



# SUSTAIN Deliverable

## D1.2 IPR Requirements

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Abstract
<p>This IPR Requirements Deliverable presents the SUSTAIN project Technology Watch, Regulatory Requirements, and IPR-Management. It is created from the work pertaining to Task 1.3, lead by AALTO, participated by all Partners. All project partners regularly search relevant State-of-the-art to ensure that there is no interference on the intellectual property. Based on Partners' key content, AALTO conducts patent search to assess "freedom to operate". AAL also manages the related regulatory requirements &amp; IPR management.</p> <p>The Deliverable is a living document as it relates to regular following up of the technological development in the fields relevant to the SUSTAIN project.</p>

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# 1 Key Observations for Technology Watch

The Technology Watch task within Task 1.3 is conducted quarterly within the SUSTAIN Project. The Technology Watch began in M6. The content is displayed in Table 1.

**Table 1. State-of-the-Art Technology Watch**

Partner	Observations M6
AALTO	<p>M6: Some recent related work on mmWave and backscatter for sensing purposes</p> <p>M. Schmidhammer and C. Gentner, "Multipath-enhanced device-free localization using low-cost ultra-wideband devices," in 2022 16<sup>th</sup> European Conference on Antennas and Propagation (EuCAP). IEEE, 2022, pp. 1–5.</p> <p>C. Yang, X. Wang, and S. Mao, "Tarf: Technology-agnostic rf sensing for human activity recognition," IEEE Journal of Biomedical and Health Informatics, 2022.</p> <p>H. Kong, X. Xu, J. Yu, Q. Chen, C. Ma, Y. Chen, Y.-C. Chen, and L. Kong, "m3track: mmwave-based multi-user 3d posture tracking," in Proceedings of the 20th Annual International Conference on Mobile Systems, Applications and Services, 2022, pp. 491–503.</p> <p>J. Wang, A. S. Abrar, and N. Patwari, "Received power-based vital signs monitoring," in Contactless Vital Signs Monitoring. Elsevier, 2022, pp. 205–230.</p> <p>A. Alabsi, W. Gong, and A. Hawbani, "Emotion recognition based on wireless, physiological and audiovisual signals: A comprehensive survey," in International conference on smart computing and cyber security: strategic foresight, security challenges and innovation. Springer, 2022, pp. 121–138.</p> <p>R. Akter, V.-S. Doan, A. Zainudin, and D.-S. Kim, "An explainable multi-task learning approach for rf-based uav surveillance systems," in 2022 Thirteenth International Conference on Ubiquitous and Future Networks (ICUFN). IEEE, 2022, pp. 145–149.</p>
UNITN	<p>Mwase, C., Jin, Y., Westerlund, T., Tenhunen, H., &amp; Zou, Z. (2022). Communication-efficient distributed AI strategies for the IoT edge. Future Generation Computer Systems.</p> <p>Mwase, C., Jin, Y., Westerlund, T., Tenhunen, H., &amp; Zou, Z. (2022). Communication-efficient distributed AI strategies for the IoT edge. Future Generation Computer Systems.</p>

	<p>Firouzi, F., Farahani, B., &amp; Marinšek, A. (2022). The convergence and interplay of edge, fog, and cloud in the AI-driven Internet of Things (IoT). <i>Information Systems</i>, 107, 101840.</p>
YTU	<p>Levi, I., &amp; Hazay, C. (2023). Garbled Circuits from an SCA Perspective: Free XOR can be Quite Expensive... <i>IACR Transactions on Cryptographic Hardware and Embedded Systems</i>, 54-79.</p> <p>Zhao, Q., Liu, X., Xu, H., &amp; Li, Y. (2023). Practical reusable garbled circuits with parallel updates. <i>Computer Standards &amp; Interfaces</i>, 103721.</p> <p>Nieminen, R., &amp; Schneider, T. (2023). Breaking and Fixing Garbled Circuits when a Gate has Duplicate Input Wires. <i>Cryptology ePrint Archive</i>.</p>
IMT	<p>Ma, J., Chang, Z., Zhang, F., Xiong, J., Ni, J., Jin, B., &amp; Zhang, D. (2022, October). Involving ultra-wideband in consumer-level devices into the ecosystem of wireless sensing. In <i>Proceedings of the 28th Annual International Conference on Mobile Computing And Networking</i> (pp. 758-760).</p> <p>Ma, J., Chang, Z., Zhang, F., Xiong, J., Jin, B., &amp; Zhang, D. (2022, October). Mobi2Sense: enabling wireless sensing under device motions. In <i>Proceedings of the 28th Annual International Conference on Mobile Computing And Networking</i> (pp. 766-768).</p> <p>Shin, W. J., Lee, Y., Cho, J., Jang, J., Seo, Y., &amp; Kahng, S. (2023). RSSI Improved for LoRa Wireless Communication, Field-Tested in the Wide-Open Area. <i>IEEE Access</i>.</p> <p>Zhang, F., Chang, Z., Xiong, J., Ma, J., Ni, J., Zhang, W., ... &amp; Zhang, D. (2023). Embracing Consumer-level UWB-equipped Devices for Fine-grained Wireless Sensing. <i>Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies</i>, 6(4), 1-27.</p>
UPC	<p>Chun, A. C. C., Ramiah, H., &amp; Mekhilef, S. (2022). Wide power dynamic range CMOS RF-DC rectifier for RF energy harvesting system: A review. <i>IEEE Access</i>.</p> <p>Kwiatkowski, E., Estrada, J. A., López-Yela, A., &amp; Popović, Z. (2022). Broadband RF energy-harvesting arrays. <i>Proceedings of the IEEE</i>, 110(1), 74-88.</p> <p>Kwiatkowski, E., Estrada, J. A., López-Yela, A., &amp; Popović, Z. (2022). Broadband RF energy-harvesting arrays. <i>Proceedings of the IEEE</i>, 110(1), 74-88.</p>

### **M6 Analysis**

We have collected relevant new research with relation to the work conducted in the project. While researchers actively publish in the domain, the specific project goals are not covered by any of the work.

## 2 IPR Management

Partners provide a list of Key Words for WP leader AALTO, which will conduct a patent search to assess "freedom to operate". The frequency at which this is done is quarterly, starting M6.

**Table 2. Key Words for “freedom to operate”- Patent Search**

Partner	Key Words, M6
AALTO	M6: RF sensing, Passive sensing, Contact-free sensing
UNITN	M6: Federated learning, Split learning, Distributed intelligence, Adaptive sensor network, Self-configuring network, Meta-intelligence, Cognitive network, Tiny machine learning
YTU	M6: Garbled Circuit Protocol, Behavioral Sentiment Analysis
IMT	M6: Human localization and tracking via passive RFID tags, Gesture recognition and vital sign monitoring via passive RFID tags, long-range object awareness sensing using LoRa signals, Room-level human sensing using Wi-Fi signals, RF-Sensing with reconfigurable intelligent surfaces (RIS)
UPC	M6: Energy harvesting for autonomous sensors, light energy harvesting in smart buildings, thermal energy harvesting in smart buildings, radiofrequency energy harvesting in smart buildings

### 2.1 Analysis of the Key Word Patent Search

Analyses of the Key Words will be documented in Sub-Chapters on a quarterly basis.

#### ***M6 Analysis***

We have collected relevant keywords for the project based and refined by the actual ongoing work.

### **3 Regulatory Requirements and IPR Management**

We will involve patent experts from Aalto University in the drafting of regulatory requirements and IPR management.