility of such losses or damages.

Nothing in this Agreement shall exclude or limit either Party's liabilities for:

- death or personal injury caused by either Party's negligence;
- or
- willful failure or gross negligence of either Party in performing its contractual obligations;
- or
- either Party's liability for fraud or fraudulent misrepresentation;
- or
- any other liability that cannot be excluded by law.

The Partner shall at its own expense effect and maintain during the term of this Agreement such insurance coverage required by applicable statutory insurance requirements and appropriate, in particular but not limited, for health, life, liability, accident, damage to property and pecuniary loss of third parties and other policies necessary and required in conducting the Partner's business with coverage of at least EUR 2 (two) million for personal injury, EUR 1 (one) million for property damage and EUR 100.000 (onehundredthousand) for pecuniary loss per contract year.



Such insurance shall, inter alia, cover damages caused by his Services and will not expire before all obligations under this Agreement and/or any individual agreements concluded hereunder have been fulfilled. Partner unrequested gives Huawei one month written notice of any change in or cancellation of such insurance coverage. Upon Huawei request, the Partner shall present to Huawei insurance certificates evidencing that the Partner has the insurance coverage required above. With respect to warranty claims and/or other liability claims, the Partner hereby, on account of performance and if and to the extent allowed by the insurance contract already assigns its relevant claims against its insurance company to Huawei, in the amount to which Huawei is entitled. Huawei hereby accepts such assignment, which Huawei is entitled to disclose. Huawei shall not demand payment from the Partner's insurance company if and to the extent the Partner makes payment to Huawei.

Section 15 - Term and Termination

This Agreement shall come into force on Effective Date and shall remain in full force until all the obligations of the Parties herein have been performed properly and legally.

Notwithstanding anything to the contrary, Huawei shall have the right to terminate this Agreement at any time for convenience provided that Huawei shall give a written notice to the Partner at least 30 (thirty) days in advance.

Either Party shall have the right to immediately terminate this Agreement upon written notice to the other Party in any of the following events:

The other Party breaches a material obligation stipulated under this Agreement that could not be cured, or if the breach is the one which is capable of being cured and has not been cured within thirty (30) days except the breaching Party has commenced to cure the breach within such time and continues to do so to the extent satisfactory to the non-breaching Party, and the breaching Party has been granted an extension for a reasonable period of time at the sole discretion of the non-breaching Party.

The direct or indirect ownership or control of the other Party that exists on Effective Date of this Agreement changes in any material manner that adversely affects the rights of the terminating Party, including the acquisition of ownership or control by a competitor of the other Party. Under such circumstance, the said other Party shall cooperate with the terminating Party to conduct an orderly termination of this Agreement.

The other Party ceases to conduct business in the normal course, becomes insolvent, enters into suspension of payments, moratorium, reorganization or bankruptcy, makes a general assignment for the benefit of creditors, admits in writing its inability to pay debts as are mature,



suffers or permits the appointment of a receiver for its business or assets, or avails itself of or becomes subject to any other judicial or administrative proceeding that relates to insolvency or protection of creditors' rights.

In the case that this Agreement is terminated by Huawei or Partner pursuant to this Agreement - if and to the extent not otherwise agreed between the Parties in writing in the course of termination - Huawei shall only pay to Partner the assured eligible costs incurred and assured reasonable value of the Development Work or Results already performed or delivered before the end of this Agreement according the termination and accepted in accordance with Section 6.

Upon any termination or expiration of this Agreement, Partner shall unrequested deliver all Results and Deliverables achieved up to the date of termination to Huawei within 4 (four) weeks to the very latest.

Section 16 - Miscellaneous

Governing Laws and Disputes Resolution

This Agreement and matters relating to the performance and validity hereof shall be construed, interpreted, applied, and governed in all respects in accordance with the laws of Italy without giving effect to principles of conflicts of law.

All disputes, controversies and differences between Huawei and Partner arising out of or relating to this Agreement, including any question regarding its existence, validity or termination shall be settled amicably through negotiations in good faith.

In the case that such dispute or controversies cannot be settled amicably through negotiations within a sixty (60)-day period, it shall be exclusively resolved by the competent courts of Milan, Italy.

Independent Contractor

The relationship of Parties established by this Agreement is that of independent contractors. Neither Party has any express or implied right or authority to assume or create any obligation on behalf of the other or to bind the other to any contract, agreement or undertaking with any third party. Nothing in this Agreement shall be construed to create a partnership, franchise, joint venture, employment or agency relationship. Neither Party shall assume liability or responsibility for the other Party's Personnel. Each Party shall: (i) ensure itself and its Personnel in compliance with all applicable laws, regulations, ordinances, and licensing requirements; and (ii) be responsible for the supervision, control, compensation, withholdings,



health and safety of its personnel.

Public Announcements

No Party hereto shall make, or cause to be made, any press release or public announcement in respect of this Agreement, the transaction documents or the transactions contemplated hereby or thereby or otherwise communicate with any news media without the prior written consent of the other Party.

Export Control

The Parties hereto shall comply with all export control laws and regulations of the European Union and its Member States as well as United Nations' Security Council resolutions and international regimes (for the purposes of this article, collectively referred to as "EXPORT LAWS") that are applicable to the Results and/or information, hardware, software and components therein delivered by Partner under this Agreement.

The Partner shall maintain an effective internal compliance program to ensure compliance with applicable EXPORT LAWS.

The Partner shall, at its own cost, use its best effort to obtain all required authorizations, permits, or licenses to the extent required by such EXPORT LAWS for the delivery to the place stated in Clause 0 or any other place within the European Union.

The Partner is obliged to notify Huawei without undue delay of any significant information with regard to any import or export license or any other governmental authorization that may be required for the delivery to the place stated in Clause 0 or any other place within the European Union in particular regarding issue, refusal, extension, amendment or laps of import or export license or any other governmental authorization which is known or becomes known to the Partner.

However if, due to potential later export of the Results to countries outside the European Union, Huawei according the applicable EXPORT LAWS is in charge of obtaining such authorisations, permits or licences from the relevant authorities, the Partner shall provide Huawei upon request with all necessary legal and technical information in order to enable Huawei to submit such declarations or applications.

In case Partner is obliged to export or transfer Results and/or information, hardware, software and components therein to perform its obligations under this Agreement and this would violate the EXPORT LAWS then the Partner shall immediately contact Huawei to negotiate adequate consequences such as amendment or termination of this Agreement.



Any compensation claims against Huawei and the Partner due to delays, obstructions, restrictions of performance resulting from any EXPORT LAWS (such as refusal, delay of granting or extension of import or export licenses or any other governmental authorizations, embargos and/or other sanctions) shall be excluded.

For the avoidance of any doubt, before Huawei orally or in tangible form exports the Results from the European Union to third countries (like e.g. China) outside the European Union, it has to check carefully, whether the Result is listed under EU and – if applicable – US export lists. If this Result is listed, Huawei has to apply upon its own expenses for export licenses from the competent EU or US export agency before it exports the Results to third countries.

Entire Agreement

This Agreement (including annexes attached herein) constitutes the complete agreement between Parties and supersedes any prior agreements or understanding between the parties with respect to such subject matter and all past course of dealing or industry custom.

Annexes

Annexes attached to this Agreement form an integral part hereof. In case of a contradiction between the main body of this Agreement and any Annex, the main body of this Agreement shall prevail, unless explicitly specified otherwise in this Annex.

Amendment

This Agreement may not be extended, supplemented or amended in any manner except by an instrument in writing expressly referring to this Agreement and duly executed by authorized representatives of Parties.

Waiver

The delay or failure of one Party to enforce any provision of this Agreement shall not constitute a waiver of such provision or the right of such Party to enforce such provision or any other provision.

Assignment

No assignment of this Agreement shall be valid without the prior written consent of both parties, which shall not be unreasonably withheld but may be subject to renegotiation in good faith of commercial terms.

Severability



If any provision contained in this Agreement is held invalid, unenforceable or contrary to laws, then the validity of the remaining provisions of this Agreement shall remain in full force. In such instance, the Parties shall use their best efforts to replace the invalid provision(s) with legally valid provisions having an economic effect as close as possible to the original intent of Parties.

Headings

All headings used in this Agreement are inserted for convenience only and are not intended to affect the meaning or interpretation of any portion of this Agreement.

Language

This Agreement is made in English only. If this Agreement is interpreted into languages other than English, such interpretation shall be deemed to be made only for reference purpose.

Protection of personal data

The PARTIES reciprocally declare that they have been informed (and, where appropriate, expressly give their consent) that the "personal data" supplied, even verbally, for the pre-contract operations or in any case gathered as a consequence and during fulfilment of this AGREEMENT, shall be used solely for the purposes of the AGREEMENT, by consultation, processing, interconnection, comparison with other data and/or any other manual and/or automated processing and, furthermore, for statistical purposes, with processing of data exclusively in anonymous form, by notification to public bodies, when such bodies request it for the pursuit of their institutional purposes, as well as to private parties, when the purpose of the request is compatible with the institutional purposes of Partner and of Huawei, fully aware that failure to supply the data may result in total or partial fulfilment of the AGREEMENT.

Data Controllers concerning this article is Huawei as identified named and with the service address above. Data Controller is the Director General for Partner. Finally, the Parties declare to be informed of the rights pursuant to the GDPR and Legislative Decree no. 196 of 30/06/2003.

Code of Conduct and Code of Ethics

Partner acknowledges that Huawei has adopted an Organizational Model within the meaning of Legislative Decree 231/2001; Partner has received this document with the communication 04/10/2016.



For the term of this AGREEMENT and for all activities related thereto, the Parties undertake to act in accordance with the principles laid down in these Codes and to have their employees and collaborators, as well as anyone taking part in the execution of the AGREEMENT, be familiar and comply therewith, and their conduct and that of the aforesaid individuals will be strictly in compliance therewith and will not damage the image and anyhow the ethical and material values which Partner and Huawei endorse and which they apply in pursuing their activities, also when dealing with third parties.

It is expressly understood that should a Party and/or its employees and/or collaborators etc., act unlawfully within the meaning of Legislative Decree 231/2001 and/or in violation of the Codes mentioned above, in the course of the activities referred to execution of this AGREEMENT, the other Party may terminate the AGREEMENT by enforcing the express termination clause within the meaning of Article 1456 Civil Code.

Counterparts

This Agreement shall be executed by Parties in two (2) identical originals of which each Party shall take one (1) and each of which shall be equally authentic.

IN WITNESS WHEREOF, Parties hereto have caused this Agreement to be executed in their respective corporate names by their duly authorized representatives.

Huawei Technologies Italia S.r.l.

Università degli Studi Roma Tre –
Dipartimento di Ingegneria

Signature:

Signature:

Name: Renato Lombardi

Name: Prof. Andrea Benedetto

Title: President Italy Research Center

Title: Direttore del Dipartimento

Date:

Date:

Annex 1 – Detailed description of research and Development Work (Statement of Work – SOW)



Annex 1. Statement of Work – SOW

1. Development Work

1.1. Research Scope

In this project, we propose to design a 4x16 planar array operating in the 5G frequency band 26.5-29.5 GHz with a scanning angle as much as close to $\pm 90^\circ$ on the azimuthal plane. Generally, a planar phased array can scan in an angular range, that, although wide, cannot reach the end-fire direction at $\pm 90^\circ$, due to the limited beam-width of the antenna array elements and mutual coupling between them. To overcome this limitation, different solutions are proposed such as i) the use of decoupling structures, ii) the design of an antenna element with as hemispherical as possible beam-width, and iii) the use of novel electrically thin lens based on metamaterials. In this framework, the simultaneous use of the three solutions could represent a potentially successful strategy for designing a wide-angle scanning array covering the entire angular range $[-90^\circ, +90^\circ]$. A careful design will be carried out for satisfying all the required specifications.

Millimeter wave band has been proposed for fifth generation (5G) mobile communication systems. Due to increase in propagation loss with frequency, micro- and nano-cells are needed for serving effectively the users. In order to maintain a good communication link, smart antenna systems that use adaptive array or switched multi-beam antennas are needed for concentrating the energy in a desired direction over a wide angular range. These amidst other benefits improve the link quality, spatial reuse and significantly reduce the amount of energy used in cellular networks.

However, conventional antenna arrays can cover an area that hardly reaches a coverage of 180° , which is typically required for a 5G micro-cell. In this framework, lens can help increasing the scanning angle by further steering the beam when the array radiates off-normal direction. However, the use of the lens alone does not allow to achieve a coverage angle of 180° , since some other limits related to the antenna elements and planar arrays should be taken into account. The first one is the elements' beam-width and the second is the mutual coupling between elements when a planar array scans its beam close to the end-fire direction. Indeed, a proper engineering of the individual radiating element of the array is always needed to exhibit a hemispherical radiation pattern. Thanks to the wider beam-width of the elements, the entire planar array is able to radiate more efficiently in end-fire direction, improving its overall performances in terms of scanning area. As for the coupling level between the antenna elements in array configuration, a de-coupling technique between the elements should be implemented to stop the propagation of surface waves at the interface between the dielectric substrate and air.

Although the lens, the antenna element and the de-coupling structure could be implemented with standard techniques and materials, in this project, we propose to involve metamaterials and metamaterial-inspired inclusions for implementing the three aforementioned components. Metamaterials are artificial materials consisting of subwavelength inclusions, able to exhibit anomalous and engineerable properties and a controllable propagation of the electromagnetic waves. Such an approach will allow us achieving a scanning angle of $\pm 90^\circ$ by a 4x16 planar array operating in the 5G frequency band 26.5-29.5 GHz.



In detail, the technical approach proposed here consists of:

1. design of the antenna element with high radiation level in $\pm 90^\circ$ -directions;
2. design of de-coupling structures between the antenna elements;
3. design of a planar/conformal lens and radome.

In particular, the antenna element will be designed in order to exhibit a radiation diagram as much hemispherical as possible. Slot or patch elements with conventional and novel shapes will be investigated, including some promising metamaterial-inspired inclusions. The de-coupling structures will be designed by exploiting the blockage effect exhibited by the high-impedance surfaces, artificial surfaces consisting of a dense array of resonant inclusions. Finally, a planar/conformal co-design of the lens and radome will be carried out. Here, metamaterial-based lens can be exploited to bend the electromagnetic wave radiated by the array and broaden its scanning range. Compared to conventional dielectric lenses, a metamaterial-based lens can be shrunk in thickness becoming a metasurface, a planar array of subwavelength inclusions, which reduces the overall thickness of the antenna system.

Currently, the difficulties and risks we have identified are related to 1) the electrical distance required between the lens and the electromagnetic radiating source, which should be large enough to allow using the well-established lens models and design methods; 2) the losses and the narrow operative band typically exhibited by high-impedance surfaces and metamaterials; and 3) the distortion effects introduced by the metasurface-based lens on the polarization of the radiated field.

Based on our experience in other projects, to mitigate these potential critical aspects, we propose to 1) exploit a co-design strategy of the array, lens, and radome, which has been successfully used in the past for designing metasurface-based cloaking devices for antennas; 2) select not-resonant metamaterial-inspired inclusions and mainly planar version of metamaterials, i.e. metasurfaces, for reducing losses, as we have already done in the design of metamaterial-based frequency selective reflectors for radar applications; 3) use specific inclusions that realize the metasurface-based lens in order to have the same electromagnetic response for both orthogonal components of the radiated field, respectively. In this last case, our team have already designed and successfully used symmetric electrically small metamaterial-inspired inclusions for conceiving filtering metasurfaces for dual-linear and circular polarization.

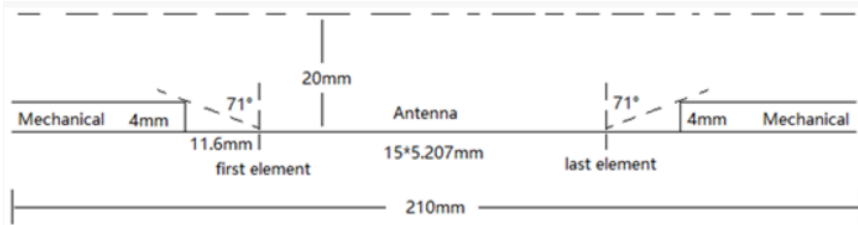
System specifications:

Item	Unit	Optimum Target Value	Comment
<i>Frequency band</i>	<i>GHz</i>	<i>26.5 – 29.50</i>	-
<i>Number of elements</i>	-	<i>4 x 16</i>	<i>Displaced as a regular planar array</i>
<i>Element type</i>	-	<i>Patch/Slot</i>	-



<u>Polarization</u>		<u>±45°</u>	<u>Dual polarization</u>
<u>Horizontal element spacing</u>	<u>mm</u>	<u>5.207</u>	-
<u>Vertical element spacing</u>	<u>mm</u>	<u>8.382</u>	-
<u>Array Realized Gain</u>	<u>dBi</u>	<u>23.4dBi</u>	<u>Broadside Beam, uniform illumination</u>
<u>Array/Lens system Realized Gain</u>	<u>dBi</u>	<u>22.4dBi</u>	<u>Broadside Beam, uniform illumination</u>
<u>Field of view in azimuth, without lens</u>	<u>deg</u>	<u>[-60,+60]</u>	<u>Preferentially met, but not mandatory</u>
<u>Field of view in azimuth, with lens</u>	<u>deg</u>	<u>[-90,+90]</u>	-
<u>Gain difference @ 0 deg steering</u>	<u>dB</u>	<u>≤1</u>	<u>Difference with lens w.r.t without lens</u>
<u>Scan Loss @ 90 deg steering</u>	<u>dB</u>	<u>≤6</u>	<u>Not considering elevation scan</u>
<u>SLL @ 0 deg steering</u>	<u>dB</u>	<u>≥13</u>	<u>Not considering elevation scan</u>
<u>SLL @ 60 deg steering</u>	<u>dB</u>	<u>≥10</u>	<u>Not considering elevation scan</u>
<u>SLL @ 90 deg steering</u>	<u>dB</u>	<u>≥5</u>	<u>Not considering elevation scan</u>
<u>XPD @ 60 deg steering</u>	<u>dB</u>	<u>≥10</u>	<u>Not considering elevation scan</u>
<u>XPD @ 90 deg steering</u>	<u>dB</u>	<u>≥5</u>	<u>Not considering elevation scan</u>
<u>Field-of-view in elevation</u>	<u>dB</u>	<u>[-15,+15]</u>	<u>Not to be considered for gain, SLL, scan loss, and XPD specifications</u>
<u>Radome</u>	-	<u>Flat/Conformal</u>	<u>Co-design with lens, flat or conformal, above the lens or on the same mechanical part of the lens</u>
<u>Thickness</u>	<u>mm</u>	<u>20</u>	<u>Including lens and Radome, total thickness less than 20 mm</u>

The shape of the lens should either be flat or curved along the horizontal axis in order to improve the steering. It should not be curved along the vertical direction since no vertical steering is required. The diagram below shows the mechanical constraints for the lens along the horizontal axis. It should be positioned on top of the two mechanical steps at the sides of the antenna opening and should not exceed 210mm in length. Please note that the two vertical dashed lines mark the center of the first and the last element of each row.



1.2. Non Research Goals

Exploring new solution for future markets.

2. Deliverables

The Partner has to deliver the following deliverables during the duration of the project.

Number	Deliverable
<u>WP1 – State-of-the-art analysis</u>	D1.1: Database of the most representative scientific articles about wide-angle scanning arrays with/without steering lens. D1.2: Document comparing the performances of the best solutions identified within each technical approach.
<u>WP2 – Technical feasibility analysis</u>	D2.1: Document discussing the technical feasibility of the different possible approaches and identification of the most promising solutions able to meet the project specifications.
<u>WP3 – Design of the individual radiating element</u>	D3.1: Technical report including: Explanation of the working principle of the designed antenna and its design scheme
<u>WP4 – Design of the wide-angle scanning array</u>	D4.1: Report describing the design scheme of the array and its performances without the decoupling network. D4.2: Report describing the working principle and the performances of the de-coupling structure and of the de-coupled array.
<u>WP5 – Co-design of the lens</u>	D5.1: Report describing the design scheme of the lens and the scanning performances of the array with the lens
<u>WP6 – Radome integration</u>	D6.1: Design scheme of the overall system and final performances report

3. Acceptance Criteria & Method



3.1. Acceptance Criteria

An evaluation group will be established, led by Renato Lombardi or his designate. All the following methods will be used to assess the progress and final Foreground of the project.

Evaluation group: A joint selected team, approved by Renato Lombardi or his designate will conduct review and assessment. The possible candidates (not limited to) of the evaluation group are: Claudio Massagrande, Sheng Haiqiang, Menchuan, Roberto Flamini.

The evaluation group takes the responsibility of conducting review and assessment of solution methodologies, the process and deliverables which includes but not limited in procedures/algorithms, prototypes, real test cases, codes, and related supporting design or implementation documents. Algorithm reviews or code walkthrough will also be conducted in the mid-term and end of project review process.

Domain expert assessment: A joint selected group of subject domain experts will be assembled to conduct the assessment, under the guidance of Renato Lombardi or his designate.

At the end of the project, a "grade" will be assigned to the completed projects, based on the assessment Foreground, and the following criteria:

Pass:

Partner completed all tasks and deliverables as discussed in Section 1.3 and Section 3 in time with acceptable quality determined by a joint project evaluation team appointed by Huawei.

Partner delivered required methodology, procedures/algorithms, implementation, code, and supporting documents based on the work plan.

4. Project Milestones

The project duration is 7 months (Phase 1 and Phase 2) from the Effective Date as defined in the Agreement. After an intermediate evaluation by Huawei, the project may be extended by another 5 months (Phase 3) as defined in planning below:

Phase	Start-End Time	Work Description	Objectives	Deliverables
Phase 1	T – T+2	WP1	<u>State-of-the-art analysis</u>	D1.1: Database of the most representative scientific articles about wide-angle scanning arrays with/without steering lens. D1.2: Document comparing the performances of the best solutions identified within each technical approach.



Phase 2	T+2 – T+7	WP2	<u>Technical feasibility analysis</u>	D2.1: Document discussing the technical feasibility of the different possible approaches and identification of the most promising solutions able to meet the project specifications.
Phase 3	T+7 – T+12	WP3 –	Design of the individual radiating element	D3.1: Technical report including: Explanation of the working principle of the designed antenna and its design scheme
		WP4 –	Design of the wide-angle scanning array	D4.1: Report describing the design scheme of the array and its performances without the decoupling network.
		WP5 –		D4.2: Report describing the working principle and the performances of the de-coupling structure and of the de-coupled array.
		WP6 –		D5.1: Report describing the design scheme of the lens and the scanning performances of the array with the lens
		Co-design of the lens		D6.1: Design scheme of the overall system and final performances report
		Radome integration		

T: effective project starting day

5. Project Monitoring & Management

Bi-weekly video conferences will be held throughout the course of the project to provide progress report and jointly discuss project-related topics. Biweekly progress reports will also be provided by the partner.

At the end of each work phase a broader report covering the scope of the work phase will also be provided by the partner.

Face to face meetings may be organized whenever felt necessary (typically, but not only, at the conclusion of each working phase) in order to broaden the scope of the discussion and will be held at Huawei's premises in Milano 2 unless agreed otherwise.

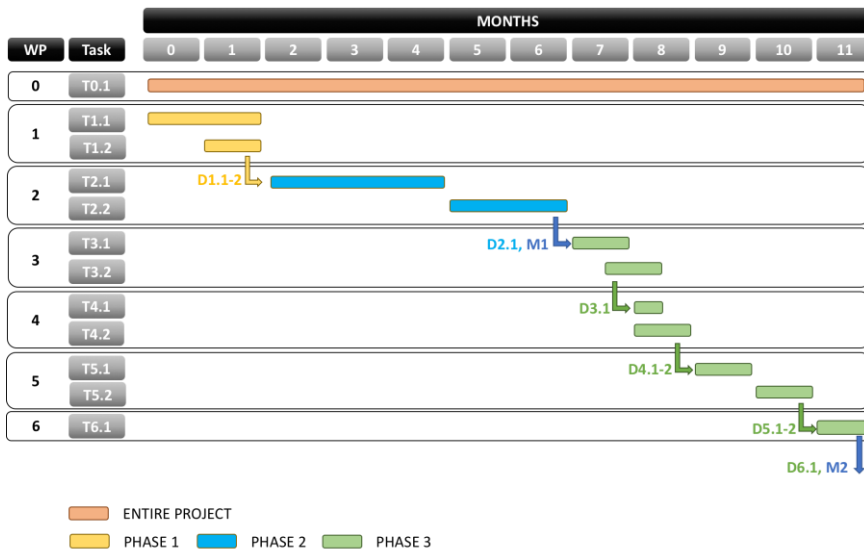


6. **Contact Person**

	Contact Person of Huawei	Contact Person of Partner
Name	Claudio Massagrande	Laura Grossi
Title	Senior Antenna Engineer	Segretario Amministrativo
Adress	Centro Direzionale Milano 2 – Palazzo Verrocchio 3p – Segrate - Milano	Amministrazione, Via Vito Volterra 62, Roma
Post Code	20090	00146
Telephone	+39 342 035 8593	+39 06 57333329
E-mail	Claudio.massagrande1@huawei.com	amm.ingegneria@uniroma3.it

Commentato [rs5]: @ Huawei BU:
 To be filled out for this specific project

7. **Work Plan**



Commentato [rs6]: @ Huawei BU:
 To be filled out for this specific project

The length of WP1 and WP2 is intended modified as per Table in section 4



Partner shall provide Huawei with authentic personal information as listed below, ensure the collection of personal information on legal basis and authorize Huawei to use the personal information for the execution of this Agreement. Huawei shall use the provided personal information appropriately, protect the personal information in accordance with the applicable laws.

Involved Staff

Filiberto Bilotti	Full Prof	T0.1; T2.2; T3.1	3
Alessandro Toscano	Full Prof	T0.1; T6.1	3
Mirko Barbuto	Assistant Prof	T2.1; T2.2; T3.1; T5.1	2
Alessio Monti	Assistant Prof	T3.1; T3.2; T4.1; T4.2	2
Davide Ramaccia	Assistant Prof	T1.1; T1.2; T3.1; T5.2	4
Stefano Vellucci	Post-doc	T1.1; T1.2; T2.1; T4,2	3
Angelica Viola Marini	PhD Student	T1.1; T2.1; T3.2; T6.1	3
Riccardo Zucchetti	PhD Student	T2.1; T4.1	2
Fabrizio Andreaus	Master Student	T1.1; T2.1; T5.1	3
Andrea Casolaro	Master Student	T3.2; T2.1; T5.2	3