Living Lab Initiative: Program Guide

September 17, 2025

Executive Summary

The Living Lab Initiative, led by CENGN and supported by Innovation, Science and Economic Development Canada (ISED) through the Strategic Response Fund (SRF), is a national program designed to accelerate the development, validation, and adoption of advanced digital technologies across key Canadian sectors. With a total investment of $45 million, the initiative provides Canadian startups and scaleups with access to commercial-grade testing environments, technical expertise, and funding to support innovation and commercialization.

The program is structured around two core project types:

- Innovation Projects: Up to $250,000 CAD in funding for testing and validating digital solutions in Living Lab environments.
- Adoption Projects: Up to $500,000 CAD in funding for collaborative projects with industry adopters to validate technologies in operational settings.

Additionally, Call for Proposal (CFP) rounds offer up to $100,000 CAD for startups and scaleups to test solutions in real-world building environments. Each CFP is time-limited, with full details provided prior to launch.

Living Labs are sector-specific facilities—such as smart farms, mobility zones, and robotics hubs—equipped with advanced infrastructure to support technologies in 5G, IoT, AI/ML, cloud computing, autonomous systems, robotics, and drones. These labs enable real-world testing in domains like Smart Buildings, Smart Mobility, Advanced Manufacturing, and Smart Farming.

The initiative also includes internship opportunities, a structured application and evaluation process, and a performance-based funding model. Projects are assessed based on technical feasibility, team capability, market impact, and alignment with national innovation goals.

By fostering collaboration between innovators, adopters, and technology partners, the Living Lab Initiative aims to strengthen Canada's digital economy, enhance global competitiveness, and drive sustainable growth across industries.

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1. CENGN Living Labs: Accelerating Canada's Digital Transformation

CENGN, with support from the Strategic Response Fund (SRF) under Innovation, Science and Economic Development Canada (ISED), has launched services in partnership with a series of Living Labs to catalyze digital transformation across key Canadian economic sectors. These Living Labs are collaborative initiatives involving CENGN and leading innovation partners—including Rogers, Nokia, and Ericsson—who provide advanced 5G and networking technologies. Each Living Lab offers a commercial-grade testing environment designed to accelerate the development and deployment of Canadian network-enabled digital solutions.

These facilities are purpose-built to support hyper-innovation, enabling Canadian startups and scaleups to validate their technologies, generate intellectual property, and achieve commercial growth. By fostering innovation in real-world settings, the Living Labs enhance the competitiveness of Canadian industry and contribute to the broader innovation ecosystem.

Connected through CENGN's national network of technology leaders, innovation hubs, and sector-focused organizations, the Living Labs form a pan-Canadian platform for collaboration and knowledge exchange. This ecosystem ensures that startups and scaleups across the country can access Living Lab services and benefit from shared insights and best practices in digital transformation.

CENGN Living Labs focus on bridging cutting-edge Information Technologies—such as 5G, IoT, AI/ML, cloud computing, Autonomous Vehicles (AVs), robotics and drones—with Operational Technologies in sectors like Smart Mobility, Smart Buildings, Advanced Manufacturing, and Smart Farming. This integration supports both the commercialization of innovative solutions and the enhancement of productivity and efficiency across Canadian industries.

Each Living Lab is a sector-specific facility—such as a farm, manufacturing plant, or residential building—equipped with advanced networking infrastructure. These environments allow Canadian innovators to test and refine their solutions under real-world conditions, ensuring market readiness and alignment with industry needs. Startups and scaleups can also collaborate directly with industry adopters to validate their technologies in context.

CENGN and its partners are currently developing eight Living Labs across British Columbia, Ontario, and Quebec

1.1 Fueling Innovation and Adoption in Canada's Digital Economy

The CENGN Living Labs Initiative is receiving $45 million in funding through Innovation, Science and Economic Development Canada's (ISED) Strategic Resources Fund (SRF). This investment is

further bolstered by in-kind contributions from industry partners, including infrastructure, expertise, and commercial-grade testing environments. A portion of this funding will be allocated directly to Canadian startups and scaleups participating in innovation and adoption projects.

- ***Innovation Projects***: Eligible Canadian Startups and scaleups **can receive up to $250,000 in funding to test, validate, and certify their digital solutions** within a CENGN Living Lab environment**.** These projects are designed to support market entry and scaling by enabling real-world testing in commercial-grade facilities. This environment allows SMEs to identify and resolve product issues, refine their solutions, and generate third-party validation—critical for commercialization, IP development, and demonstrating value to potential customers.

- ***Adoption Projects***: Eligible Canadian Startups and scaleups **collaborating with industry adopters (potential customers) can receive up to $500,000 in funding to validate their digital technology solutions** within a CENGN Living Lab. These adoption projects are designed to test solutions directly in the context of the adopter's operational environment, ensuring they meet real-world requirements. By aligning the technology with the adopter's specific needs, these projects not only support refinement and validation but may also lead to a commercial agreement to implement the solution within the adopter's operations.

- ***Call for Proposal***: The Call for Proposal (CFP) program is a collaborative initiative led by a partner organization in partnership with CENGN. Canadian startups and scaleups can receive up to **$100,000 CAD** to test and validate their digital solutions in real-world building environments. Each Call for Proposal is **open for a limited time**, with full details to be shared by **CENGN** prior to launch. Selected projects gain access to funding, technical support, and Living Lab facilities to accelerate commercialization and adoption.

- ***Internships***: In addition to project funding, the initiative offers internships in key technology areas like 5G, AI/ML, data science, cybersecurity, cloud computing, and software development. These placements—primarily hosted by startups and scaleups—provide hands-on experience and are also available across the broader innovation ecosystem and Living Labs. Your organization can benefit from student expertise in areas such as:

    - **IT & Engineering**: IoT testing, wireless systems, robotic upgrades, DevOps, AI/ML integration, cybersecurity audits
    - **Operational Technology**: HVAC optimization, drone development, robotic manipulation
    - **Business Development**: Market research, branding, competitive strategy, go-to-market planning

Participation in all project types is limited to Canadian startups and scaleups offering digital transformation solutions. While industry adopters and partners may be headquartered internationally, direct funding is reserved exclusively for Canadian innovators.

Throughout the funding cycle, CENGN and its national ecosystem will leverage the Living Labs as testbeds for transformative digital technologies. These projects will drive the commercial growth of Canada's most promising tech companies and accelerate the adoption of innovative solutions across key economic sectors—enhancing productivity, efficiency, and competitiveness.

1.2 Membership

As part of joining CENGN's innovation ecosystem, a **one-time $2,500 membership fee** will be billed separately to successful applicants under CENGN's standard membership agreement. This fee is **not reimbursable** through project funding.

Membership provides valuable access to CENGN's broader innovation ecosystem, including:

- Ecosystem connections and collaboration with industry leaders and peers
- Participation in CENGN programs and projects beyond the funded initiative
- Technology support to strengthen solution development
- Opportunities to innovate technologies driving Canadian prosperity
- Access to digital talent and skills development through internships and partnerships
- Resources to accelerate business growth and market readiness

This membership ensures SMEs benefit from ongoing engagement, visibility, and support across CENGN's national platform.

2 Project Details

2.1 Application Intake

Applications will be accepted through two streams

- ***Rolling Intake:*** Applications may be submitted at any time and will be reviewed on an ongoing basis.
- ***Calls for Proposals:*** Specific funding calls will be issued periodically, each with defined submission deadlines.

2.2 Project Duration

- ***Maximum Project Duration:***
    - Innovation Projects: 12 Months

- Adoption Projects: 24 Months

- ***Program End Date:*** All projects must be completed by December 31, 2027, with the overall program concluding on March 31, 2028***.***

2.3 Funding Model

The program operates on a cost-reimbursement model, covering up to 40% of eligible project expenses. Applicants are responsible for securing the remaining funding from other sources.

3 Eligibility

3.1 Basic Eligibility Requirements: Mandatory Project Selection Criteria

Mandatory criteria are essential, non-negotiable requirements that an Applicant must meet to have their Project proposal considered for selection.

3.2 MANDATORY CRITERIA

Criteria		**Compliant (Yes/No)**
M1	The Applicant must be a registered organization in Canada with 499 or fewer full-time employees	
M2	The Applicant must provide the following business information: a) Registered Business Name b) CRA Business Number c) Location of Incorporation d) Articles of Incorporation	
M3	The technology solution must be capable of being deployed in a CENGN Living Lab.	
M4	The Applicant must provide resumes of all key team members proposed.	
M5	The Applicant must submit a firm proposal, all-inclusive price for the Work and Eligible Supported Costs, which must not exceed the maximum funding available of either CAD $250,000 for an Innovation Project or CAD $500,000 for an Adoption Project. At least 90% of the Eligible Supported Cost work must be performed in Canada.	

Criteria		Compliant (Yes/No)
M6	The Applicant must declare combined level of financial assistance from all government (federal, provincial, territorial, municipal) sources as to not to exceed seventy-five percent (75%) of Eligible Supported Costs incurred by any Industry Collaborator and one hundred percent (100%) of Eligible Supported Costs incurred by any Post Secondary Collaborator.	
M7	For Adoption Project Proposals, the Applicant must provide a minimum of one (1) Letter of Intent from a Canadian for-profit customer for whom the technology has been developed for and commitment to support public facing blueprint development.	
M8	All participants must be willing to sign a participation agreement	
M9	The Applicant must demonstrate financial management capacity to carry out the Project • Credit review (Dun & Bradstreet) • 2-year cash flow forecast	

3.3 Eligible Project Selection Criteria: Point Rated Criteria

Project proposals which meet all the mandatory criteria will be evaluated and scored as outlined in Section 3.2. Applications must achieve a minimum total score of 70 (out of 100). Applications must also achieve the minimum pass scores noted below for criteria R3, R4 and R6.

3.3.1 Point Rated Criteria

Criteria		Maximum Score	Minimum Pass Score
R1	Understanding of Market Challenge, Solution Value Proposition and Commercial Potential	10	N/A
R2	Team Experience and Capability	10	N/A
R3	Feasibility of the Project in Meeting the Technical and Business Objectives Through Access of the Living Lab	30	22
R4	Project Plan	25	20
R5	Risks management and mitigation strategies	10	N/A

Criteria		Maximum Score	Minimum Pass Score
R6	Benefits to Canada	15	10
OVERALL SCORE		100	70

3.3.2 Description of the Point Rated Evaluation Criteria

3.3.2.1 CRITERION 1: UNDERSTANDING OF THE MARKET CHALLENGE, SOLUTION VALUE PROPOSITION AND COMMERCIAL POTENTIAL

This criterion assesses the degree to which the proposal exhibits an understanding of the industry challenge(s), the value proposition of the solution and the potential commercial impact.

Score	Benchmark Statements
10	The proposal not only demonstrates a broad and deep understanding of how the solution will address the technology / industry problem but also includes an adopter with defined business objectives and user acceptance criteria for the outcome of the Project.
7	The proposal demonstrates a detailed understanding of how this solution will address the technology / industry challenge with clear value proposition and market demand.
4	The proposal demonstrates only a limited understanding of how the solution will address the technology / industry challenge, with minimal demonstrated market value.
0	The proposal does not clearly describe how this solution will address the technology / industry challenge, and fails to demonstrate market demand.

3.3.2.2 CRITERION 2: TEAM EXPERIENCE AND CAPABILITY

This criterion assesses the combined technical capability and experience of the key individuals designated to carry out the Project.

Score	Benchmark Statements
10	The proposal clearly demonstrates that the proposed team is highly experienced in developing closely related technologies of comparable scope and complexity. The proposal also includes the participation of at least one student to perform science, technical, engineering, mathematical and/or business tasks.
8	The proposal shows the team has worked with closely related technologies of comparable scope, complexity and possesses all the technical capabilities and experience required to perform the Project.
5	The proposal demonstrates that the team has technical capability and experience with the related technologies, though some key areas are underdeveloped.
2	The proposal demonstrates that the proposed team does not have the capacity or lacks key technical skills and experience to conduct the Project.

0	The proposal fails to demonstrate that the proposed team has technical capability and experience with the related technologies.

3.3.2.3 Criterion 3: Feasibility of the Project in Meeting the Technical and Business Objectives Through Access to the Living Lab

This criterion assesses the overall value in accessing the Living Lab and how likely the proposal is to fulfill the Project's technical and business objectives.

Score	Benchmark Statements
30	The Project is robust and convincing, with a high probability of successfully meeting the technical and business objectives. There is a clear and substantial benefit to accessing the services of the Living Lab.
22	The Project is likely to meet the technical and business objectives and there is demonstratable impact gained from accessing the Living Lab.
15	The Project is unlikely to meet the technical and business objectives and/or the use of the Living Lab does not provide material benefit to the Project.
0	The applicant has not expressed how the Project will meet its targeted objectives, nor have they demonstrated the value of accessing the Living Lab.

3.3.2.4 Criterion 4: Project Plan

This criterion assesses the methodology underpinning the Project and the thoroughness of the Project Plan. The plan will be evaluated based on its completeness, credibility, and effectiveness.

Score	Benchmark Statements
25	The proposal provides a coherent and comprehensive Project Plan with all elements covered.
20	The proposal provides a credible Project Plan, addressing all key elements.
10	The proposal presents an inadequate Project Plan, with multiple elements missing or poorly addressed, raising doubts about the likelihood of a successful completion.
0	The proposal lacks a concrete Project Plan, creating no confidence that the Project will successfully meet its objectives.

3.3.2.5 Criterion 5: Risk Management and Mitigation Strategies

This criterion evaluates the identification of potential risks and challenges that may arise during the Project, as well as the effectiveness of the proposed measures to prevent or address these risks. The proposal must outline the key risks associated with the Project and the mitigation strategies for each.

Score	Benchmark Statements
10	The proposal demonstrates clear understanding of key risks and obstacles, providing detailed, well-reasoned and realistic remedial measures to ensure the Project's successful completion.
8	The proposal shows a general understanding of key risks and potential challenges, and proposes elements of remedial measures to ensure feasibility, with grounded justifications.

5	The proposal identifies some, but not all risks and some mitigation strategies are defined. However, the information is incomplete, and details are lacking.
2	The proposal identifies risks, but the related mitigation strategies proposed are insufficient.
0	The proposal fails to identify any key risks or mitigation strategies, or some risks are identified but no related mitigation strategies are provided.

3.3.2.6 Criterion 6: Benefits to Canada

This criterion evaluates the Project objectives, and it's benefits to Canada and Canadians.

Score	Benchmark Statements
15	The proposed economic, innovation, social, and environmental benefits for Canadians are clear, thorough, and persuasive.
10	The proposal demonstrates economic, innovation, social, and/or environmental benefits to Canada.
5	The proposed benefits to Canada from participating in a Living Lab Project are not clear or logical.
0	The proposal does not address economic, innovation, social, or environmental benefits in Canada.

3.4 Ineligible Project Activities

The following activities are considered out of scope and will not be eligible for funding under the CENGN Living Lab Project:

- Activities focused solely on experimental or theoretical research without a clear path to commercial application or use.
- Initiatives that may be perceived as anti-competitive in nature. For ex: "Tying Arrangements: A company requires customers to buy a secondary product or service when they purchase a primary one, limiting consumer choice and competition"
- Projects that would proceed at the same scale, scope, and timeline without CENGN Living Lab Project funding support.

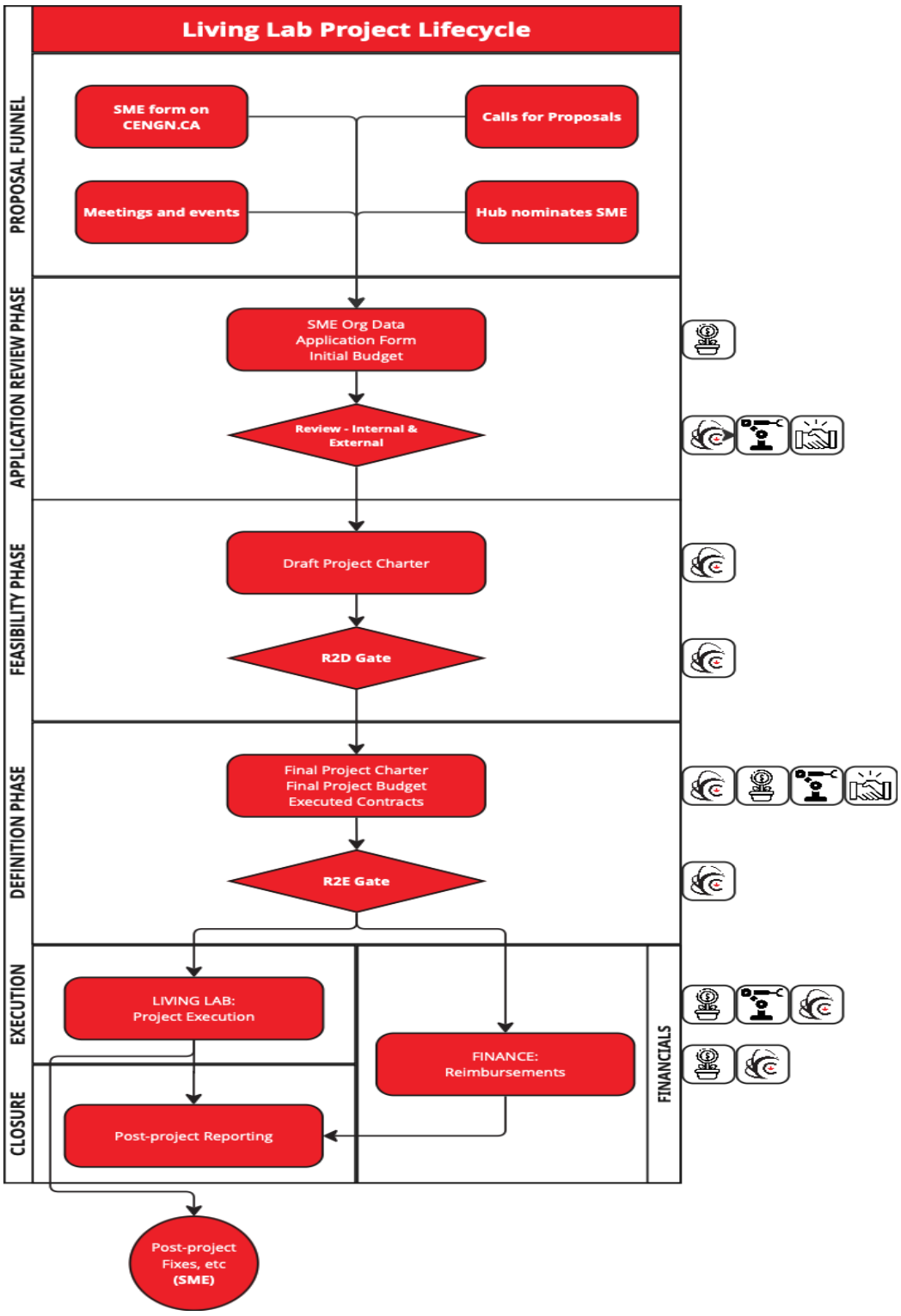
4 Application Stages

4.1 The Application Process

4.1.1 CENGN Support for Project Applications

Canadian small and medium-sized enterprises (SMEs) developing digital technology solutions that support transformation in key economic sectors are eligible to submit proposals for Innovation or Adoption Projects through the CENGN Living Lab Program. Proposals can be submitted via the CENGN portal.

4.1.2 Step-by-step process:



4.1.2.1 PROPOSAL PHASE:

SMEs interested in participating must submit their project applications through the **CENGN Portal.** While proposals may be initiated through outreach from CENGN or nominations by Referring Partners, all formal applications must be completed and submitted via the Portal.

- Please note: The **CENGN website** provides general program information and resources, but it is not used for submitting applications.

4.1.2.2 APPLICATION REVIEW PHASE:

- Step 1: **Eligibility Screening**: All submitted applications are first reviewed by the CENGN team to ensure they meet the nine mandatory eligibility criteria. Only applications that satisfy all requirements will proceed to the next stage (Refer to the mandatory eligibility criteria in section 3.2).
- Step 2: **Comprehensive Evaluation**: Eligible applications are then evaluated by an External Review Panel and the CENGN Living Lab Project Team. This stage uses a set of predefined scoring criteria to assess the project's value, feasibility and alignment with initiative goals. (Refer the predefined scoring criteria in section 3.3).

4.1.2.3 FEASIBILITY PHASE:

In this stage the SME submits a Draft Project Charter which includes the following information the proposed project.

- Company Description
- Project Description
- Technical requirements and technology developed or to be tested
- Draft project resources
- Internship plans (if any)
- Draft project scheduling

CENGN Living Lab Project team will evaluate the document along with the Living Lab hosts and the technical partner to determine the feasibility of the project.

4.1.2.4 DEFINITION PHASE:

Once an SME successfully passes the feasibility phase, the project advances to the next phase. At this stage, the SME collaborates closely with CENGN and the Living Lab Project Team to co-develop the following key components:

- Final Project Charter
- Technical Feasibility Assessment
- Project Schedule and Work Plan

- Final Budget and Funding Award Details
- Partner Feedback and Contributions
- Risk Identification, Dependencies, and Mitigation Strategies

This collaborative process ensures that the project is strategically aligned, technically sound, and ready for successful execution within the Living Lab environment.

Additionally, the SME enters the execution phase, during which CENGN issues an Ultimate Recipient Agreement (URA). This agreement outlines all project requirements, reporting obligations, and roles of the Project Technology Partners and Living Lab Hosts.

4.1.2.5 Project Execution:

This final stage marks the transition from project approval to implementation.

- The SME collaborates with the Living Lab host and technology partners to carry out the project. Throughout this phase, the CENGN team provides ongoing support to ensure successful execution and alignment with project goals.

4.1.2.6 Project Closure:

At the end of the project SMEs are required to report on project outcomes, including job creation, technology deployment, and environmental, economic, and social impacts. CENGN uses a performance framework to track these results and is required to report to ISED.

5 Application Stage

SMEs interested in participating must submit their project applications through the **CENGN Portal.** This section provides a structured narrative to assist applicants in completing the CENGN Living Lab Project Application Form. It outlines the intent of each section, the documentation required, and how each component aligns with the point-rated evaluation criteria.

5.1 Section 1 – Problem Statement and Proposed Solution

(**Evaluation Criterion: R1**)

This section introduces the applicant's solution and establishes the foundation for the project's relevance and value.

- **Proposed Solution**
  Applicants should provide the name and a concise description of their product or solution, emphasizing its core capabilities and primary value proposition. The submission should include the current Technology Readiness Level (TRL), referencing the Government of Canada's TRL Guide

and Assessment Tool. Real-world testing, customer feedback, and adoption progress should be highlighted.
Required Documentation: TRL assessment, product overview, pilot or customer feedback.

- **Market Need and Value Proposition**
  This subsection requires a clear articulation of the market problem the solution addresses. Applicants should support their claims with industry data or market trends and explain how their solution uniquely resolves the issue. Key differentiators and competitive advantages must be identified.
  Required Documentation: Market research, competitor analysis, value proposition summary.
- **Market Opportunity and Competitive Positioning**
  Applicants must define the Total Addressable Market (TAM) and Serviceable Addressable Market (SAM), if available. Evidence of market demand through lead customers, enterprise buyers, or stakeholder commitments should be included.
  Required Documentation: Market sizing reports, letters of support, partnership agreements.
- **Solution Adopter(s)**
  Applicants should indicate whether a Canadian adopter has been identified and whether a Letter of Intent (LOI) has been secured.

5.1.1 Section 1A – Adoption Projects

(**Evaluation Criterion: R1**)

This section is applicable if a Canadian adopter is participating in the project.

- **Adopter Details**:
  Applicants must provide the adopter organization's name, address, and contact information.
- **Adopter Letter of Intent**:
  A completed LOI must be submitted using the provided template. The LOI should outline the adopter's challenges, the value of the proposed solution, and anticipated benefits such as job creation or efficiency improvements. It must also confirm the adopter's commitment to supporting a public-facing blueprint. The **editable Adopter Letter of Intent template** is accessible through the **CENGN Portal**. Applicants may download the template after creating an account, prior to initiating a formal application.
  Required Documentation: Completed LOI with quantitative and qualitative impact estimates.

5.2 Section 2 – Team Experience and Capability

(Evaluation Criterion: R2)

This section evaluates the qualifications and experience of the project team.

- **Team Biographies:**
  Applicants should provide short biographies (100 words each) for the project lead and up to four key contributors. Each biography should describe the individual's role, relevant expertise, and duration of involvement with the solution.
  Required Documentation: Short bios, full resumes.
- **Potential Intern:**
  If the applicant is interested in hosting an intern, they must specify the preferred field of study, academic level, work location, and a brief description of the intern's expected contributions.
  Required Documentation: Internship role summary.

5.3 Section 3 – Project Impact of Accessing a Living Lab

(Evaluation Criterion: R3)

This section assesses how the Living Lab environment will support the project's success.

- **Living Lab Selection**:
  Applicants must select their first and second choice Living Labs and justify their selections based on project needs.
  Required Documentation: Justification narrative.
- **Technical Objectives**:
  Applicants should outline their technical goals and describe how Living Lab services (e.g., 5G, infrastructure) will support these objectives. The impact of not having access to these services should also be addressed.
  Required Documentation: Technical plan, optional diagrams.
- **Business Objectives and Market Validation**:
  This subsection should describe the product's current development stage and how the project aligns with the company's strategic goals. Applicants should explain how the project will support commercialization and reduce market entry risks.
  Required Documentation: Business strategy, commercialization roadmap.
- **Strategic Benefits of Project Success**:
  Applicants must outline the anticipated business and technological benefits within 12 months of project completion, including IP generation, revenue growth, and partnership development.
  Required Documentation: Strategic forecasts, benefit projections.
- **Disruptive and Innovative Aspects**:
  This subsection should highlight the solution's innovative or disruptive features, including technological breakthroughs and market differentiation.
  Required Documentation: Innovation summary, intellectual property filings.

5.4 Section 4 – Project Plan

(Evaluation Criterion: R4)

This section outlines the execution strategy for the proposed project.

- ***Project Overview and Objectives***:
  Applicants should describe the project's scope, goals, and required resources. Any dependencies or risks that may affect the timeline should be noted.
  Required Documentation: Project summary.
- ***Key Milestones, Deliverables, and Team Contributions***:
  A timeline of major milestones and deliverables must be provided, along with a description of each team member's role.
  Required Documentation: GANTT chart, team roles matrix.
- ***Success Criteria and Impact***:
  Applicants must define measurable success criteria, including technical, commercial, and business outcomes.
  Required Documentation: Key performance indicators (KPIs), success metrics.

5.5 Section 5 – Risk Management

(Evaluation Criterion: R5)

- This section evaluates the applicant's ability to identify and mitigate project risks.
- **Key Risks and Mitigations**:
  Applicants must identify 3 to 6 major risks, rate their likelihood and impact (on a scale of 1 to 5), and describe mitigation strategies and responsible parties.
  ***Required Documentation*:** Optional Risk Register Template**.**

5.6 Section 6 – National/Ecosystem Impact

(Evaluation Criterion: R6)

This section assesses the broader impact of the project on Canada's innovation ecosystem.

- **Industry and Transformative Impact**:
  Applicants should describe how the project could transform their industry and contribute to new knowledge or standards.
- **Collaboration and Digital Adoption in Canada**:
  This subsection should explain how the project will foster innovation partnerships and promote digital adoption across sectors.
- **Lasting Benefits to Canada**:

Applicants must outline expected benefits in areas such as economic development, sustainability, innovation, policy, and social impact.
Required Documentation: Impact assessments, stakeholder endorsements.

- **Increasing Canada's Global Competitiveness:**
  This subsection should describe how the project will enhance Canada's position in global markets and strengthen domestic supply chains.
  Required Documentation: Export strategies, market analysis.

5.7 Section 7 – Participation Agreement

Applicants must confirm their willingness to sign a participation agreement if selected for the program.

5.8 Section 8 – Innovation Highlight

If selected, CENGN may feature the project in a promotional Innovation Highlight. Applicants are asked to confirm their interest and provide a profile photo and company logo.

6 Reporting Requirements

Funding recipients are required to report on project outcomes, achievements, and deliverables, including—but not limited to—job creation, technology deployment, and environmental, economic, and social impacts.

As a results-driven organization, CENGN employs a comprehensive performance management framework to monitor and evaluate the effectiveness of its investments. This framework aligns with reporting obligations to Innovation, Science and Economic Development Canada (ISED).

Each investment agreement outlines the expected project outcomes and the corresponding performance indicators that will be tracked throughout the project lifecycle. The Applicant Project Team is responsible for submitting all required data through:

- Quarterly progress reports
- Final project reports
- Outcome surveys

Failure to submit these reports or respond to surveys as specified in the Ultimate Recipient Agreement (URA) may result in delayed reimbursement of eligible project costs. Prolonged non-compliance may lead to termination of the URA and/or recovery of funds already disbursed by CENGN.

7 DATA AND IP

External reviewers, infrastructure partners and Living Lab hosts engaged in CENGN-supported projects may access sensitive SME data and intellectual property (IP) strictly for project-related purposes. This data must be treated as confidential, handled securely, and not shared with third parties without written consent from both the SME and CENGN. All IP developed by the SME remains its property unless otherwise agreed. External Reviewers may not claim ownership or use of SME data or project-generated IP.

SMEs must agree to provide non-confidential summaries of the data and IP created during their projects. These summaries will be shared with other CENGN partners, who may then reach out to explore partnerships or further development.

8 BUDGET TEMPLATE

The editable budget template is accessible through the CENGN Portal. Applicants may download the template after creating an account, prior to initiating a formal application.

9 SERVICES DESCRIPTIONS

9.1 ADVANCED COMMUNICATIONS TESTING SERVICE

9.1.1 Overview

The Advanced Communications Testing Service helps Canadian SMEs accelerate innovation by providing access to flexible 5G test beds and spectrum bands—including commercial, Non-Competitive Local Licensing (NCLL), and experimental—across low, mid, and high-band (mmWave) frequencies. This service supports testing and validation of 5G-enabled technologies in both real-world and simulated environments, through multiple Living Labs such as Smart Farming Living Lab, Connected Robotics Living Lab and 5G Advanced Performance Living Lab, with support from Rogers Communications and Ericsson. Target sectors include autonomous mobility, smart manufacturing, precision agriculture, immersive media, and critical IoT.

9.1.2 Service Tiers and Scope

9.1.2.1 BASIC SERVICE TIER: SELF-DIRECTED TESTING

- Target Users: SMEs needing minimal support.
- Features:
    - Up to 5 SIMs
    - Instructions to connect up to 5 user devices (UEs) or CPEs to the 5G network.
    - No network customization or technical assistance beyond initial setup.

- Devices are configured with a QoS profile, but SMEs do not get access to network logs.

- Use Case: Ideal for early-stage testing or proof-of-concept validation.

9.1.2.2 Advanced Service Tier – Test Plan Consulting & Network Change Testing:

- Includes everything in the Basic Tier, plus:
- Additional Features:
  - Access to a shared pool of 50 SIMs (more can be requested with approval).
  - Up to 10 hours of consulting with Living Lab experts.
  - Ability to test during planned network changes, where available.
  - SMEs can request log reports (subject to approval), where available.
  - Option to integrate the SME's 5G-connected devices at the Living Lab a secure, isolated environment in CENGN's data centre infrastructure, accessible over the Internet.
- Use Case: Suitable for more complex testing involving multiple devices or network behavior analysis.

9.1.2.3 Premium Service Tier – Low-Latency Edge Compute Testing (where available):

- Includes everything in the Advanced Tier, plus:
- Additional Features:
  - Access to low-latency edge compute (MEC) infrastructure (where available).
  - Up to 10 additional consulting hours to:
  - Define infrastructure needs.
  - Set up applications on the edge platform.
  - Refine test plans.
- Use Case: Best for testing real-time, latency-sensitive applications like AR/VR, robotics, or autonomous systems.

9.1.2.4 Service Scope

- In Scope: Access to 5G spectrum, limited supervised facility access, SIM provisioning
- Out of Scope: Real-time troubleshooting, unsupervised access, facility modifications

9.1.2.5 Wireless Performance

Detailed throughput and latency data are provided for different spectrum bands and locations around Bayview Yards. For example, N261 mmWave, N78 High-Band and N14 Low-Band (for lower speeds, suitable for rural applications).

9.1.3 Testing Types

There are three main types of testing available to SMEs through the CENGN Living Labs program:

9.1.3.1 Functional Testing

- Focuses on verifying that a product, device, or application behaves as expected based on its specifications.
- Examples:
    - System-level testing: End-to-end validation of device/application performance on 5G networks.
    - Integration testing: Ensures interoperability between devices, sensors, and applications in distributed systems (e.g., IoT or robotics).
    - Regression testing: Confirms that updates or changes (e.g., firmware or network updates) don't break existing functionality.

9.1.3.2 Non-Functional Testing

- Evaluates the performance characteristics of a system rather than its specific functions.
- Examples:
    - Performance testing: Measures throughput, latency, jitter, and packet loss across different 5G bands (low, mid, mmWave).
    - Scalability testing: Assesses how the system handles many connected devices (e.g., smart city sensors, robotics fleets).
    - Reliability testing: Long-duration tests to validate system stability under normal and peak loads.
    - User Experience (UX) testing: Evaluates how users interact with systems like drones or robots, focusing on safety, intuitiveness, and effectiveness.

9.1.3.3 Specialized Testing

- Targets unique scenarios, stress conditions, or compliance requirements.
- Examples:
    - Network stress testing: Simulates congestion, mobility, and failover to assess robustness.
    - Fault injection testing: Introduces controlled misconfigurations (e.g., QoS changes) to test resilience of critical or low-latency applications.
    - Compliance testing: Verifies readiness for industry-standard certifications.
- EMC testing: Assesses electromagnetic compatibility in interference-free environments like anechoic chambers

9.1.4 Living Labs

The Advanced Communications Testing Service may be delivered at multiple living labs.

9.1.4.1 Focus

- ***Connected Robotics Living Lab: Powered by University of Waterloo's RoboHub and Rogers***
    - Robotics, autonomous systems, and advanced communications.

- ***Smart Farming Living Lab: Powered by University of British Columbia (UBC) Farms and Rogers***
  - Agriculture, forestry, and environmental innovation
- ***5G Advanced Performance Living Lab: Powered by Ericsson (at Bayview Yards, Ottawa)***
  - General-purpose 5G testing and innovation

9.1.4.2 Facilities & Assets:

- ***Connected Robotics Living Lab: Powered by University of Waterloo's RoboHub and Rogers***
  - Indoor and outdoor testing spaces.
  - Anechoic chamber for interference-free testing.
  - Fleet of robots and motion capture systems.
  - Access to Rogers 5G network (including mmWave n261, mid-band n78, low band n71).
  - SIM cards, routers, and PCIe 5G modules.
- ***Smart Farming Living Lab: Powered by University of British Columbia (UBC) Farms and Rogers***
  - Agriculture, forestry, and environmental innovatio Farm fields and forest zones.
  - SIM cards, routers, PCIe 5G modules.
  - Equipment like tractors and drones (with pilot support)
- ***5G Advanced Performance Living Lab: Powered by Ericsson (at Bayview Yards, Ottawa)***
  - Indoor/outdoor testing spaces
  - Access to various spectrum bands: N77, N78, N261, N14
  - Mobile Edge Computing (MEC) capabilities

9.1.4.3 Network Capabilities:

- ***Connected Robotics Living Lab: Powered by University of Waterloo's RoboHub and Rogers***
  - 5G Standalone (SA) and Non-Standalone (NSA)
  - LTE bands (700, AWS-1, 2600, 1900, 850)
  - WiGig (60 GHz)
- ***Smart Farming Living Lab: Powered by University of British Columbia (UBC) Farms and Rogers***
  - 5G bands: n71 (600 MHz), n78 (3.5 GHz), mmWave n261 (28 GHz)
  - LTE bands: n12 (700 MHz), n2 (1900 MHz), n66 (2100 MHz), n7 (2600 MHz)

9.1.4.4 Expert Support:

- ***Connected Robotics Living Lab: Powered by University of Waterloo's RoboHub and Rogers***
  - Support for integration, simulation, and robotics setup.
  - Rogers provides 5G network advisory and configuration support.
- ***Smart Farming Living Lab: Powered by University of British Columbia (UBC) Farms and Rogers***
  - Test plan review and agricultural equipment operation.
  - Rogers provides 5G network advisory and configuration support

9.1.4.5 Common Features Across Living Labs:

- Access to commercial, NCLL, and experimental 5G spectrum.
- Tiered service levels (Basic, Advanced, Premium).
- Consulting support for test planning and execution.
- Facility access must be pre-approved and supervised.
- No real-time troubleshooting or unsupervised access.

9.1.5 Use Cases

We list some representative examples, below, to illustrate the variety of use-cases supported by this service, depending on the facilities available at each Living Lab.

9.1.5.1 Testing on NCLL and Experimental Spectrum

- Purpose: Validate devices and applications using Non-Competitive Local Licensing (NCLL) and experimental spectrum bands.
- Why It Matters: These bands are reserved for innovation, allowing safe testing without disrupting public networks. They help ensure future compatibility with national spectrum allocations.
- Example: A company tests its 5G-enabled sensor platform on the N77 band to align with Canadian spectrum regulations.

9.1.5.2 Advanced 5G Feature Validation

- Purpose: Evaluate performance using cutting-edge 5G features like Standalone (SA), Multi-Access Edge Compute (MEC), and mmWave.
- Why It Matters: These features will define next-gen connectivity; early validation ensures readiness for future deployments.
- Example: Testing an AR application using MEC and mmWave to assess latency and throughput before public rollout.

9.1.5.3 Massive IoT Deployment Testing

- Purpose: Assess system behavior with large numbers of IoT devices in real-world conditions.
- Why It Matters: Scalability and reliability are critical for smart infrastructure and industrial IoT.
- Example: Deploying thousands of environmental sensors across a smart farm to monitor connectivity and data flow.

9.1.5.4 Critical IoT Performance Testing

- Purpose: Validate real-time responsiveness and reliability for mission-critical IoT systems.
- Why It Matters: Emergency and safety applications demand ultra-low latency and secure communication.
- Example: Testing connected body cameras and drones used by first responders to ensure reliable video streaming and control.

9.1.5.5 Large-Scale 5G Device Deployment

- Purpose: Simulate high-density environments to test device and network performance.
- Why It Matters: Events like concerts or sports games stress networks; testing helps optimize performance under load.
- Example: Simulating a stadium scenario with thousands of devices to evaluate bandwidth contention and app stability.

9.1.5.6 High-Speed & Low-Latency Application Testing

- Purpose: Validate applications requiring high throughput and minimal delay.
- Why It Matters: Use cases like streaming, robotics, and autonomous vehicles depend on consistent, fast data transmission.
- Example: Testing AI-powered camera systems for real-time video analytics in traffic monitoring.

9.1.5.7 Fixed Wireless Access (FWA) Testing

- Purpose: Assess 5G-enabled CPEs and antennas for residential and enterprise internet.
- Why It Matters: FWA is a cost-effective alternative to fiber, especially in underserved areas.
- Example: Deploying 5G routers in rural homes to measure latency, provisioning speed, and failover reliability.

9.1.5.8 Rural Connectivity Testing

- Purpose: Validate solutions designed for remote or low-density regions.
- Why It Matters: Long-range, low-band spectrum is essential for bridging the digital divide.
- Example: Testing smart agriculture devices using N71 spectrum to ensure coverage across large farms.

9.1.5.9 Smart Cities & Smart Homes Validation

- Purpose: Test IoT solutions in urban and suburban environments using live 5G networks.
- Why It Matters: Real-world validation ensures reliability of automation, monitoring, and logistics systems.
- Example: Evaluating a smart delivery tracking system in a suburban neighborhood using 5G connectivity.

9.1.5.10 Radio Interference & Spoofing Simulation

- Purpose: Assess device resilience to signal interference and spoofing attacks.
- Why It Matters: Security and reliability are crucial for public safety and enterprise applications.
- Example: Using an anechoic chamber to simulate spoofing attempts on a drone's control system.

9.1.5.11 Indoor Advanced Positioning (Planned)

- Purpose: Test indoor positioning systems where GPS is unreliable.
- Why It Matters: Accurate indoor tracking is vital for logistics, robotics, and AR navigation.
- Example: Validating an autonomous robot's navigation system inside a warehouse using 5G-based IAP APIs.

9.2 Autonomous Vehicle Testing Service

9.2.1 Overview

The Autonomous Vehicle Testing Service provides Canadian SMEs with access to real-world and simulated environments to test autonomous vehicles and smart mobility solutions. It supports validation of performance, safety, connectivity, and resilience under varied conditions.

9.2.2 Service Tiers and Scope

9.2.2.1 Basic Service Tier – Device and System Testing

- Purpose: Initial validation of autonomous vehicle systems.
- What's Included:
  - Access to Area X.O facilities for physical testing (e.g., track testing, ADAS verification).
  - Use of available network connectivity (5G, LTE, LoRaWAN, Wi-Fi).
  - Pre-compliance testing for standards like ISO, SOTIF, FUSA.
  - SME is responsible for developing and executing the test plan.
  - Living Lab provides advice on facility usage and compatibility.
- Best For: SMEs conducting early-stage testing of autonomous systems.

9.2.2.2 Advanced Service Tier – Application and System Integration

- Purpose: Integration of vehicle systems with SME applications.
- What's Included:
  - All Basic Tier services.
  - Integration with a secure, isolated slice of CENGN's infrastructure.
  - Up to 10 hours of technical assistance from CENGN engineers.
  - Advisory support for test methods and procedures.
- Best For: SMEs testing how their autonomous systems interact with backend applications or cloud services.

9.2.2.3 Premium Service Tier – Test Advisory & Execution Assistance

- Purpose: Full-service support for test planning, execution, and analysis.
- What's Included:
  - All Advanced Tier services.
  - Expert support from Area X.O for:

- Test plan development
- Execution assistance
- Data gathering and interpretation
- Access to data logging, telemetry, video output, and storage (Azure or CENGN data center).

- Best For: SMEs needing comprehensive support for complex or high-stakes testing.

9.2.2.4 LIVING LAB

Smart Mobility and Smart Agriculture Living Lab, powered by Area X.O is a cutting-edge test and demonstration facility in Ottawa.

9.2.3 Focus

- Accelerate innovation and commercialization of autonomous and connected vehicle technologies.
- Provide real-world and simulated environments for testing smart mobility solutions.
- Support sectors including:
  - Smart Mobility
  - Cybersecurity
  - UAVs and Robotics
  - Clean Tech
  - Public Safety
  - Smart Agriculture
  - Defense and Electrification

9.2.4 Facilities & Assets

- 16 km of urban-configured roadways
- Simulated intersections and railway crossings
- 100-acre smart farm for Agri-tech testing
- Aerospace and robotics test site in Killaloe
- DARTT Facility with diverse terrain (gravel, sand, water, fields, sidewalks)
- Climate simulation and weather condition testing
- Mannequin launch systems (adult, child, cyclist)
- High-resolution sensor networks and real-time data feeds
- Lexus vehicle platform with integrated sensors
- V2X Roadside and Onboard Units
- LiDAR, Radar, GNSS, IMU, and camera systems
- Drones and pilots available for hire
- Data storage via Linux, Azure, and CENGN data centers

9.2.5 Network Capabilities

- Private LTE/5G Networks:

  - LTE B7 (2600 MHz), LTE B14 (700 MHz Public Safety)
  - 5G sub-6 n78, C-Band n77, mmWave n260 & n261
- Operational Technology (OT) Networks:
  - LoRaWAN Gateway
  - Television White Space (TVWS)
  - RTK GPS with Novatel and Swift systems
- Connectivity Equipment:
  - Cradlepoint, Sierra Wireless, and Nokia 5G routers
  - SIM cards

9.2.6 Expert Support

- Advisory services for test plan development and execution
- Technical guidance on equipment setup, integration, and diagnostics
- Simulation and digital twin capabilities for pre-deployment validation
- Data logging and export support (system logs, telemetry, video)
- Co-created final project reports to document outcomes and KPIs
- Access to Area X.O experts for interpreting test results and optimizing validation strategies

9.2.7 Use Cases

We list some representative examples, below, to illustrate the variety of use-cases supported by this service, depending on the facilities available at each Living Lab.

9.2.7.1 Autonomous Vehicle Testing

- Purpose: Conduct functional testing and validation of in-cabin technologies, ADAS (Advanced Driver Assistance Systems), LIDAR, Radar, GNSS, and V2X (Vehicle-to-Everything) communications.
- Why It Matters: Ensures autonomous vehicles meet industry standards and road safety requirements, improving reliability and public trust.
- Example: An SME tests its ADAS system's lane-keeping and collision avoidance features using real-world road scenarios and V2X communication protocols.

9.2.7.2 Vehicular Communications Testing

- Purpose: Evaluate advanced communication technologies such as CV2X (Cellular Vehicle-to-Everything), V2I (Vehicle-to-Infrastructure), V2V (Vehicle-to-Vehicle), and 5G/IoT integration.
- Why It Matters: Real-time connectivity between vehicles and infrastructure is essential for intelligent transportation systems and traffic safety.
- Example: Testing a vehicle's ability to receive traffic light status updates via V2I to optimize speed and reduce idling time at intersections.

9.2.7.3 Autonomous Delivery Vehicle Testing

- Purpose: Validate autonomous pods for last-mile delivery in urban and suburban environments using sensors like LIDAR, radar, and cameras.
- Why It Matters: Demonstrates the feasibility of autonomous delivery, reduces operational costs, and enhances service reliability.
- Example: An SME tests its autonomous delivery pod navigating a predefined route with safe drop-off points for packages in a residential area.

9.2.7.4 Autonomous Vehicle Platooning

- Purpose: Test V2V communication capabilities to enable synchronized vehicle convoys for fuel efficiency and traffic flow optimization.
- Why It Matters: Platooning reduces fuel consumption and improves road capacity, especially on highways.
- Example: Using Area X.O's Lexus vehicle and an SME's platform, two vehicles maintain close formation and coordinated braking on a highway using GNSS and radar.

9.2.7.5 Cybersecurity & Penetration Testing

- Purpose: Assess the resilience of autonomous and connected vehicle technologies against cyber threats in both simulated and real-world environments.
- Why It Matters: Cybersecurity is critical for protecting vehicle systems, user data, and public safety.
- Example: An SME performs penetration testing on its vehicle's infotainment system to identify vulnerabilities in wireless communication protocols.

9.2.7.6 Regulatory Pre-Certification

- Purpose: Prepare SMEs for compliance testing with ISO and Euro NCAP standards before public deployment.
- Why It Matters: Early validation helps avoid costly delays and ensures smoother certification processes.
- Example: An SME tests its autonomous braking system in a controlled environment to meet Euro NCAP pedestrian safety benchmarks.

9.3 IoT-Enabled Sensor Testing Service

9.3.1 Overview

The **IoT-Enabled Sensor Testing Service** provides Canadian SMEs with access to real-world and controlled environments to test IoT devices (e.g., sensors, actuators) and systems (e.g., data collection, control applications). It supports validation of functionality, performance, connectivity, and resilience.

9.3.2 Service Tiers and Scope

9.3.2.1 Basic Tier – Device and System Testing

This tier is designed for SMEs who want to test their IoT devices in real-world environments without backend integration.

- Device Installation: SMEs install their IoT devices (e.g., sensors, actuators) at Living Lab facilities.
- Connectivity Access: SMEs can use available network options like LoRaWAN, LTE, 5G, and Wi-Fi.
- Advisory Support: Labs provide guidance on installation and validation planning.
- Non-disruptive Setup: Installations must not interfere with the day-to-day operations of the lab (e.g., farm activities).
- No Backend Integration: Devices are not connected to SME applications or backend systems.

Example Use Cases:

- Soil moisture sensor testing in farm fields.
- Vibration sensors on agricultural equipment.
- Environmental sensors deployed in urban intersections.

9.3.2.2 Advanced Tier – Application and System Integration

This tier builds on the Basic Tier and adds support for full system integration and advanced testing.

Includes Everything in Basic Tier, plus:

- Secure Integration: Devices can be connected to SME applications via a secure, isolated slice of CENGN's infrastructure.
- Remote Access: SMEs can access their applications over the Internet.
- Test Planning Support: CENGN provides advisory services for test methods, procedures, and integration.
- Data Services: Includes data logging, export, and storage options (e.g., Azure or CENGN data center).
- Custom Test Scenarios: Co-created test plans based on SME objectives.

Example Use Cases:

- Real-time air quality monitoring with cloud analytics.
- Smart intersection systems with sub-second latency validation.
- Livestock tracking with GPS and cloud-based alerting.

9.3.3 Living Labs

9.3.3.1 Focus

- Provide real-world and controlled environments for validating IoT sensors, actuators, and systems.
- Support innovation in agriculture, smart cities, environmental monitoring, and infrastructure.
- Enable SMEs to test performance, connectivity, and resilience of IoT solutions.
- Accelerate commercialization and reduce time-to-market for Canadian SMEs.

9.3.3.2 Facilities & Assets

- ***Smart Mobility and Smart Agriculture Living Lab, Area X.O (Ottawa & Killaloe, ON):***
  - 100-acre smart farm, urban-configured roadways, and simulated intersections.
  - DARTT Facility with diverse terrain (gravel, sand, water, fields, sidewalks).
  - Dedicated agricultural testing fields and private intersections.
  - High-resolution sensor networks and environmental monitoring systems.
  - Equipment: drones for rent, tractor operation support, and data storage options.
- ***Smart Farming Living Lab, UBC Smart Farm (Vancouver, BC):***
  - 24-hectare certified organic farm and forest ecosystem.
  - 5 hectares of agricultural fields and 15 hectares of forest.
  - Greenhouse and crop-specific planting options.
  - High-resolution sensor networks for GHG, climate, and soil monitoring.
  - Storage rental and access to UBC research facilities.

9.3.3.3 Network Capabilities

- ***Smart Mobility and Smart Agriculture Living Lab, Area X.O:***
  - Private LTE/5G networks: LTE B7/B14, 5G n78/n77/n260/n261.
  - OT networks: LoRaWAN, TVWS, RTK GPS.
  - Connectivity tools: CloudGate Gateway, SIM/eSIM profiles, Azure data center.
- ***Smart Farming Living Lab, UBC Smart Farm:***
  - Commercial LTE/5G via Rogers: LTE n12/n7/n66, 5G n71/n78.
  - No native LoRaWAN; SMEs may bring their own.
  - Connectivity via 5G backhaul or Ethernet.
  - Data center access through CENGN infrastructure.

9.3.3.4 Expert Support

- ***Smart Mobility and Smart Agriculture Living Lab, Area X.O:***
  - Advisory services for test plan development and execution.
  - Technical setup support, diagnostics, and equipment operation.
  - Simulation scenarios and analytics development.
  - Assistance with drone flight certification (SFOC).
  - Data logging and export (telemetry, video, system logs).

- ***Smart Farming Living Lab, UBC Smart Farm:***
  - Agricultural and ecological research consulting via UBC Centre for Sustainable Food Systems.
  - Test plan review focused on plant life and organic certification compliance.
  - Equipment operation support (e.g., tractor, drone pilot).
  - Collaboration opportunities with UBC researchers for reduced pricing.

9.3.4 Use Cases

We list some representative examples, below, to illustrate the variety of use-cases supported by this service, depending on the facilities available at each Living Lab.

9.3.4.1 Soil Moisture Monitoring

- Purpose: Validate the accuracy and reliability of a new soil moisture sensor for smart irrigation.
- Why It Matters: Accurate soil moisture data is essential for optimizing water usage, improving crop yields, and supporting sustainable agriculture.
- Example: An equipment manufacturer installs sensors in UBC Smart Farm test plots and uses a LoRaWAN gateway with 5G backhaul to transmit data to their cloud application, monitoring performance across different soil types and weather conditions over a growing season.

9.3.4.2 Environmental Sensing Network

- Purpose: Test an urban air quality monitoring system using IoT-enabled sensors for pollutants like CO_2, NO_2, and particulate matter.
- Why It Matters: Real-time environmental data supports public health initiatives and helps municipalities make informed decisions about urban planning and traffic management.
- Example: A system integrator installs sensors at Area X.O intersections and connects them to a cloud analytics platform via 5G to validate latency, resilience, and dashboard accuracy.

9.3.4.3 Equipment Maintenance Monitoring

- Purpose: Evaluate vibration sensors for predictive maintenance in harsh field conditions.
- Why It Matters: Early detection of equipment issues reduces downtime, maintenance costs, and improves operational efficiency.
- Example: A startup mounts sensors on agricultural and utility equipment at Area X.O to test performance under vibration, dust, and temperature extremes, while transmitting telemetry data over LTE and 5G networks.

9.3.4.4 Traffic and Safety Monitoring

- Purpose: Validate a smart intersection solution that manages sensor arrays and generates real-time alerts.
- Why It Matters: Enhancing traffic safety and flow through intelligent systems reduces accidents and improves urban mobility.

- Example: A solution developer integrates radar, lidar, and thermal sensors at Area X.O intersections, simulates traffic scenarios, and verifies sub-second alert latency over 5G.

9.3.4.5 Livestock & Wildlife Tracking

- Purpose: Test IoT devices for tracking crop growth, livestock, or wildlife in rural and forested environments.
- Why It Matters: Accurate tracking supports precision agriculture, conservation efforts, and scalable deployment of smart farming technologies.
- Example: An Agritech SME deploys GPS-enabled sensors at UBC Smart Farm to monitor battery life, data transmission, and scalability with hundreds of active devices connected to a cloud-based analytics platform.

9.3.4.6 Greenhouse Gas Monitoring

- Purpose: Validate GHG emission sensors for agricultural applications.
- Why It Matters: Monitoring emissions helps meet environmental regulations and supports sustainable farming practices.
- Example: A device manufacturer installs sensors in UBC Smart Farm fields to test calibration accuracy, long-term stability, and LTE/5G interoperability, demonstrating readiness for government reporting standards.

9.4 Human-Robot Interactivity Testing

9.4.1 Overview

CENGN's **Human-Robot Interactivity Testing Service** enables SMEs to test robotic systems designed to interact with humans in safe, controlled environments.

- Location: Delivered at the Connected Robotics Living Lab, powered by Univerity of Waterloo's RoboHub and Rogers.
- Environment: Offers both indoor and outdoor testing spaces with:
  - 5G connectivity (commercial and non-commercial bands)
  - High-precision indoor positioning
  - Powered gantry, theatrical lighting, privacy glass
  - Safety and environmental controls
- Access: Limited per SME due to high demand
- Support: Includes consulting, test planning, and integration assistance from RoboHub experts

9.4.2 Service Tiers and Scope

9.4.2.1 In Scope

- Access to expert researchers and consulting

- Use of Waterloo RoboHub's state-of-the-art facility
- Ability to rent robots from RoboHub's fleet
- Access to facilities that support human-robot interactivity testing
- Access to 5G network infrastructure and the Internet
- Real-time support from a dedicated point-of-contact during on-site testing

9.4.2.2 Out of Scope

- Long-term equipment hosting or storage
- On-site data storage
- Long-term testing projects
- Changes to 5G network configurations after initial setup
- Permanent changes to the physical facilities

9.4.2.3 Client Responsibilities

- Bring and operate their own robots/systems
- Provide insurance and meet safety requirements
- Comply with facility guidelines and training

9.4.3 Living Lab

9.4.3.1 Focus

- Enable testing and validation of mobile, stationary, and integrated robotic systems designed to interact with humans.
- Support safe evaluation of human-robot interaction, collaborative robotics, and multi-agent coordination.
- Facilitate innovation in robotics across sectors like healthcare, manufacturing, logistics, and hospitality

9.4.3.2 Facilities & Assets

- State-of-the-art indoor robotics testing facility with:
  - High-precision indoor positioning system
  - Powered gantry, theatrical lighting, switchable privacy glass
  - Safety and environmental controls
  - Outdoor testing space at the Avril building parking lot
- Access to a globally unique fleet of robots:
  - Gen2/Gen3 arms, Panda Powertool, LBR iiwa, NAO, TALOS, QDrone, Clearpath Warthog
  - GNSS sensors and RTK GPS antennae
  - Equipment rental available

9.4.3.3 Network Capabilities

- 5G & Wireless Connectivity:
  - Indoor: 5G n78 (3.5 GHz), mmWave n261 (28 GHz, non-commercial)
  - Outdoor: LTE 700, AWS-1, 2600, 1900, 850 MHz; 5G n71, n41
  - OT Wireless: 60 GHz WiGig
- Connectivity Tools:
  - SIM cards, PCIe/M.2 5G modules, Inseego MiFi routers, Quectel modems
- Network Access Support:
  - Rogers provides 5G services; RoboHub manages access and configuration

9.4.3.4 Expert Support

- Consulting & Advisory Services:
  - Project onboarding and design validation consulting
  - Support for equipment setup, integration, and diagnostics
  - Assistance with motion capture, simulated environments, and robot operation
- Access to over 45 faculty experts in:
  - Human-Robot Interaction, Autonomous Systems, AI/ML, Embedded Systems, Assistive Devices, Robotics in Health, Art, and Design

9.4.3.5 Deliverables:

- Test plan development, data logging/export, final project report
- Real-time support during on-site testing
- Short-term access with strong emphasis on planning and preparation

9.4.4 Use Cases

We list some representative examples, below, to illustrate the variety of use-cases supported by this service, depending on the facilities available at each Living Lab:

9.4.4.1 Collaborative Robot Safety Validation

- Purpose: Validate the safety features of collaborative robots designed to work alongside humans in industrial environments.
- Why It Matters: Ensuring safe human-robot interaction is critical for workplace safety, regulatory compliance, and adoption in manufacturing settings.
- Example: An equipment manufacturer uses Waterloo RoboHub's motion capture systems to test emergency stop functions and proximity detection in a robot designed for assembly line tasks.

9.4.4.2 Sensors that Improve Human Safety

- Purpose: Evaluate the performance of safety-enhancing sensors and control systems under varied environmental conditions.

- Why It Matters: Sensor accuracy can be affected by lighting, reflections, and noise—testing ensures reliability in real-world scenarios.
- Example: An SME tests a vision-based proximity sensor by adjusting lighting and introducing reflective surfaces in RoboHub's controlled environment to simulate factory conditions.

9.4.4.3 Multi-Agent System Coordination Testing

- Purpose: Assess how autonomous robots coordinate with each other and with human workers in logistics or warehousing environments.
- Why It Matters: Effective coordination improves efficiency, safety, and adaptability in dynamic workspaces.
- Example: An SME tests swarm robots handing off materials to human workers in simulated warehouse tasks, using RoboHub's tracking systems to monitor responsiveness and navigation.

9.4.4.4 Human-Robot Social Interaction Study

- Purpose: Study how service robots interpret and respond to human gestures, voice commands, and proximity cues.
- Why It Matters: Natural and intuitive interaction is essential for robots in healthcare, hospitality, and customer service roles.
- Example: An SME uses gaze tracking and vision systems in RoboHub's indoor spaces to evaluate how a robot responds to a user's body language and spoken instructions in a simulated hospital reception area

9.5 Robotics Functional Equipment Testing Service

9.5.1 Overview

The **Robotic Functional Testing Service** provides SMEs with access to secure, scalable, and monitored environments to test robotic systems in real-world conditions. It supports both autonomous and remotely operated robots across various domains such as mobility, sensing, navigation, manipulation, and integration.

9.5.2 Service Scope

9.5.2.1 Customer Responsibilities

- Bring and operate their own robots
- Ensure safety compliance and insurance
- Follow facility guidelines and training

9.5.2.2 Facility Responsibilities

- Provide access, training, and support
- Assist with test planning and integration

9.5.2.3 DELIVERABLES

- Pre-scheduled test environment access
- Technical setup support
- Co-developed test plans
- Data logging and export
- Final report with KPIs and performance results

9.5.3 Living Labs

The service is delivered through three main Living Labs, each offering unique capabilities:

9.5.3.1 FOCUS

- ***Smart Mobility and Smart Agriculture Living Lab, Area X.O:***
  - Smart mobility, public safety, cybersecurity, agriculture, UAVs, CAVs, clean tech, and advanced robotics.
  - Real-world testing aligned with NIST standards.
- ***Smart Farming Living Lab, University of British Columbia (UBC) farms:***
  - Sustainable agriculture, agroecology, food systems research.
  - Emphasis on organic certification and Indigenous knowledge systems.
- ***Connected Robotics Living Lab, University of Waterloo's RoboHub:***
  - Robotics research, human-robot interaction, autonomous systems.
  - Innovation in multi-robot and human-robot teams.

9.5.3.2 FACILITIES AND ASSETS

- ***Smart Mobility and Smart Agriculture Living Lab, Area X.O:***
  - 100-acre smart farm, 16 km smart city zone, aerospace test site in Killaloe.
  - Diverse terrain: gravel, sand, water, fields, sidewalks.
  - Private intersections with PTZ cameras, thermal sensors, Lidar, radar.
  - LoRaWAN, TVWS, and environmental sensors.
- ***Smart Farming Living Lab, University of British Columbia (UBC) farms:***
  - 24-hectare organic farm and forest ecosystem.
  - Cultivates over 200 varieties of fruits, vegetables, and herbs, including:
  - Tomatoes, carrots, lettuce, kale, squash, beans, berries, and culinary herbs.
  - Greenhouse, forest areas, and high-resolution sensor networks.
  - Dedicated agricultural and forest testing fields.
- ***Connected Robotics Living Lab, University of Waterloo's RoboHub:***
  - Indoor facility with gantry, lighting, privacy glass, and positioning systems.
  - Outdoor test space at AVRIL building.
  - Fleet of rentable robots (e.g., NAO, TALOS, QDrone, Clearpath Warthog).

9.5.3.3 Network Capabilities

- ***Smart Mobility and Smart Agriculture Living Lab, Area X.O:***
  - Private LTE/5G network (bands: LTE B7, B14; 5G n78, n77, n260, n261).
  - Nokia Digital Automation Center (NDAC)
- ***Smart Farming Living Lab, University of British Columbia (UBC) farms:***
  - Rogers 5G network (bands: n71, n12, n2, n66, n78).
  - LTE support and SIM card provisioning.
- ***Connected Robotics Living Lab, University of Waterloo's RoboHub:***
  - Rogers 5G (bands: n71, n41, n78, mmWave n261).
  - LTE support and WiGig (60 GHz)

9.5.3.4 Expert Support

- ***Smart Mobility and Smart Agriculture Living Lab, Area X.O:***
  - Consultation during project planning.
  - Support for network access and facility use.
  - Optional assistance in test plan development and reporting.
- ***Smart Farming Living Lab, University of British Columbia (UBC) farms:***
  - Access to UBC Centre for Sustainable Food Systems.
  - On-site technical support and consultation.
  - Collaboration with researchers for project integration.
- ***Connected Robotics Living Lab, University of Waterloo's RoboHub:***
  - Access to over 45 faculty experts.
  - Project onboarding and design validation consulting.
  - Support for UX, sensor calibration, and simulated environments.

9.5.3.5 Use Cases

We list some representative examples, below, to illustrate the variety of use-cases supported by this service, depending on the facilities available at each Living Lab

9.5.4 Robotic System Monitoring and Coordination

- Purpose: Validate systems that monitor and coordinate multiple robots or sensors.
- Scenario: Robots navigate sidewalks or indoor spaces while communicating with a central system.
- Environment: Includes 5G connectivity, realistic urban infrastructure (e.g., curbs, signage), and multi-camera monitoring.

9.5.5 Robotics and Automation for Agriculture

- Purpose: Test autonomous agricultural robots for tasks like planting, pest control, and crop analysis.
- Scenario: Use of autonomous tractors, mobile robots, or greenhouse systems.

- Environment: Agricultural fields or vertical farming setups with geospatial mapping and soil/water testing.

9.5.6 Autonomous Delivery Robot Navigation

- Purpose: Validate last-mile delivery robots in urban or campus settings.
- Scenario: Robots use computer vision, LiDAR, and wireless connectivity to navigate.
- Environment: Simulated urban zones with sidewalks, ramps, and crosswalks; equipped with 5G and monitoring systems.

9.5.7 Ground Vehicles for Public Safety and Emergency Response

- Purpose: Test unmanned robots for search & rescue, perimeter security, or hazardous inspections.
- Scenario: Robots with cameras, thermal sensors, and communication systems operate in disaster-like conditions.
- Environment: Outdoor areas with varied terrain, fog, water spray, and obstacles.

9.5.8 Warehousing and Logistics Automation

- Purpose: Validate indoor robots and robotic forklifts for inventory and storage tasks.
- Scenario: Robots navigate warehouse zones, handle pallets, and avoid dynamic obstacles.
- Environment: Simulated warehouse setups with shelving, navigation aids, and environmental sensors.

9.5.9 Mining and Industrial Inspection

- Purpose: Test robots for monitoring, hazard detection, and equipment inspection in industrial or underground settings.
- Scenario: Robots equipped with thermal cameras, gas detectors, and LiDAR operate in low-light or hazardous zones.
- Environment: Simulated industrial terrains with visibility challenges and geospatial mapping support.

9.6 Unmanned Aerial Systems (UAS) Testing Service

9.6.1 Overview

The Unmanned Aerial Systems Testing Service provides startups and SMEs with access to secure, monitored environments for testing drone technologies. It supports both autonomous and remotely operated drones, including those operating Beyond Visual Line of Sight (BVLOS).

9.6.2 Service Design

9.6.2.1 Customer Responsibilities

- Drones and licensed pilots can be rented as part of the project plan
- Bring and operate their own drone(s)
- Provide any required licensing, insurance, or regulatory documentation
- Ensure drones meet basic safety and remote-shutdown capability requirements
- Comply with on-site safety training and facility guidelines

9.6.2.2 Facility Responsibilities

- Provide access, training, and support
- Assist with test planning and integration

9.6.2.3 Deliverables

- Pre-scheduled test environment access
- Technical setup support
- Co-developed test plans
- Data logging and export
- Final report support (created by SME)

9.6.3 Testing Types:

These are the core capabilities that SMEs can evaluate when testing drones at the Living Labs:

9.6.3.1 Mobility

- Assess how drones move in different environments (urban, rural, indoor, outdoor).
- Includes vertical takeoff, hovering, and maneuverability in tight or obstacle-rich spaces.

9.6.3.2 Sensing

- Validate onboard sensors such as:
    - Cameras (RGB, infrared, thermal)
    - LiDAR
    - Multispectral sensors
    - GNSS (GPS)
- Used for tasks like mapping, surveillance, crop analysis, and obstacle detection.

9.6.3.3 Navigation

- Test autonomous flight paths, route-following logic, and obstacle avoidance.
- Includes GNSS-based and vision-based navigation systems.

9.6.3.4 MANIPULATION

- Evaluate drones with payload handling capabilities:
  - Cargo drop systems
  - Package delivery mechanisms
  - Precision placement or retrieval

9.6.3.5 INTEGRATION

- Ensure drones work seamlessly with other systems:
  - Ground control stations
  - Edge/cloud data centers
  - Smart city infrastructure
  - Agricultural monitoring platforms

9.6.3.6 BEYOND VISUAL LINE OF SIGHT (BVLOS)

- Test long-range autonomous operations where the drone is not visible to the operator.
- Includes airspace coordination, regulatory compliance, and safety protocols.

9.6.4 Living Labs

The service is delivered through three main Living Labs, each offering unique capabilities:

9.6.4.1 FOCUS

- ***Smart Mobility and Smart Agriculture Living Lab, Area X.O:***
  - UAVs, smart mobility, public safety, cybersecurity, agriculture, CAVs, clean tech, and advanced robotics.
  - High-risk drone testing in controlled airspace.
- ***Smart Farming Living Lab, University of British Columbia (UBC) farms:***
  - Sustainable agriculture, agroecology, forestry, and food systems research.
  - Emphasis on organic certification and Indigenous knowledge systems
- ***Connected Robotics Living Lab, University of Waterloo's RoboHub:***
  - Robotics and drone research, autonomous systems, human-robot interaction.
  - Innovation in multi-drone coordination and BVLOS testing

9.6.4.2 FACILITIES AND ASSETS

- ***Smart Mobility and Smart Agriculture Living Lab, Area X.O:***
  - DARTT (Drone and Advanced Robotic Testing and Training) Facility.
  - 100-acre smart farm, smart city zone with 16 km of urban roadways.
  - Class C airspace (Ottawa) and Class G airspace (Killaloe).
  - Diverse terrain: gravel, sand, water, fields, sidewalks.
  - LoRaWAN, TVWS, GNSS stations, RTK GPS.

- ***Smart Farming Living Lab, University of British Columbia (UBC) farms:***
  - 24-hectare organic farm and forest ecosystem.
  - Cultivates over 200 varieties of fruits, vegetables, and herbs but blueberry, strawberry and apples available for testing .
  - Class C airspace over farm fields.
  - 5 hectares of agricultural fields and 15 hectares of forest.
  - High-resolution sensor networks for GHG, climate, and soil monitoring
- ***Connected Robotics Living Lab, University of Waterloo's RoboHub:***
  - Indoor facility with gantry, lighting, privacy glass, and positioning systems.
  - Outdoor test space at AVRIL building (Class G airspace).
  - RTK antennae, GNSS sensors, and rentable drones (e.g., QDrone, Clearpath Warthog)

9.6.4.3 Network Capabilities

- ***Smart Mobility and Smart Agriculture Living Lab, Area X.O:***
  - Private LTE/5G network (bands: LTE B7, B14; 5G n78, n77, n260, n261).
  - Nokia Digital Automation Center (NDAC)
- ***Smart Farming Living Lab, University of British Columbia (UBC) farms:***
  - Rogers 5G network (bands: n71, n12, n2, n66, n78).
  - LTE support and SIM card provisioning.
- ***Connected Robotics Living Lab, University of Waterloo's RoboHub:***
  - Rogers 5G (bands: n71, n41, n78, mmWave n261).
  - LTE support and WiGig (60 GHz)

9.6.4.4 Expert Support

- ***Smart Mobility and Smart Agriculture Living Lab, Area X.O:***
  - Consultation during project planning.
  - Support for network access and facility use.
  - Optional assistance in test plan development and reporting.
- ***Smart Farming Living Lab, University of British Columbia (UBC) farms:***
  - Access to UBC Centre for Sustainable Food Systems.
  - On-site technical support and consultation.
  - Drone flight approval required via UBC's planning portal.
- ***Connected Robotics Living Lab, University of Waterloo's RoboHub:***
  - Access to over 45 faculty experts.
  - Project onboarding and design validation consulting.
  - Support for UX, sensor calibration, and simulated environments

9.6.4.5 Available Assets

Asset Category	Area X.O	UBC Smart Farm	Waterloo RoboHub
IT Communications	LTE B7, B14; 5G n78, n77, n260, n261; NDAC; NDN	5G n71, LTE n12, n2, n66, n7; 5G n78; SIM cards, MiFi routers	LTE 700, AWS-1, 2600, 1900, 850; 5G n71, n41, n78, n261; WiGig
OT Communications	LoRaWAN, CloudGate, TVWS	Not available	WiGig (60 GHz)
Airspace	Class C (Ottawa), Class G (Killaloe)	Class C over farm fields	Class G over AVRIL parking lot
RTK GPS / GNSS	Novatel + RTCM V3; Swift RTK GPS & IMU x5	Not available	RTK antennae on AVRIL building; GNSS sensors on request
Drone Equipment	Drone testing supported; rentals possible	SMEs must bring their own drones	Drone and robot rentals from RoboHub fleet
Agricultural Fields	100 acres (configurable plots)	5 hectares farm + 15 hectares forest	Not applicable
Sensor Network	High-resolution sensors (GHG, climate, soil, weather)	Not available	Not available
Indoor Facilities	DARTT facility with varied terrain	Greenhouse and farm buildings	High-precision positioning, gantry, lighting, privacy glass
Data Storage	Azure cloud storage available	Not available	Not available

9.6.5 Use Cases

We list some representative examples, below, to illustrate the variety of use-cases supported by this service, depending on the facilities available at each Living Lab

9.6.5.1 Drone-Assisted Traffic Surveillance

- Purpose: Validate the use of drones equipped with perception devices for aerial traffic monitoring, incident detection, and obstruction identification.
- Why It Matters: Enhances traffic management by providing real-time visibility in congested or construction-affected areas, improving response times and public safety.
- Example: A client deploys drones with cameras and GNSS to monitor traffic at private intersections within the Living Lab. Data is transmitted via 4G/5G to a central hub or edge datacenter for analysis and actionable insights.

9.6.5.2 Autonomous Drone Testing for Smart Cities

- Purpose: Evaluate drone navigation and data-gathering capabilities in urban environments, especially for beyond-visual-line-of-sight (BVLOS) operations.

- Why It Matters: Supports smart city applications while ensuring regulatory compliance and public safety in complex urban settings.
- Example: A client tests a drone equipped with Lidar and infrared imaging across smart intersections, bike lanes, and suburban zones provided by Area X.O, using 5G connectivity for real-time communication.

9.6.5.3 Drones and Remote Sensing for Agriculture

- Purpose: Validate drones equipped with imaging and sensing technologies for agricultural monitoring, including crop health, irrigation planning, and yield forecasting.
- Why It Matters: Enables precision agriculture, improving resource efficiency and productivity.
- Example: A customer deploys multi-rotor drones with multispectral sensors over custom-prepared test plots at the Living Lab, integrating data with geospatial tools and soil moisture monitoring systems.

9.6.5.4 Delivery and Cargo Drop Systems

- Purpose: Test drones designed for last-mile delivery and logistics, focusing on payload handling, drop accuracy, and autonomous return-to-base functionality.
- Why It Matters: Supports scalable, efficient delivery solutions for urban and emergency logistics.
- Example: A client tests vertical takeoff drones with payload bays in a smart city testbed featuring sidewalks, ramps, and signage, using 5G and multi-camera systems to validate performance

9.6.5.5 Autonomous Navigation and BVLOS Testing

- Purpose: Validate drone systems operating autonomously or beyond visual line of sight using GNSS or vision-based navigation.
- Why It Matters: Critical for extended missions in remote or complex environments where manual control is impractical.
- Example: A customer tests BVLOS drones in Area X.O's classified airspace and fenced facilities, evaluating route-following logic and airspace coordination with and without wireless connectivity.

9.6.5.6 Swarming and Multi-Drone Coordination

- Purpose: Test coordinated drone operations for tasks like formation flying, distributed data collection, or synchronized performance.
- Why It Matters: Enables scalable drone applications in surveillance, monitoring, and entertainment through autonomous collaboration.
- Example: A client deploys multiple drones with swarm algorithms in open airspace and indoor facilities, using 4G/5G networks to validate synchronized control and shared task execution

9.7 Performance Benchmarking Service

9.7.1 Overview

CENGN's Performance Benchmarking Service helps SMEs test and optimize their applications under real-world conditions. It supports various deployment environments and testing scenarios, enabling SMEs to validate performance, scalability, and reliability without needing to build their own infrastructure.

9.7.2 Service Tiers

The Performance Benchmarking Service from CENGN is structured into three service tiers, each offering different levels of support and infrastructure access for SMEs testing their applications. Here's a clear explanation of each tier:

9.7.2.1 Basic Service Tier – Self-Directed Testing

Designed for SMEs with in-house expertise who need infrastructure access only.

- Includes:
  - Access to CENGN infrastructure (bare metal servers, VMs, or cloud platforms).
  - Documentation and knowledge base for setup and best practices.
  - Basic troubleshooting support (e.g., VM provisioning, network issues).
  - Weekly sync meetings and a final project report.
- Not Included:
  - Test plan development or execution.
  - Assistance with test tools or automation.
  - Performance analysis or custom software development.
- **Ideal for SMEs** who want to run their own tests independently.

9.7.2.2 Advanced Service Tier – Guided Testing with Expert Support

Designed for SMEs needing help with test planning and execution.

- Includes Everything in Basic Tier, plus:
  - Up to 10 hours of consulting support (test design, setup, execution).
  - Help with defining benchmarking objectives and selecting methodologies.
  - Infrastructure monitoring and support during testing.
  - Structured performance data presentation for SME analysis.
- Not Included:
  - Full end-to-end performance analysis (SMEs analyze results themselves).
  - Custom software development or ongoing advisory beyond the project scope.
- **Ideal for SMEs** looking for expert guidance to ensure meaningful and accurate benchmarking.

9.7.3 Testing Types

9.7.3.1 Load Testing

- Goal: Validate application performance under high user traffic.
- Example: An e-commerce SaaS company tests its app to handle 500,000 concurrent users during Black Friday
- Tools Used: JMeter, Kubernetes Horizontal Pod Autoscaling
- Metrics: Response times, error rates, CPU/memory usage

9.7.3.2 Stress Testing

- Goal: Push the system to its limits to identify breaking points.
- Example: A collaboration app simulates millions of real-time notifications.
- Tools Used: Locust, JMeter
- Metrics: API rate limits, database write speeds, error rates

9.7.3.3 Scalability Testing

- Goal: Ensure the system scales effectively with demand.
- Example: A video streaming company tests VM auto-scaling using ProxMox.
- Tools Used: Locust, ProxMox API.
- Metrics: Scaling speed, performance under burst loads.

9.7.3.4 Latency Testing

- Goal: Measure response times under various conditions.
- Example: A chatbot app must respond in under 500ms.
- Tools Used: JMeter, Wireshark, tc (traffic control).
- Metrics: API response time, network round-trip time, database query time.

9.7.3.5 Throughput Testing

- Goal: Validate data processing capacity over time.
- Example: An IoT traffic monitoring system simulates data from 100,000+ sensors.
- Tools Used: JMeter, Locust, Terraform.
- Metrics: Messages per hour, processing speed, system efficiency.

9.7.3.6 Resource Utilization Testing

- Goal: Optimize infrastructure usage and cost.
- Example: A SaaS company tests CPU, RAM, and disk usage across VM sizes.
- Tools Used: JMeter, Prometheus, Grafana.
- Metrics: CPU load, RAM consumption, disk I/O, bandwidth usage.

9.7.3.7 Endurance (Soak) Testing

- Goal: Validate long-term stability and reliability.
- Example: A transaction processing app is tested for 30 days of continuous operation.
- Tools Used: Locust.
- Metrics: Memory leaks, CPU usage, database performance over time.

9.7.3.8 Security Performance Testing

- Goal: Assess impact of security features on performance.
- Example: A startup tests its secure API gateway for latency and throughput.
- Tools Used: Open-source security test tools.
- Metrics: API response time under encryption, authentication, and rate limiting.

9.7.4 Infrastructure Deployment Options

CENGN offers three main infrastructure types for SMEs to run their benchmarking tests:

9.7.4.1 Bare Metal Servers

- Access: Full OS-level control via SSH; optional RDP/HTTPS
- Networking: Virtual Networking between VMs, Bare Metal and Internet
- Storage: Storage allocated by CENGN by project needs

9.7.4.2 Virtual Machines (VMs)

- Standard Sizes: Standard VM sizes available
- Access: OS-level control via SSH; optional RDP/HTTPS
- Networking: Virtual Networking between VMs and Internet
- Storage: Storage allocated by CENGN by project needs

9.7.5 Networking & Monitoring

- Secured with Zero Trust network access
- CENGN-recommended monitoring tools, or SME-provided tools may be supported

10 Living Labs Description

10.1 Connected Robotics Living Lab

- Location: **University of Waterloo's RoboHub**
- Focus: Robotics, autonomous systems, and human-robot interaction
- Key Features:
    - Indoor/outdoor testing spaces with advanced robotics infrastructure
    - Anechoic chamber, motion capture systems, and a fleet of robots

- 5G (SA/NSA), LTE, and WiGig connectivity
- Expert support from RoboHub and Rogers for integration and simulation

- Pricing
  - SMEs are strongly encouraged to **consult with Waterloo RoboHub** experts before testing to ensure their test plans are efficient and feasible within the limited time available at the facility.
  - Facility access is limited, especially for the RoboHub showcase, which is available only for short periods
  - Careful planning and preparation are essential to maximize productivity during the allocated time.

Service	Fees
Full day at your location with RoboHub experts	$5k-$10k per day
Half-day at your location with RoboHub experts	$2.5k-$5k per half-day
Full day on campus with RoboHub in-house experts	$2.5k-$5k per day
Half-day on campus with RoboHub in-house experts	$1k-$2.5k per half-day

10.2 Smart Farming Living Lab

- Location: **University of British Columbia (UBC) Farms**
- Focus: Agriculture, forestry, and environmental innovation
- Key Features:
  - Organic Farm fields and forest zones for sensor and equipment testing featuring blueberries, strawberries, apples, and forest zones
  - Agricultural machinery (tractors, drones) and high-resolution sensors
  - Rogers 5G and LTE network access
  - Support for organic certification and collaboration with UBC researchers
- Pricing
  - Pricing is determined by land usage type (e.g., shared vs. exclusive, invasive vs. non-invasive), technician time, and storage requirements—not by the selected service tier.
  - Project **pricing follows the UBC Farm Project Pricing Schedule**, which serves as the authoritative source.
  - The table below highlights the most commonly applied pricing elements.

Access / Service	Fees	Description
Admin and start-up fees, per location	$300-$500	For instance, conducting tests at both a field site and a forest site within the UBC Smart Farm is considered two separate locations.

Type 1: Shared, Non-invasive, low-impact, Recurring Facility (Land) Usage	$ 0.00 per m2 per season	Shared use of 'Type 1' areas—such as farm fields, unamended grasslands, or forested zones—is permitted for low-impact activities like sensor-based scanning or collecting small soil samples.
Type 2: Exclusive or Semi-exclusive unamended grass, forest, or brush.	$ 2.46 per m2 per season	Exclusive or semi-exclusive use of 'Type 2' areas—including unamended grasslands, forest, or brush—requires restoration of the site to its original condition upon project completion. The associated cost is $24,600 per hectare per season.
Type 3: Shared, Non-invasive Facility (Land) Usage	$ 3.07 per m2 per season	Shared use of 'Type 3' fields—those containing existing crops—is permitted for non-invasive robotic equipment testing, such as robotic weed removal. The crops are expected to remain viable for sale during the season. The associated cost is $30,700 per hectare per season."
Type 4: Exclusive or Semi-Exclusive, Invasive Facility (Land) Usage	$3.69 per m2 per season	Type 4' fields are specially planted for invasive robotic equipment testing. As the crop is not expected to be marketable during the testing season, the usage cost is $36,900 per hectare per season. Restoration of the site may be required after project completion.
Technician Labour	$79.72 per hour	Labour in direct support of a project, including consultation about aspects of a project
Onsite Storage Rental	$59.85 per day	8'x10' shed on site

10.3 5G Advanced Performance Living Lab

- Location: Bayview Yards, Ottawa (Powered by Ericsson)
- Focus: General-purpose 5G testing and innovation
- Key Features:
  - Indoor/outdoor spaces with access to multiple spectrum bands
  - Mobile Edge Computing (MEC) infrastructure
- Ideal for latency-sensitive applications like AR/VR and autonomous systems
- Pricing: There is no cost to the SME, as all expenses are covered under the Living Labs initiative.

10.4 Smart Mobility and Smart Agriculture Living Lab

- Location: Area X.O (Ottawa & Killaloe, ON)
- Focus: Autonomous vehicles, smart mobility, UAVs, cybersecurity, and agriculture
- Key Features:
    - 16 km of urban-configured roadways and 100-acre smart farm
    - Featuring broad-acre crops such as corn and soybeans, along with mixed horticulture including farmer's market-style vegetables and pumpkins. With sufficient lead time, additional crop types can be accommodated.
    - DARTT facility for drone and robotics testing
    - Class C and G airspace for BVLOS drone operations
    - Private LTE/5G, LoRaWAN, TVWS, and GNSS infrastructure
    - Expert support for simulation, data logging, and regulatory compliance
- Pricing
    - No fixed price list; preliminary quotes provided upon request

11 APPENDICES

11.1 APPENDIX 1 – ELIGIBLE COSTS: CENGN SRF PROGRAM COST PRINCIPLES FOR ULTIMATE RECIPIENTS

11.1.1 Eligible Costs

Eligible Costs incurred and paid by the Recipients are those, which are necessary to carry out the Project Activities as part of the CENGN SRF Program. These costs are generally non-recurring and incremental to the ordinary business activities of the Recipients.

Eligible Costs shall be reasonable, such that the nature and the amounts do not exceed what an ordinary prudent person would conduct in a similar business context and can be directly attributable to the completion of the Project Activities included in the Statement of Work. These costs must be determined in accordance with the Recipients' cost accounting practices as accepted by CENGN and applied consistently over time. The cost accounting system should clearly establish an audit trail that supports all costs claimed.

11.1.2 Affiliated Persons Clause

Affiliated Persons are to be understood and treated as defined in the Income Tax Act, which includes but is not limited to; two or more entities that have similar ownership personnel; or entities that have a working business relationship.

In the case of Eligible Costs for goods or services incurred and paid with an Affiliated Person, the amount of the costs incurred and paid must:

I. not exceed their Fair Market Value.

II. in the case of a good or service for which there is no Fair Market Value, the amount must not exceed the Fair Market Value of Similar Goods; or

III. in the case of a good or service for which there is neither a Fair Market Value nor Similar Goods, the amount must not exceed the sum of the applicable Direct Costs with Indirect Costs (Overhead) at the rate stipulated by this Agreement**,** plus five percent (5%) profit.

**Note: It is important for Recipients', from the outset, to self-identify any related parties or Affiliated Persons who will be contracted to provide goods or perform services for completion of Project Activities. For wholly owned subsidiaries of the Ultimate Recipient's completing Project Activities, its Eligible Supported Costs incurred and paid will be claimed by the Ultimate Recipient on their behalf and costs are to be treated as if the wholly owned subsidiary is one of the Recipients.*

11.1.3 Reporting Responsibility

It is the Ultimate Recipient's responsibility to provide financial records, costing methods, management estimates and legitimate business causes to support the claimed costs to the satisfaction of CENGN and ultimately the Minister.

11.1.4 Eligible Cost Activities

For the Ultimate Recipients, Eligible Costs will generally include expenditures related to the following activities:

I. Industrial research, including activities related to the discovery of new knowledge

II. that aim to support the development of new technology-driven products, processes

III. or services at early-stage technology readiness levels; and

IV. Large-scale technology demonstration, including the advancement and

V. development of new technologies into product-specific applications at mid-to-late

VI. stage technology readiness levels.

Eligible Projects should cover a broad range of TRLs to support the development and growth of innovation ecosystems through activities from research to commercialization.

11.1.5 Eligible Cost Categories

In performing the Project Activities included in the Statement of Work, Eligible Cost categories may include the following:

A. **Direct Labour**: meaning the portion of gross wages or salaries incurred and paid by the Recipients for eligible activities which can be specifically identified and measured as having been performed for the Project Activities and which is so identified and measured consistently by the Recipients' cost accounting system. The cost accounting system should sufficiently prove the hours worked by employees are directly related to the Project Activities.

B. **Subcontractors and Consultants**: meaning the costs of subcontracts or consultants incurred and paid for Project Activities are the costs for work or services performed by an external third party, which can be specifically identified and measured as having been incurred and paid for the Project Activities. The Recipients cannot be a Recipient and a Subcontractor or on the same Eligible Project.

The indirect cost (overhead) rate calculation for the Recipients does not apply to bona fide subcontractors and consultants.

** Option: In the case of Recipients with high Subcontractors and Consultants costs or low direct labour costs, indirect costs (overhead) thresholds calculated to a maximum of five percent (5%) on eligible Subcontractors and Consultants costs, but no more than eighteen percent (18%) of total Eligible Supported Costs may apply. Such thresholds would be calculated for each Recipient and each individual Eligible Project if more than one Eligible Project is selected for an Ultimate Recipient.*

C. **Direct Materials**: meaning the cost of materials which are incurred and paid and can be specifically identified and measured as having been processed, manufactured and used in the performance of the Project Activities, which are measured consistently by the Recipients' cost accounting system.

I. Materials purchased solely for the activities of the Project shall be at the net laid down cost to the Recipients, net of any sale taxes and after any discounts offered by the suppliers.

II. Materials issued from the Recipients' general stocks shall be measured in accordance with the material pricing method consistently used by the Recipients.

Direct Materials include, but are not limited to, items such as circuit boards, cables and metals, essentially any raw material that is "used up" by completing Project Activities.

D. **Equipment:** meaning the capital cost of equipment, which are incurred and paid and can be specifically identified as having been purchased for Project Activities and measured consistently by the Recipients' costing system. Significant equipment required to complete the Project Activities should be detailed in the Statement of Work. See below scenarios for clarification of costs related to equipment:

I. If a recipient has built the equipment themselves, the costs would be allocated to the appropriate cost categories (direct material, direct labour, etc.).

II. If a recipient has equipment built by a third party, the costs would be allocated to the equipment category if readily identifiable, otherwise the equipment could be reported in subcontractors and consultant's category; and

III. If a recipient outright purchases a piece of equipment, the costs would be allocated to the Equipment category.

Capital equipment acquired under the Agreement may be subject to CENGN's and the Minister's approval for disposal.

Equipment costs include but are not limited to, the purchase of equipment necessary for the Project activities, costs to alter or modernize the equipment, costs to get the equipment into working order, and shipping costs.

E. **Land, Building and Building Improvement**: meaning the capital cost of land, buildings or building improvement that are incurred and paid, and are necessary to carry out Project Activities and have been approved by CENGN and the Minister. Eligible building costs may include the acquisition costs, construction of new or the expansion of existing facilities, the development of testing facilities, investments in modern buildings, building and land leases (the incremental cost of leasing land during the work phase of the Project Activities), and permanent building improvement. See below scenarios for clarification of costs related to buildings:

I. If a recipient has built the facility themselves, the costs would be allocated to

II. the appropriate cost categories (Direct Material, Direct Labour, etc.);

III. If a recipient has a facility built by a third party, the costs would be allocated to

IV. the subcontractors and consultant category; and

V. If a recipient outright purchases an already existing building, the costs would

VI. be allocated to the building category.

F. **Other Direct Costs**: meaning those eligible direct costs, not falling within the categories of direct cost mentioned above, but which are incurred and paid, and can be specifically identified and measured as having been incurred and paid by the Recipients for the activities of the Project and which are so identified and measured consistently by the Recipients' costing system.

G. **Travel and Outreach Costs**: meaning those eligible direct costs incurred and paid by the Recipient that are directly related to Project Activities. Travel expenses shall be appropriate, economical, reasonable and available to most of the employees of the Recipients. Travel costs can be claimed, to the maximum allowance, as per the conditions in the national joint council directive or treasury board policies.

A copy of the Recipients' travel policy may be required for review by CENGN during the claim process.

11.1.6 Indirect Costs (Overhead)

Indirect costs (overhead) are those costs which, though necessarily having been incurred and paid by the Recipients for the conduct of the business in general, cannot be identified and measured as directly applicable to the carrying out of Project Activities included in the Statement of Work.

Indirect costs (overhead) include, but are not limited to:

A. **Indirect materials and supplies** including but not limited to, supplies of low-value, high-usage and consumable items, such as paintbrushes and safety supplies, which meet the definition of direct material costs but for which it is commercially unreasonable, in the context of the activities of the Project, to account for their costs in the manner prescribed for direct costs. Costs such as stationery, office supplies, postage and other necessary administration and management expenses, small tools, such as ladders, drills, paint sprayer, and general inventory build-up;

B. **Indirect labour, Project management, and administrative support,** including but not limited to the remuneration of executive and corporate officers, general office wages and salaries, clerical expenses, HR, accounting/finance staff, overtime premiums, bonuses, all types of benefits paid by employer, for example, CPP, EI, fringe benefits, medical benefits, dental benefits, pension benefits and other taxable benefits.

Administration costs spent on the following activities is considered an indirect cost:

I. review and approval of documents,

II. oversight,

III. quality review,

IV. strategic guidance,

V. participation in all-staff meetings,

VI. professional development,

VII. performance reviews and any costs associated with interactions with government including application,

VIII. claims,

IX. amendment, and

X. audit and reporting communications.

Notwithstanding the above, indirect costs (overhead) will not include those direct labour costs described in Section 5. A. of Schedule 2 – **CENGN SRF Program Cost Principles for Ultimate Recipients**.

A. Indirect building costs including, but not limited to, snowplowing costs, public utilities expenses of a general nature including but not limited to, power, HVAC, lighting, and the operation and maintenance of general assets and facilities;

B. Expenses such as property taxes, rentals of equipment and building (not covered as part of direct costs) and depreciation costs;

C. Indirect equipment costs including, but not limited to, maintenance cost of assets, office equipment, office furniture, etc.; and

D. Other indirect costs including, but not limited to, daily commutes, unreasonable modes of transportation, general software and licenses, and travel insurance.

Indirect costs (overhead) thresholds of fifty-five percent (55%) on eligible Direct Labour but no more than eighteen percent (18%) of total Eligible Supported Costs will apply for each Recipients (and for each individual Eligible Project if more than one Eligible Project is selected for an Ultimate Recipient).

** In the case of Recipients with high Subcontractors and Consultants costs or low direct labour costs: indirect costs (overhead) thresholds calculated to a maximum of five percent (5%) on eligible Subcontractors and Consultants costs, but no more than eighteen percent (18%) of total Eligible Supported Costs may apply. Such thresholds would be calculated for each of the Recipients and each individual Eligible Project if more than one Eligible Project is selected for an Ultimate Recipient).*

11.1.7 Ineligible Costs

Ineligible Costs incurred and paid by the Recipients are not eligible for SRF Contribution, regardless of whether they are reasonably and properly incurred and paid in the carrying out of the Network Activities.

Ineligible Costs includes:

I. any form of interest paid or payable on invested capital, bonds, debentures, bank or other loans together with related bond discounts and finance charges; the interest portion of the lease cost that is attributable to cost of borrowing regardless of types of lease;

II. legal, accounting and consulting fees in connection with financial reorganization (including the set-up of new not-for-profit organizations), security issues, capital stock issues, obtaining of licenses, establishment and management of agreements with Ultimate Recipients and prosecution of claims against the Minister. Such legal costs associated with developing the agreement template and in connection with obtaining patents or other statutory protection for Project intellectual property are considered eligible;

III. losses on investments, bad debts and expenses for the collection charges;

IV. losses on other projects or contracts;

V. federal and provincial income taxes, goods and services taxes, value added taxes, excess profit taxes or surtaxes and/or special expenses in connection with those taxes, except duty taxes paid for importing is Eligible Cost;

VI. provisions for contingencies;

VII. premiums for life insurance on the lives of officers and/or directors where proceeds accrue to the Recipient;

VIII. amortization of unrealized appreciation of assets;

IX. depreciation of assets paid for by CENGN and the Minister;

X. fines and penalties;

XI. expenses and depreciation of excess facilities;

XII. unreasonable compensation for officers and employees;

XIII. product development or improvement expenses not associated with the work being performed under the Project;

XIV. advertising, except reasonable advertising of an industrial or institutional character placed in trade, technical or professional journals for the dissemination of information for the industry or institution;

XV. entertainment expenses (including, but not limited to, alcohol, non-travel expenses);

XVI. donations;

XVII. dues and other memberships other than regular trade and professional associations;

XVIII. extraordinary or abnormal fees for professional advice in regard to technical, administrative or accounting matters, unless approval from CENGN and the Minister is obtained;

XIX. selling and marketing expenses associated with the products or services or both being developed under the Agreement.

XX. in-kind costs; and

XXI. recruiting fees, unless approval from the Minister is obtained.

11.1.8 Departmental Collaboration with Recipients

Recipients may seek to collaborate with federal departments and agencies. This may occur to leverage capacity across sectors, transfer knowledge, and further shared objectives. The following criteria must be met for costs to be reimbursed by CENGN under the SRF Program:

I. A fee is charged by the federal department providing the service, and a payment is made by the Recipient for the service rendered.

II. The transaction for the service is recorded and identifiable.

III. The same service must be available to everyone for the same fee charged (i.e. the same cost for the same level of service).

IV. The service must not be anti-competitive:

   a. It must not provide an unfair competitive advantage.
   b. It must not discourage competition.

V. The recipient is not obligated to use the service; and

VI. The service provided must meet the definition of Eligible Costs and comply with the Eligible Costs categories.

11.2 Appendix 2 – Adoption Project Letter of Intent template

The editable Adoption Project template is accessible through the CENGN Portal. Applicants may download the template after creating an account, prior to initiating a formal application

11.2.1 Detailed Summary: Letter of Intent (LOI) – CENGN Living Lab Adoption Project

The Letter of Intent (LOI) formalizes a proposed collaboration between a SME and an adopter organization to support the development, testing, and commercialization of an innovative product within the CENGN Living Lab framework. While non-binding, the LOI outlines the shared goals, roles, and responsibilities of both parties in the SME project, which aims to validate and scale a custom technology solution in a real-world environment.

11.2.1.1 Purpose

- To demonstrate market interest and commercial potential for SME's product as part of its application to the Strategic Resource Fund (SRF).
- To define the scope of collaboration between SME and Adopter in refining and validating the product.
- To support Canadian innovation and the adoption of advanced networking technologies through CENGN's Living Labs.

11.2.1.2 Roles & Responsibilities

Technology Provider (SME):

- Leads the project, including planning, coordination, and securing SRF funding.
- Sets up and maintains the beta product infrastructure at the Living Lab.
- Conducts testing, collects data, and analyzes results.
- Prepares case studies and reports for CENGN and SRF evaluation.
- Participates in project retrospectives and provides updates to stakeholders.

Adopter Organization:

- Participates in project planning and provides feedback on product features.
- Supplies sample data for testing under simulated real-world conditions.
- Assesses product performance and suggests improvements.
- Supports XYZ's funding claims and contributes to case study development.
- May enter agreements for access to Living Lab facilities if needed.

11.2.1.3 Confidentiality & Feedback

- Confidential information shared during the project is protected under the LOI.
- Feedback provided by either party may be used to improve the other's technology or products, without obligation or compensation, provided it does not infringe on intellectual property rights.

11.2.1.4 Costs

- Each party is responsible for its own costs related to the project.

11.2.1.5 Legal Status

- The LOI is **not legally binding**, except for confidentiality and feedback provisions.
- A formal agreement may be developed later if both parties agree to proceed.

11.3 Appendix 3 – Technology Readiness Levels (TRL)

Technology Readiness Levels (TRL) is a measurement system that has been developed to assess the maturity level of a particular technology. There are nine Technology Readiness Levels (TRL), with TRL 1 being the least ready for commercialization and TRL 9 being ready to be used in real-life conditions.

Level 1: Basic principles of concept are observed and reported

Scientific research begins to be translated into applied research and development. Activities might include paper studies of a technology's basic properties.

Level 2: Technology concept and/or application formulated

Invention begins. Once basic principles are observed, practical applications can be invented. Activities are limited to analytic studies.

Level 3: Analytical and experimental critical function and/or proof of concept

Active research and development is initiated. This includes analytical studies and/or laboratory studies. Activities might include components that are not yet integrated or representative.

Level 4: Component and/or validation in a laboratory environment

Basic technological components are integrated to establish that they will work together. Activities include integration of "ad hoc" hardware in the laboratory.

Level 5: Component and/or validation in a simulated environment

The basic technological components are integrated for testing in a simulated environment. Activities include laboratory integration of components.

Level 6: System/subsystem model or prototype demonstration in a simulated environment

A model or prototype that represents a near desired configuration. Activities include testing in a simulated operational environment or laboratory.

Level 7: Prototype ready for demonstration in an appropriate operational environment

Prototype at planned operational level and is ready for demonstration in an operational environment. Activities include prototype field testing.

Level 8: Actual technology completed and qualified through tests and demonstrations

Technology has been proven to work in its final form and under expected conditions. Activities include developmental testing and evaluation of whether it will meet operational requirements.

Level 9: Actual technology proven through successful deployment in an operational setting

Actual application of the technology in its final form and under real-life conditions, such as those encountered in operational tests and evaluations. Activities include using the innovation under operational conditions.

11.4 Appendix 3 – Important Links

- Living Lab
  - CENGN Living Lab Initiative
  - Smart Agriculture Living Lab powered by UBC Farm
  - Smart Mobility and Smart Agriculture Living Lab Powered by Area X.O
  - 5G Advanced Performance Living Lab Page
  - Connected Robotics Living Lab
- Other Living Lab Pages
  - Sectors
  - Call for Proposals
- Services
  - Main Services Page
  - Certification/IP Services
  - Application Layer
  - Model Layer
  - Data Layer
  - Physical Layer
  - Validation