INATrace Technical Guide

- This technical guide provides **a comprehensive overview of INATrace**, an advanced, open-source, multi-tenant web application tailored for supply chain traceability.

- The guide is designed to help **technical teams, hosting providers, and potential implementers** understand the infrastructure, deployment requirements, and essential technical skills needed to operate INATrace effectively.

- By consolidating **detailed technical specifications** and **practical recommendations**, this guide serves as a valuable resource for ensuring successful adoption and management of INATrace in the field.

General overview

INATrace is a complex, multi-tenant and open-source web application developed using a micro-service-based architecture. Before diving into how deployment and management of the technology can be transferred in the field and which options are available, it is mandatory to provide some general high-level comments.

1. **A web application is a software that is accessed via a web browser**, such as Google Chrome or Firefox, but is hosted by a third party on a server connected to the Internet. A web application can perform various tasks, such as sending and receiving emails, playing games, shopping online, or editing documents. Unlike traditional applications that need to be installed on your computer or device, web applications can be used from anywhere with an internet connection. Only the server side (where the application actually runs) requires installation and deployment of various components (database, web server, etc.).

2. **The scale and complexity of a web application is very different from that of a web site**. A web site is a collection of pages whose content is moderately interactive and dynamic, while a web application requires more computational power and specific resources due to the dynamic nature of users' data and actions. A hosting service for a website is usually not sufficient for a web application even if the required skills are comparable.

Infrastructure

INATrace instances can be deployed by any hosting or cloud provider that satisfies the minimal functional requirements. In particular, the provider must make the following available:

- Kubernetes cluster
- MySQL Database
- File storage
- For the technical details, see **Fehler! Verweisquelle konnte nicht gefunden werden.**

The hosting or cloud provider must also allow for the usage of internal and external services, such as:

- E-Mail service
- Exchange Rates API (https://exchangeratesapi.io/)
- Google Maps

Each instance should be related to its specific domain (e.g. inatrace.rw; inatrace.hn), which must be registered, owned, managed, and paid for by the owner of the system.

Resources breakdown

Service	Characteristics
MySQL 8 managed service	3 CPU, 24 GB RAM, 150 GB storage
Cloud Access Virtual Machine	1 CPU, 1 GB RAM, no storage
Computational Node number 1 for Kubernetes	2 CPU, 8 GB RAM, no storage
Computational Node number 2 for Kubernetes	2 CPU, 8 GB RAM, no storage
File storage	Block storage attached as volumes to a computational node
Oracle Container Service	Stores the Docker images of the services to be deployed on the Kubernetes cluster

Costs mainly depend on the price offers from the chosen hosting/cloud provider, and, more marginally, on possible adjustments and dimensioning (e.g. decrease or increase of the needed resources, depending on the expected volume of data and transactions).

Technologies

The technologies used within INATrace are:

- Java with Spring Boot, as the language and stack for the backend
- Javascript with Angular version 10, as the main language and framework for the frontend
- MySQL version 8 is the database management system. From the available information [Liquibase](#) is used for automatic database migrations.
- Docker and Kubernetes are used to prepare the code for deployment and as the orchestrator of the deployments.

Required skills

Any third-party company interested in deploying an INATrace instance would require specific expertise in the following fields:

- **Web application design and development**. A web application is a complex organism. At least one person of the team must have 5+ years of seniority as software architect in the field of web application. The person should have participated to the development of a multi-language and cross-border web application. Experiences with value-chains connected to product selling is appreciated, but not mandatory.

- **Java**. At least one person must have 3+ years of experience in creating backends and APIs with Java programming language. A minimum of 2+ years of experience with Spring (a Java based framework for web applications) and Apache Tomcat or Jetty application server is required.

- **Angular (Javascript)**. The frontend of the web application is written using Angular version 10. At least one person must have 4+ years in writing highly dynamic user interfaces using Javascript (or Typescript) and frameworks like Angular, React or Vue. Vertical experience of 1+ years on Angular should be favored altough online courses can bridge the gap. The exact version (Angular 10) is not a mandatory requirement. Experiences with multi-language application development is highly appreciated

- **User interface and experience design**. All web applications have a user interface. Having a dedicated experience designer is not required as professionals or local agencies can be contacted on-demand (especially when planning to introduce new features or big changes). If the company has a user experience and interface designer this can be considered as a plus to quickly solve challenges. That person should have 1+ years of experience and be open to explore and accept suggestions to/from others.

- **Database management**, focused on MySQL. Database management is crucial for INATrace as it is the ground truth for all operations. At least one person must have 5+ years of experience in designing and operate medium-large scale databases. Specific knowlegde of MySQL version 8 is appreciated, but not required. Knowledge of tools like Liquibase for handling database schema changes should be favored.

- **DevOps using Linux based operating systems, Docker and Kubernetes**. Releases and deployments are managed using Docker and Kubernetes. The company should have a person with 4+ years of server and infrastructure management based on Linux operating systems (e.g. How to provision a server, how to configure access using SSH in a secure manner, how to protect data in a safe manner, how to perform backups and disaster recovery), 2+ years of experience with Docker images and containers and 2+ years of experience with Kubernetes cluster management and deployment. Kubernetes is a relative new technology that someone might not use as there are plenty of alternative options; so, in the case of lacking Kubernetes knowledge 3+ years of deployment using containerized infrastructure on virtual private servers or virtual machine can be acceptable. The suggestion is that the person will take a course on Kubernetes specific points to bridge the gap.

- **Git**, all team members must use Git version control on a daily basis since 2+ years. The specific platform (either GitHub or Gitlab) is not important as managing code using version control is cross platform.

In addition to those technical skills, the following is also necessary for the integration of value chains:

- Process analysis and modelling knowledge
- Deep understanding of the chosen value chain(s), in their local context

Finally, in order to sustain the open-source nature of INATrace, the following skills and attitude would also be necessary:

- Git and other versioning systems
- Willingness and commitment to "develop in the open" (issues and pull requests on the GitHub repository, frequent commits to GitHub, frequent release, etc.)
- Willingness and ability to contribute to an open-source project (evaluate and accept external requests, engage openly with external developers and users, etc.)

Assessment for local companies

Here below, we suggest a list of questions to evaluate IT companies that would be interested to provide services on/around INATrace. Each question is accompanied by a short explanation of the question's rationale.

Technical assessment

- Do you follow, or are you inspired by Agile approaches and practices? (e.g. Kanban, Scrum,...)

    o Those are software development methods indicating appropriate mindset, skillset, and processes for managing flexible and changing requirements

- How many employees do you have? What are the roles?

    o Here the rationale is to assess the number of person and who can provide support. A single person company cannot be excluded by definition, but the risk of not being able to handle support requests and technical challenges increases as the number of employee decrease. Having dedicated teams or person to software development, support and maintenance makes clearer who to contact in case of problems and the reactivity

    o Also, the broad number of skills necessary to run / maintain INATrace is unlikely to be provided by one single person

- What technologies and/or specific frameworks are you using daily?

    o Answers may vary but could be names of programming languages or names of specific frameworks and library. The expected list should contain Java, JavaScript, Angular, Docker and Kubernetes

- Did you develop specific integrations between existing services?

    o Here we want to assess what custom activities they did to integrate various third-party services, like Google Maps or a mapping library, third party APIs

- After presenting the technology stack used by INATrace and if during the previous answer there was a name not mentioned, e.g. Java. Would you be open to learn the

technology? What would you do to learn this technology and get a sufficient level of expertise (which kind of training, etc.)?

- o This gives a glimpse of how they exit from their comfort zone

- Are you creating web applications for your clients?

    - o What technological stack are you using?

    - o Where do you host the web application you produce? (self-hosting, or outsourcing to another company?)

    - o We need to distinguish pure websites and web applications. If they mention Wordpress or Drupal or other Content Management Systems, ask to see what features they provide and how they host them, if they developed everything from scratch or are using plugins. In most cases those are not web applications, but websites with a bit of interactivity provided by plugins. The goal here is to understand whether they have the expertise to handle a "real" and complex web application.

- What kind of experience do you have with Linux operating systems? Are you managing servers with Linux operating systems?

    - o A basic skill on Linux operating system is required as this is the baseline for some commands in the current INATrace stack

- Can you describe your experience in using Git for version control?

- Have you ever contributed to open-source projects? Can you point us to some of your contributions?

- Do you have experience with Docker?

    - o Docker is a tool to obtain reproducible artifacts to simplify the deployment. It is the basis of processes required by Kubernetes, so knowledge about it is required

- Do you use Kubernetes to deploy applications for your clients? If yes, do you manage it yourself or do you use a managed service offered by a provider

    - o The current INATrace infrastructure seems heavily based on it, so some knowledge is absolutely required. Alternatively, knowledge transfer and capacity development should be taken into account.

- Are you using a cloud provider (e.g. Amazon AWS, Azure, Google Cloud Platform, Oracle Cloud)? If yes which one? How many years of experience do you have with that provider?

    - o Could you give us an estimation of monthly costs to host: 1 Kubernetes cluster with 2 nodes with 8GB, a MySQL managed database with 24GB of RAM and 150 GB of disk space

- Are you using a local, in country, hosting provider? If yes, who is and what services it offers?

- o If they use a local provider this can have a positive impact and should be investigated more.
  - What services are offered by the provider?
  - What are you hosting/renting on that provider?
    - Do you know if they provide comparable services to Managed Kubernetes cluster, Managed Database and storage? → In case they don't know having the name and url of the provider can be helpful to perform a double check. If they don't provide such services is a sign that the provider is not suitable for further investigation
  - What is the minimum bandwidth guarantee?
  - What storage services are offered?
  - What are the hosting costs?

- Do you have experiences in infrastructure migration from different providers?

- Do you know how to configure DNS and network related infrastructure for serving a web application hosted on a server?

Depending on the evolution and roadmap, additional technical skills might be added to this list. For example, current discussions tend to envision a support for geospatial data (for farm management and deforestation monitoring), which would increase the portfolio of needed expertise and skills.

Procedural assessment

NB: if the following requirements are not met by the IT service provider, it could be sufficient to involve an external specialist in this field. However, ensuring a very close cooperation between them ("ensure that they fully understand each other") will be key to a successful implementation.

- What experience and expertise do you have in process analysis and mapping?
- What is your experience, knowledge and expertise in relation with the value chain(s) to be included into the INATrace instance?

With the expected growing number of users and use cases, the value chains will become more varied and more complex. Therefore, all the activities related to process analysis and mapping, as well as the interactions with the users (training, support, collection of feedback, etc.) are expected to increase.