Tailored IoT & BigData Sandboxes and Testbeds for Smart, Autonomous and Personalized Services in the European Finance and Insurance Services Ecosystem

D6.2-Testbeds Status and Upgrades – II

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1.0	2021-05-10	CP	First Version for Internal Review
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2.1	2021-05-23	CP,INNOV	Quality Review
3.0	2021-05-31	CP	Version for Submission

Executive Summary

The goal of task T6.1 “Testbeds Analysis, Customization and Continuous Upgrade” is to describe the analysis of existing testbeds (i.e., testbeds of incumbent organizations) in terms of their current resources and gaps for supporting BigData, IoT, AI experimentation in-line with the INFINITECH approach. It will accordingly specify the ways they have to be extended in terms of hardware and/or software resources.

This is the second version of the deliverable of the three versions which are meant to provide the outcomes of task T6.1, intending to report updated information available since the initial specifications that were reported in the first version D6.1.

In particular, the deliverable contains:

- An updated analysis of Testbeds infrastructure that each Pilot will use for Pilot development and the relative Sandboxes that will be hosted, as well as a reporting of the mapping of each Testbed to the Reference (Blueprint) Testbed already deployed, serving as guidance for all Pilots to follow the “INFINITECH way” of development.
- Proposed extensions or upgrade actions or methodology of the testbeds infrastructure that will be required to be implemented in order to support the development of BigData, IoT and AI-based innovations and support the basic guidelines for Testbeds and Sandboxes deployment, based on the feedback and specs already described as part of the WP6 deliverables.

The work related to task T6.1 will continue until Month 30, where the last version that will be submitted as Testbeds will be upgraded dynamically in order to fulfil the INFINITECH project and the relevant pilots’ Testbeds & Sandboxes needs.

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Abbreviations

3DS	Three-Domain Secure
4MLD	Fourth Money Laundering Directive
API	Application Programming Interface
AWS	Amazon Web Services
BDVA	Big Data Value Association
CI/CD	Continuous Integration/Continuous Development
CPU	Central Processing Unit
DB	Database
DDR	Double data rate,
DEV	Development
DL	Deep Learning
ESG	Environmental, Social, and Governance
ETF	Exchange-Traded Fund
GDPR	General Data Protection Regulation
gPRC	High-performance, open source universal RPC framework
GRIB2	Second version of the World Meterological Organization's (WMO) standard for distributing gridded data
HTTP	Hypertext Transfer Protocol
HTTP	Hypertext Transfer Protocol
IAM	Identity and Access Management
IoT	Internet of Things
JWT	JSON Web Token
KYB	Know Your Business
KYC	Know Your Customer
MiFID	Markets in Financial Instruments Directive
MiFIR	Markets in Financial Instruments and Amending Regulation
ML	Machine Learning
MPI	Message Passing Interface
NDA	Non-Disclosure Agreement
NETCDF4	Network Common Data Form
NIS	Network and Information Systems
OCR	Optical Character Recognition
OES	Operators of Essential Services
OKD	Distribution of Kubernetes optimized for continuous application development and multi-tenant deployment
P2PP	Peer-to-Peer Payment
PaaS	Platform as a Service
PAN	Primary Account Number
PCI DSS	Payment Card Industry Data Security Standard
PDF	Portable Document Format
PHP	Popular general-purpose scripting language (Hypertext Pre-processor)
PIA	Privacy Impact Assessment
POC	Proof of Concept

PSD2	Payment Service Directive 2
PSP	Payment Service Provider
PSU	Payment Service User
QTSP	Qualified Trust Service Provider
RA	Reference Architecture
RAM	Random Access Memory
REST	Representational state transfer
RTS	Regulatory Technical Standard
SA	Supervisory Authority
SCA	Strong Customer Authentication
SECaaS	Security-as-a-Service
SFTP	Secure File Transfer Protocol
SHARP	Smart, Holistic, Autonomy, Personalized and Regulatory Compliance
SIT	System Integration Test
SME	Small and Medium-Sized Enterprises
SSD	Solid State Disk
TBD	To be defined
TI	Threat Intelligence
TOTP	Time-Based One-Time Password
UAT	User Acceptance Test
VCPU	Virtual CPU
VDIH	Virtualized Digital Innovation Hub
WRF-ARW	Weather Research and Forecasting (WRF) - ARW (Advanced Research WRF)
WRFDA	Weather Research and Forecasting (WRF) model data assimilation system (WRFDA)
XML	Extensible Markup Language
YAML	YAML Ain't Markup Language

1 Introduction

Task 6.1 provides the initial Specification for hardware & software, as well as any additional security or special requirements of the existing or planned to be built testbeds for hosting the Pilots' executions in terms of their existing resources and gaps for supporting BigData, IoT, AI experimentation in-line with the INFINITECH approach.

This deliverable intends to provide updated details that each testbed will use in order to support the Pilots' execution, utilizing the current Specification for the 10+2 Testbeds, that will be deployed as part of the INFINITECH Project.

Finance organizations (incumbent banks and Fintech companies) of the consortium will host the 10 Testbeds and one shared Testbed will host FinTech/InsuranceTech pilots. Also, one more Reference (Blueprint) Testbed is already deployed, which provides through the actual realization (with a full compliance) of the INFINITECH RA Development and Deployment views, the main deployment guidelines to be followed from all Pilots' Testbeds and Sandboxes deployment.

The project's results will be validated in the scope of 15 high impact pilots providing complete coverage of the sectors, including Know Your Customer (KYC), customer analytics, personalized portfolio management, credit risk assessment, preventive financial crime analysis, fraud anticipation, usage-based insurance, agro-insurance and more.

With respect to previous deliverable D6.1, this deliverable includes the following additional information and contributions:

- An updated analysis about the Testbeds Infrastructure and deployment that will be used from all INFINITECH Pilots in section 3
- A mapping of each Testbed to the Reference (Blueprint) Testbed already deployed, serving as guidance for all Pilots to follow the "INFINITECH way" of development in section 4.
- Proposed extensions or upgrade actions, as well as the methodology that will be followed in order all the Pilot's Testbeds infrastructure to be compliant with the Reference (Blueprint) Testbed Guidelines in Section 5.

1.1 Objective of the Deliverable

This deliverable contains a report for readiness and compliance of the relative infrastructure (hardware & software) deployments of each pilot, compared to the Reference (Blueprint) Testbed already described and deployed by the Consortium. The deliverable contains the as-is current deployment for each pilot of the ten (10) testbeds hosted from Finance organizations (incumbent banks and Fintech companies) of the consortium and also the one shared Testbed that will host five (5) FinTech/InsuranceTech pilots, that will be implemented as part of the INFINITECH. Moreover, it includes specifications of the planned actions or modifications that will be performed to match the guidelines of the Reference (Blueprint) Testbed from each Pilot are included, as well as reports regarding any required upgrades. If a full match is not possible, the detailed motivation and proposed alternative solution that each Pilot will follow is also a part of this deliverable.

1.2 Insights from other Tasks and Deliverables

The deliverable D6.2 is the second one that is released for task T6.1, so it contains the updates of the initial analysis for the current status of the infrastructure (hardware & software) that will be used for all testbeds to host the Pilots of the INFINITECH Project. Based on this description, other deliverables of WP6 will be conducted by implementing the same versioning process for future deliverables. In more detail, Tasks T6.2 and T6.3 will provide an updated deliverable D6.5 Tools and Techniques for Tailored Sandboxes and Management of Datasets-II, to be used by all testbeds. Tasks T6.4 and T6.5, considering that they already provided the updated specifications for all Testbeds and Sandboxes from either incumbent or FinTech/InsuranceTech Pilots, will put in place (in the field testbed and sandboxes) the tools and mechanisms defined in tasks T6.2 and T6.3, and will also provide the necessary updates for Sandboxes deployment of the respective Pilots, as part of the new versions of the relative deliverables D6.7 and D6.10. Task 6.6 will specify and implement processes for certifying and standardizing digital finance/insurance solutions in the project's tailored sandboxes and testbeds. The following diagram (Figure 1) depicts the interconnections between WP6 Tasks:

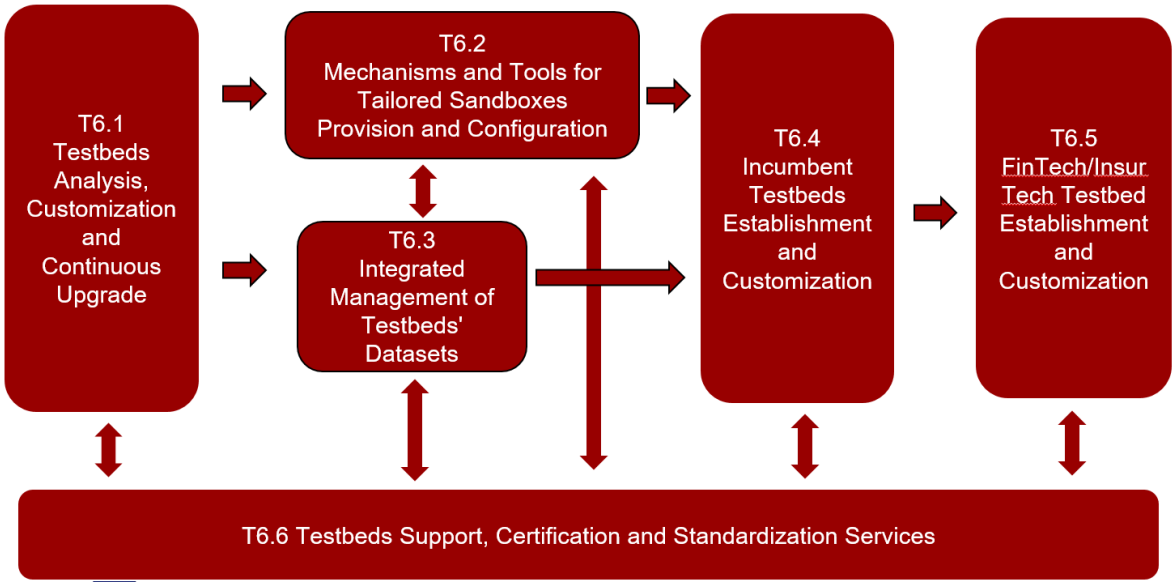

Figure 1 – Schema of the links among Tasks of WP6

1.3 Structure

This deliverable is composed of five main sections. Chapter 1 is the introduction to the deliverable and includes the description of the objective, insights from other tasks and deliverables, as well as this deliverable's structure. Chapter 2 describes the methodology followed for the collection of the relative information from all INFINITECH Partners participating in the deliverable. Chapter 3 contains a short review analysis and deployment scenarios for all the Testbeds that will be deployed in the scope of the INFINITECH project. Chapter 4 describes the Testbeds & Sandboxes implementation readiness compared to the Reference (Blueprint) Testbed specifications, with the relative planned actions for upgrades or migration described in Chapter 5. Finally, Chapter 6 concludes the document.

2 Methodology

The major sources of insights for deliverable D6.2 and more specifically for Chapters 4 and 5 are the INFINITECH Pilots and their contributions based on a specific questionnaire that was distributed for collection of the relative information, regarding the readiness of their Testbeds and Sandboxes deployment compared to the Reference (Blueprint) Testbed and the planned actions or alternative solutions in case of no compliance possible. The answers to the questionnaire are included in Chapter 4 and were mainly based on the contents from other deliverables of WP2 and WP6:

- D2.18 - User Stories and Stakeholders' Requirements – II - Confidential
- D2.19 - Reference Scenarios and Use Cases – II - Confidential
- D2.6- Specifications of INFINITECH Technologies - II
- D2.21 Security and Regulatory Compliance Specifications – II - Confidential
- D2.23 Initial Specification of Testbeds, Data Assets and APIs – II – Confidential
- D6.4 - Tools and Techniques for Tailored Sandboxes and Management of Datasets - I
- D6.7 - Sandboxes in Incumbent Testbeds - I
- D6.10 - Sandboxes for FinTech/InsuranceTech Innovators – I
- Blueprint guidelines for the INFINITECH way deployments of project pilots and technologies

The results of those contributions are explained in the following sections.

3 Testbeds & Sandboxes Infrastructure

3.1 Introduction

The INFINITECH Tailored Sandboxes and Testbeds will make available a number of **testbeds** for experimentation, testing and validation of BigData, AI and IoT solutions.

Based on the progress of the INFINITECH project and according to the relative plan from all the pilots' partners, there will be deployed:

(i) Ten (10) testbeds that will be established in incumbent financial organizations of the consortium based on Cloud services or on-premise deployment.

(ii) One (1) shared testbed that will be established and made available to Financial/FinTech/InsurTech enterprises of the consortium for their pilots, hosted on the partner NOVA's Data Center.

(iii) One (1) testbed that will be provisioned and established in order to support the experimentation of the INFINITECH Reference (Blueprint) Testbed Guidelines, hosted on the AWS (Amazon Web Services), built upon the requirements of one or more of the INFINITECH pilots.

The set of hardware resources like storage, compute and network is considered as a testbed, as shown in Figure 2.

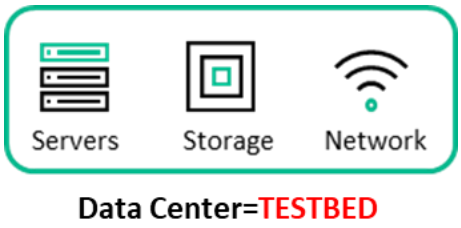

Figure 2 - Testbed

The resources can either be deployed inside a private Data Centre or in any cloud provider.

Therefore, the 15 pilots that have been foreseen will be executed in 10+2 testbeds, in addition to the Reference (Blueprint) Testbed, as shown in Figure 3 below:

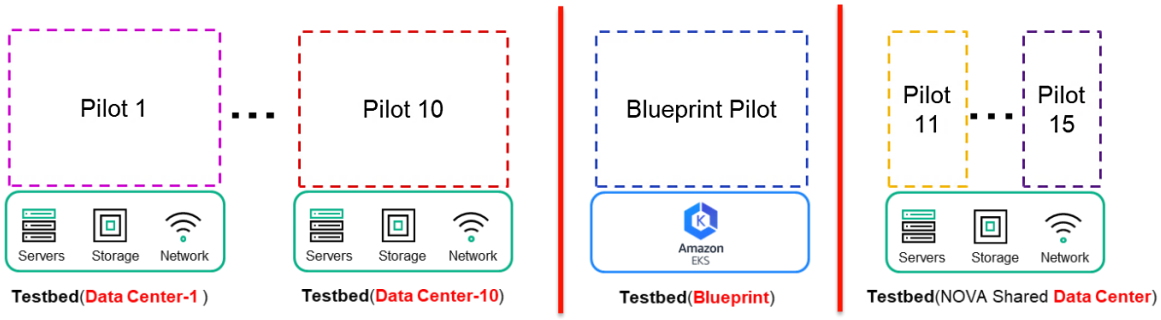

Figure 3 - Testbeds and Pilots

Each INFINITECH pilot will have one or more Use Cases (realized by one or more pilot Apps, each one realized by one or more INFINITECH microservices). In our vision, each Use Case will be a Sandbox provisioned by the leverage of Kubernetes Namespaces [1], as Kubernetes [2] will be the Container Orchestrator & Management engine that will allow applications or components that will be developed for each sandbox to quickly scale according to the requirements and to be easily updated. In this general context, each pilot App will be realized as a collection of interconnected Kubernetes PODs.

Each Testbed will host one or more sandbox environments depending on the relevant user stories validation that each pilot decides that require to have a separate environment for validation of the business requirements.

Within each Pilot, several use cases can be solved by different sets of applications, no matter the type of the testbed (dedicated or shared) being used, as described in Figures 4 and 5 below:

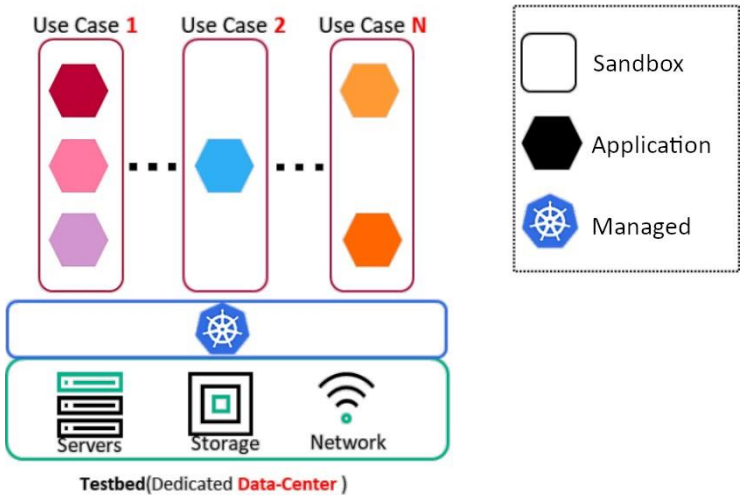

Figure 4 – Pilot Dedicated Testbed vs. Sandbox

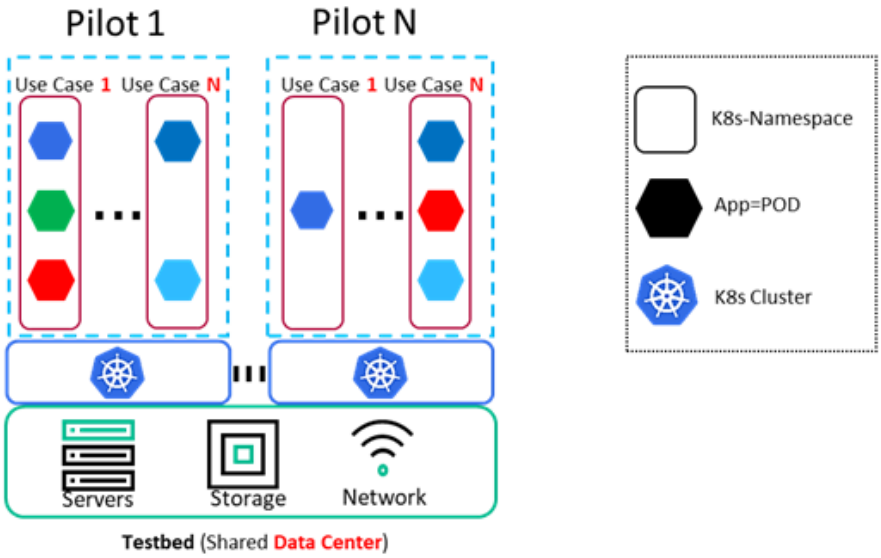

Figure 5 - Shared testbed vs. Sandbox

3.1.1 INFINITECH Pilots Testbeds

The following table describes the updated list of dedicated or shared testbeds and the expected hosting (on-premise/cloud) that will be implemented from all INFINITECH Pilots:

Testbed Host	Pilot No	Title	Leader	Hosting
Category 1 - T7.2 Smart, Reliable and Accurate Risk and Scoring Assessment				
BANKIA (Spain)	Pilot 1	Invoices Processing Platform for a more Sustainable Banking Industry	BANKIA	AWS Private Cloud BANKIA
NOVA (Portugal)	Pilot 2	Real-time risk assessment in Investment Banking	JRC	On-Premise (NOVA)
GFT (Italy)	Pilot 15	Open Inter-banking Pilot	ABILAB	Amazon Cloud in AWS
Category 2 - T7.3 Personalized Retail and Investment Banking Services				
BPFI(Ireland)	Pilot 3	Collaborative Customer-centric Data Analytics for Financial Services	BPFI	On-Premise (PPFI)
PRIVE (Austria)	Pilot 4	Personalized Portfolio Management ("Why Private Banking cannot be for everyone?")	PRIVE	Privé own Amazon Cloud in AWS
BOC (Cyprus)	Pilot 5b	Business Financial Management (BFM) tools delivering a Smart Business Advise	BOC	Amazon Cloud in AWS
NBG(Greece)	Pilot 6	Personalized Closed-Loop Investment Portfolio Management for Retail Customers:	NBG	Microsoft Azure
Category 3 - T7.4 Predictive Financial Crime and Fraud Detection				
CXB (Spain)	Pilot 7	Operation Whitetail – Avoiding Financial Crime	CXB	Hybrid (On-premise (CXB) & INFINITECH Cloud AWS)
BOS(Slovenia)	Pilot 8	Platform for Anti Money Laundering Supervision (PAMLS)	BOS	On-Premise (BOS)
AKTIF (Turkey)	Pilot 9	Analyzing Blockchain Transaction Graphs for Fraudulent Activities	AKTIF	Amazon Cloud in AWS
ENG (Italy)	Pilot 10	Real-time cybersecurity analytics on Financial Transactions' BigData	PI	GFT's AWS Cloud environment
Category 4 - T7.5 Personalized Usage-Based Insurance Pilots				
NOVA (Portugal)	Pilot 11	Personalized insurance products based on IoT connected vehicles	ATOS	On-Premise (NOVA)
NOVA (Portugal)	Pilot 12	Real World Data for Novel Health-Insurance products	SILO	On-Premise (NOVA)
Category 5 - T7.6 Configurable and Personalized Insurance Products for SMEs and Agro-Insurance				
NOVA (Portugal)	Pilot 13	Alternative/automated insurance risk selection - product recommendation for SME	WEA	On-Premise (NOVA)

NOVA (Portugal)	Pilot 14	Big Data and IoT for the Agricultural Insurance Industry	GEN	On-Premise (NOVA)

Table 1 – INFINITECH Updated list of Testbeds & hosting Pilots

3.1.2 Incumbent Testbeds and Sandboxes

Pilots 1, 3, 4, 5b, 6, 7, 8, 9, 10, and 15 from a deployment point of view, namely in terms of Testbeds (infrastructure) and Sandboxes (components), are treated as Incumbent Testbeds and Sandboxes. Each Pilot will have its own infrastructure and technology which in principle could be different from all the others and even from the Reference (Blueprint) Testbed implementation. However, the main guidelines and the logical concepts will be followed and amapping is already provided by the pilots in deliverable D6.7 - Sandboxes in Incumbent Testbeds - I [3].

3.1.3 Shared Testbeds and Sandboxes

Pilots 2, 11, 12, 13 and 14 will be deployed in a shared Testbed, that will implement the Reference (Blueprint) Testbed configuration for each one of the specific INFINITECH Pilots, on a bare-metal environment hosted by the NOVA infrastructure in terms of all software layers.

In the specific case of the NOVA infrastructure, the relative shared Testbed will have the following characteristics:

- CPU: 4x Intel Xeon-G 6238R (Total: 112 Cores / 224 vCores)
- Memory: 1 TB
- GPU: 1x NVIDIA Tesla M10 Quad GPU (2560 CUDA Cores)
- Storage: (6 to 12 TB) x 3

As previously mentioned, INFINITECH testbeds will rely on Kubernetes to orchestrate containers and to manage the resources of the nodes conveniently. As dedicated resources will be required for each of the shared Testbed pilots, a Kubernetes Cluster will be initialized and a relative number of nodes will be deployed based on the number of dedicated resources required for each pilot. Also, in order to automate the process of migrating a Kubernetes Cluster from Amazon Web Services (AWS) to a bare-metal environment (like NOVA infrastructure), the installation and configuration of all software layers beneath Kubernetes Cluster is required before the deployment of each pilot.

Details of the proposed configuration setup of the shared Testbed are described in Deliverable D6.10 – Sandboxes for FinTech/InsuranceTech Innovators – I [4].

3.1.4 Reference Testbeds and Sandboxes

In order to provide a reference infrastructure setup that all INFINITECH Pilots need to follow and implement to the higher degree possible, in deliverable D6.4 – Tools and Techniques for Tailored Sandboxes and Management of Datasets [5] , an Initial design and implementation of the INFINITECH Reference (Blueprint) Testbed Guidelines, through the actual realization (with a full compliance) of the INFINITECH RA Development and Deployment views, is described.

The Reference (Blueprint) Testbed of the INFINITECH Project is based on a cloud Infrastructure and Services provided by Amazon Web Services (AWS). AWS provides Kubernetes EKS managed services, which we leverage

in the INFINITECH Reference Testbed implementation through the provisioning of a basic cluster of two worker nodes.

All pilots have the opportunity to test some of their specific use cases on the Reference (Blueprint) Testbed, but the final and target ("production level") pilot will be deployed in a dedicated infrastructure. For guidance of all Pilots development, specific documentation was developed and is available - Blueprint guidelines for the INFINITECH way deployments of project pilots and technologies [6] – as well as a video presentation (webinar) [7].

3.2 Deployment scenarios of Testbed and Sandboxes

As described above, all Pilots will be deployed in a dedicated or shared Testbed, so in the following paragraphs we will provide a short description of the possible implementation scenarios that we envisaged that will be followed. Based on our current status, Testbeds will be deployed in three different variations:

- Cloud infrastructure
- On-Premise Infrastructure
- Hybrid infrastructure

3.2.1 Public Cloud Provider deployment

Cloud Infrastructure deployment will be based on Private AWS account deployment for Pilots 1, 4, 5b, 9 and 10, with a Private MS Azure account deployment being used for Pilot 6. The relative Cloud environments will be provided from the respective Pilot Host INFINITECH Partners as described in Table 1 above, which will also be responsible for all the relative maintenance and support activities.

3.2.2 On premise deployment

Pilot 8, based on the relative Partner regulatory requirements, will host their testbed and sandboxes using its own on-premise infrastructure, as the relative partner is the Central Bank of Slovenia. Deployment using on-premise infrastructure implies that the Partner's resources will have to provide all the DevOps services, as well as the relative maintenance and support, in order for the relative Pilot's scope to be realized and maintained.

3.2.3 Hybrid deployment

As described above, Pilots' Testbeds can be hosted on private Data Centre (on-premise) or in any cloud provider. However, it is possible for real case scenarios to follow a mixed approach: for example, this could be due to legacy reasons or to the fact that the containerization system used to containerize a specific component is not compatible with the Kubernetes installation in the Testbed. In this case, it is mandatory to have an alternative way, using a hybrid approach to be implemented following the specifications already described in Deliverable D6.10 – Sandboxes for FinTech/InsuranceTech Innovators – I [4], namely the sidecar deployment, which is represented in Figure 6 below:

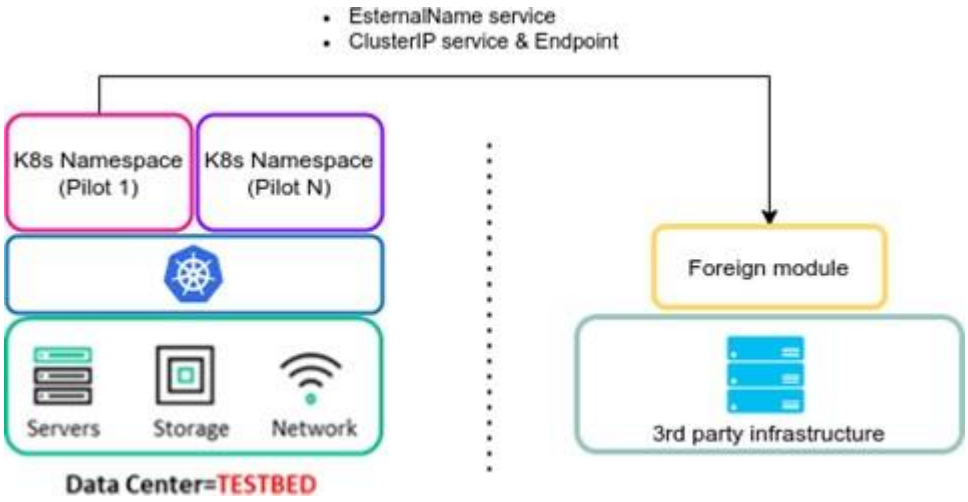

Figure 6 – Hybrid Testbed Deployment Diagram

4 Pilots Testbeds vs INFINITECH Reference (Blueprint) Testbed Guidelines

Based on the contents of the previous Chapter 3, where we have made a short description of the alternative ways of Testbeds and Sandboxes deployment for all INFINITECH Pilots, we expect that the Reference (Blueprint) Testbed will be deployed, through the actual realization (with a full compliance) of the INFINITECH RA Development and Deployment views, being used from all pilots.

The Reference (Blueprint) Testbed of The INFINITECH Project has been decided to be implemented on the AWS (Amazon Web Services) public provider. In particular, such Blueprint will be hosted on the Amazon EKS (Elastic Kubernetes Service). Amazon EKS is a managed service that allows to use a Kubernetes environment without the need to install, operate, and maintain Kubernetes control plane or nodes.

A high-level figure of the Pilot's Testbed and Sandboxes with a clear mapping to the Reference (Blueprint) Testbed and Sandboxes concepts, clarifying the physical and logical view of the Pilot, is depicted below in Figure 7. The specific figure is based on the initial Proof of Concept (PoC) implementation of Pilot 5b: Business Financial Management (BFM) tools delivering a Smart Business Advise, owned by the partner Bank of Cyprus (BOC).

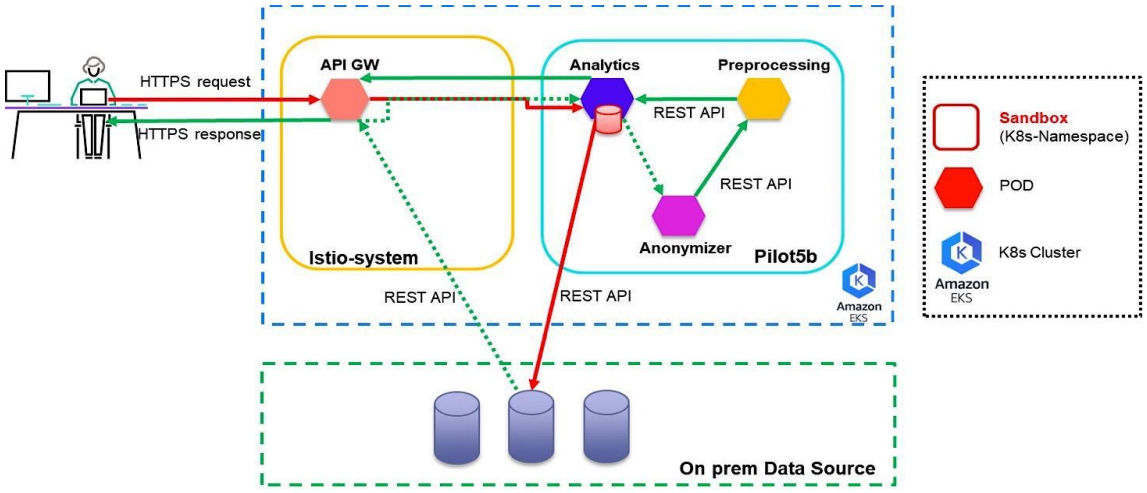

Figure 7 - Pilot physical and logical mapping vs Reference Testbed

One of the major objectives of having provided a reference (Blueprint) testbed is exactly the powerful concept explained above: a potential easy and straightforward replication of it for all the INFINITECH target pilots' environments.

Based on the technological choices of INFINITECH project, the reference (Blueprint) testbed that has been created on AWS can be recreated from scratch, with respect to the deployment view perspective, by each of the partners for their own pilots in two possible ways:

a) a fully automated way on the AWS cloud provider or to MS-Azure with slight modifications,
b) a partially automated way, in a bare metal environment, leveraging their on-premise private data center infrastructure or the shared NOVA's Data Centre.

The two alternative ways are described in figure 8 below:

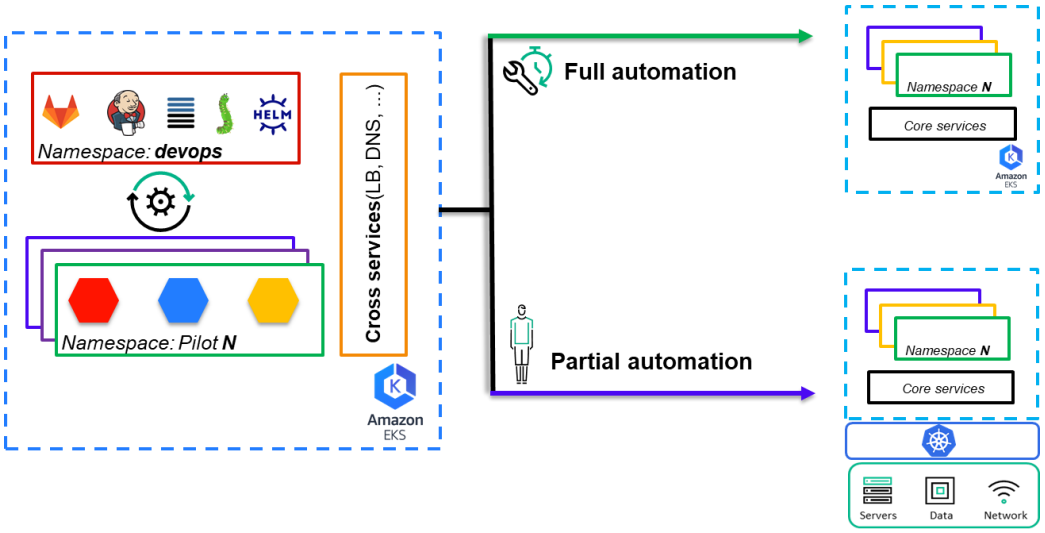

Figure 8 - Blueprint environment recreation ways

The guidelines for all Pilots and partners, of the "INFINITECH way", on how to organize their artefacts in the project's code repository, and make use of the CI/CD pipelines to

i) make their solutions available to other partners and
ii) automate the deployment of a pilot

are available in the Blueprint guidelines for the INFINITECH way deployments of project pilots and technologies [6] , as well as a video presentation (webinar) [7].

4.1 INFINITECH Reference (Blueprint) Guidelines

In the following paragraphs we intend to report the Testbeds and Sandboxes deployed from each Pilot and how these deployments are following the INFINITECH Reference (Blueprint) Testbed Guidelines, as well as provide the actions planned for migration or improvements adoption of the "INFINITECH way". This is considered as part of the development roadmap that each Pilot will follow.

For each Pilot, we will depict in what degree (full/partial/no) the aspects of the as-is Testbed deployments are based on the Reference (Blueprint) Testbed guidelines ("INFINITECH way"), for the following main areas:

1. Source Version Control: Each technology provider/contributor keeps their artefacts on target source version control service (gitlab.infinitech-h2020.eu) with dedicated group/project. On each project, the relevant source code, references to precompiled references and instructions (in the sense of a Docker file) about how to automatically build Docker images that includes the technology artifacts, should be placed.
2. Application packaging: All applications delivered or used as part of a pilot, are being deployed as Docker containers
3. Artefacts' versioning: Delivered applications artefacts are published and versioned on the INFINITECH Harbor artifact repository: harbor.infinitech-h2020.eu

4. Microservices architecture: Each Pilot use case application is developed following a microservices based approach and it is deployed using Kubernetes manifest files
5. Automatic use case deployment: Each use case application can be deployed on Blueprint Kubernetes cluster, according to a provided Continuous Delivery pipeline configured on: jenkins.infinitech-h2020.eu
6. Use of technology components building blocks: Technology components building blocks (provided by technical WPs 3-4-5) are pilot agnostic and instantiated per Use Case, so as to be configured and instantiated within use case deployments
7. Testbed: A Testbed is the set of resources (e.g., storage, network connection, compute resources) managed by an orchestrator (in practice a Kubernetes cluster) that deploys on demand applications for a specific application (use case).
8. Sandbox: A sandbox refers to whatever is inside a Kubernetes namespace and provides a specific use case. As a fact, an integrated pilot solution might consist of several use cases, and therefore several sandboxes deployed within the same Kubernetes cluster.

4.2 Testbeds for Smart, Reliable and Accurate Risk and Scoring Assessment

4.2.1 Pilot 1 - Testbed for Invoices Processing Platform for a more Sustainable Banking Industry

Pilot 1 ("Invoices Processing Platform for a more Sustainable Banking Industry") is managed by BANKIA. It aims to apply Artificial Intelligence technologies over scanned notary invoices for cost savings and increased effectiveness. AI can be leveraged to extract relevant indicators from digitized invoices: the indicator can then be used to automatically and accurately rate notaries based on a sustainability index.

4.2.1.1 Pilot 1 Testbed Deployment vs INFINITECH Reference (Blueprint) Testbed Guidelines

For Pilot 1 deployment and operation, the AWS Bankia Private Cloud will be used to implement cloud-based testbed, and the readiness related to INFINITECH Reference (Blueprint) Testbed main guidelines is described below:

Guideline # and Title	Guideline Description	Pilot Testbed AS-IS coverage vs guideline	Pilot Testbed AS-IS status vs guideline	Pilot Testbed TO-BE actions vs guideline (gap analysis)
1. Source Version Control	Each technology provider/contributor keeps their artefacts on target source version control service (gitlab.infinitech-h2020.eu) with dedicated group/project. On each project the source code or instructions (e.g., a Docker file) about how to build Docker container images starting from built artefacts, should be placed.	Partial	Artefacts source code are stored in a dedicated Gitlab instance (Bankia's AWS VPC) grouped in a dedicated project with the following sub-groups: • Services • Infrastructure • Libraries For each service artefact, the "openshift" folder stores the YAML files with the Build and Deploy configuration instructions, about how to build and deploy the service artefact as Docker container images.	We are using the same source control tool (Gitlab) as the H2020 guideline, but installed in Bankia's dedicated AWS VPC. For the moment we are not planning to use or clone our Gitlab project into the gitlab.infinitech-h2020.eu. But, in case needed, the clone process will be quite straightforward.
2. Application packaging	All applications delivered or used as part of a pilot are built as Docker containers	Yes	Pilot Applications are built and deployed as Docker containers in our OKD (OpenShift) Platform in our Bankia's AWS VPC.	

3. Artefacts' versioning	Delivered applications artefacts are published and versioned on the INFINITECH Harbor artifact repository: harbor.infinitech-h2020.eu	Partial	Delivered applications artefacts are versioned in our internal OKD Image Registry. In addition, our reusable services and libraries are also versioned and stored in a dedicated Nexus repository instance deployed in our AWS-OKD Cluster.	For the moment we are not planning to use the INFINITECH Harbor artefact repository, keeping our artifacts versioned internally.
4. Microservices architecture	Each Pilot use case application is developed following a microservices based approach and it's deployed on Kubernetes	Yes	We are using the Openshift Kubernetes version: OKD, that follows the microservices deployment approach.	
5. Automatic use case deployment	Each use case application can be deployed on Blueprint Kubernetes cluster, according to a provided Continuous Delivery pipeline configured on jenkins.infinitech-h2020.eu	Partial	Each use case application is deployed in our private OKD Cluster in Bankia's AWS VPC, according with a Continuous Delivery pipeline configured on a dedicated Jenkins instance deployed in our cluster.	We are using the same CI/CD tool (Jenkins) as indicated in the H2020 guidelines, but installed in Bankia's dedicated AWS VPC. For the moment we are not planning to move to the jenkins.infinitech-h2020.eu. But, in case needed, the migration process will be straightforward.
6. Use of technology components building blocks	Technology components building blocks (provided by technical WPs 3-4-5) are pilot agnostic and instantiated per Use Case, so they are configured and instantiated within use case deployments.	Yes	Our reusable services (AI ML/DL, Data Ingestion and Data storage) are pilot agnostic and instantiated per use case, as a Service POD with external configuration parameters provided via YAML ConfigMap (OKD object).	
7. Testbed	A Testbed is the set of resources (e.g., storage, network connection, compute resources) managed by an orchestrator (in practice a Kubernetes cluster) that deploys on demand applications for a specific application (use case).	Yes	Our resources (reusable services and OKD objects) are managed by a dedicated Kubernetes-based Cluster (Openshift OKD) and deployed on demands to a specific project/namespace (user	

			case) from the internal Service Catalogue.	
8. Sandbox	A sandbox refers to whatever is inside a Kubernetes namespace and provides a specific use case. As a fact, an integrated pilot solution might consist of several use cases, and therefore several sandboxes deployed within the same Kubernetes cluster	Yes	Our pilot has just 1 use case (eNotarios), with all its components contained (or sandboxed) inside Kubernetes project/namespace in our OKD instance.	

Table 2 – Pilot 1 Testbed Readiness vs INFINITECH Reference (Blueprint) Testbed Guidelines

4.2.2 Pilot 2 - Testbed for Real-time risk assessment in Investment Banking

Pilot 2 will implement a real-time risk assessment and monitoring procedure for two standard risk metrics: VaR (Value-at-Risk) and ES (Expected Shortfall). The main outcome is the measurement of market risks of assets portfolios. In addition, the pilot will evaluate what-if scenarios allowing pre-trade analysis.

4.2.2.1 Pilot 2 Testbed Deployment vs INFINITECH Reference (Blueprint) Testbed Guidelines

Pilot 2 Testbed will be hosted in NOVA Shared Testbed infrastructure as described in paragraph 3.1.3 above and is one of the two Pilots selected for deployment based on INFINITECH Reference (Blueprint) Testbed Guidelines and currently is the only one in full compliance, as described in the table below:

Guideline # and Title	Guideline Description	Pilot Testbed AS-IS coverage vs guideline	Pilot Testbed AS-IS status vs guideline	Pilot Testbed TO-BE actions vs guideline (gap analysis)
1. Source Version Control	Each technology provider/contributor keeps their artefacts on target source version control service (gitlab.infinitech-h2020.eu) with dedicated group/project. On each project, the source code or instructions (e.g., a Docker file) about how to build Docker container images starting from built artefacts, should be placed.	Yes	All pilot's artefacts have been pushed to Gitlab (source code, Docker files, Kubernetes YAML files)	Already compliant
2. Application packaging	All applications delivered or used as part of a pilot are built as Docker containers.	Yes	The utilized pilot technologies are built as docker containers.	Already compliant

3. Artefacts' versioning	Delivered applications artefacts are published and versioned on the INFINITECH Harbor artifact repository: harbor.infinitech-h2020.eu	Yes	The pilot artefacts are already published and versioned on the INFINITECH Harbor artifact repository.	Already compliant
4. Microservices architecture	Each Pilot use case application is developed following a microservices based approach and it is deployed on Kubernetes.	Yes	The pilot application is developed following a microservices based approach and it is deployed on Kubernetes.	Already compliant (one use case)
5. Automatic use case deployment	Each use case application can be deployed on Blueprint Kubernetes cluster, according to a provided Continuous Delivery pipeline configured on jenkins.infinitech-h2020.eu	Yes	The CI/CD has been configured properly. However, only the CI process is enabled due to lack of resources on the AWS testbed.	Already compliant with(?) the CI. Configured but not enabled the CD pipeline.
6. Use of technology components building blocks	Technology components building blocks (provided by technical WPs 3-4-5) are pilot agnostic and instantiated per Use Case, so they are configured and instantiated within use case deployments.	Yes	The pilot utilizes the following tech tools: Infinistore (WP3), Kafka direct Injector (WP3), Online Aggregates (WP5), AI for VaR prediction (WP5).	Already compliant
7. Testbed	A Testbed is the set of resources (e.g., storage, network connection, compute resources) managed by an orchestrator (in practice a Kubernetes cluster) that deploys on demands applications for a specific application (use case).	Partial	The pilot has been successfully deployed in AWS testbed.	Migration from AWS to NOVA infrastructure is needed. Planned for May 2021
8. Sandbox	A sandbox refers to whatever is inside a Kubernetes namespace and provides a specific use case. As a fact, an integrated pilot solution might consist of several use cases, and therefore several sandboxes deployed within the same Kubernetes cluster.	Yes	A sandbox has been successfully configured and deployed into pilot's Kubernetes namespace.	Already compliant

Table 3 – Pilot 2 Testbed Readiness vs INFINITECH Reference (Blueprint) Testbed Guidelines

4.2.3 Pilot 15 -Testbed for Open Inter-Banking

Pilot 15 ("Inter-Banking Open Pilot") is managed by ABILAB. It aims to leverage Machine Learning and Natural Language Understanding paradigms to implement the prototype of a solution that could address and tackle shared business pains among several banks. The solution will read and analyze extensive internal documentation

of banks in real time to highlight the main concepts and compare them with reference taxonomies to build a common business glossary. Pilot 15 will be hosted and deployed on the Testbed Blueprint that will be developed according to the pilot requirements.

4.2.3.1 Pilot 15 Testbed Deployment vs INFINITECH Reference (Blueprint) Testbed Guidelines

Pilot 15 Testbed will be hosted in AWS Cloud and intends to follow the INFINITECH Reference (Blueprint) Testbed Guidelines, so in the table below both the as-is status and compliance actions are being described:

Guideline # and Title	Guideline Description	Pilot Testbed AS-IS coverage vs guideline	Pilot Testbed AS-IS status vs guideline	Pilot Testbed TO-BE actions vs guideline (gap analysis)
1. Source Version Control	Each technology provider/contributor keeps their artefacts on target source version control service (gitlab.infinitech-h2020.eu) with dedicated group/project. On each project the source code or instructions (e.g., a Docker file) about how to build Docker container images starting from built artefacts, should be placed.	Partial	The pilot artefacts have not yet been pushed on GitLab.	Develop the client as a docker.
2. Application packaging	All applications delivered or used as part of a pilot are built as Docker containers.	Partial	Only the client pilot technologies will be released as docker containers.	The release of the fully functional client is expected before the summer '21 (end of June 2021).
3. Artefacts' versioning	Delivered applications artefacts are published and versioned on the INFINITECH Harbor artifact repository: harbor.infinitech-h2020.eu	Partial	The client pilot artefacts will be published on the INFINITECH Harbor artifact repository.	The deployment of the Pilot client into the INFINITECH Harbor repository will be carried out on September 2021.
4. Microservices architecture	Each Pilot use case application is developed following a microservices based approach and it's deployed on Kubernetes.	Partial	The pilot application is developed following a microservices based approach and it's deployed on Kubernetes.	Already compliant but the final version will be released only before summer.
5. Automatic use case deployment	Each use case application can be deployed on Blueprint Kubernetes cluster, according to a provided Continuous Delivery pipeline configured on jenkins.infinitech-h2020.eu	Partial	The client software has been designed to support CI/CD pipelines but it has still to be fully configured.	INFINITECH Jenkin will be used to deploy the client application.

6. Use of technology components building blocks	Technology components building blocks (provided by technical WPs 3-4-5) are pilot agnostic and instantiated per Use Case, so they are configured and instantiated within use case deployments.	Partial	The pilot will be based on Infinistore technology tool for data management, and search.	First release of the integrated pilot is expected end of May 2021.
7. Testbed	A Testbed is the set of resources (e.g., storage, network connection, compute resources) managed by an orchestrator (in practice a Kubernetes cluster) that deploys on demands applications for a specific application (use case).	Partial	The pilot will be deployed in AWS testbed.	The AWS testbed is expected end of June 2021.
8. Sandbox	A sandbox refers to whatever is inside a Kubernetes namespace and provides a specific use case. As a fact, an integrated pilot solution might consist of several use cases, and therefore several sandboxes deployed within the same Kubernetes cluster.	Partial	One or more sandboxes will be deployed in a bank-specific manner into pilot's Kubernetes namespace.	The sandboxes are expected to be deployed by the end of June 2021.

Table 4 – Pilot 15 Testbed Readiness vs INFINITECH Reference (Blueprint) Testbed Guidelines

4.3 Testbeds for Personalized Retail and Investment Banking Services

4.3.1 Pilot 3 - Testbed for Intelligent Analysis for KYC Transactions Data and Data Services for STOP THE TRAFFIK

The Pilot 3 ("Intelligent Analysis for KYC Transactions Data and Data Services for STOP THE TRAFFIK") intends to use Financial transactions Data and Online Social media Data for KYC, AML or Stop the Traffic scenarios. It will evaluate data sharing proposition with consumers and how these would work within the context of a fintech eco-system. Also, through the Pilot, it is intended to understand methodologies supporting sharing of data directly, and the necessary extra security controls to be applied. Finally, part of the pilot's scope is to consider a framework for banks to offer data custodian services, where customers have control over the management, usage and sharing of their own banking data.

4.3.1.1 Pilot 3 Testbed Deployment vs INFINITECH Reference (Blueprint) Testbed Guidelines

As Pilot 3 main partner Bank of Ireland (BOI) did not finally enter the INFINITECH Consortium and leadership was taken from Banking and Payments Federation Ireland (BPFI), the pilot's scope was revised and all development, as well as the Testbed deployment were revisited. Based on that, new partners IBM Ireland and Bank of Ireland (BOI) Data Analytics Team that is expected that will join the INFINITECH consortium. Currently Pilot 3 Testbed is

planned to be hosted in Testbed infrastructure provided from BPFI or BOI, but the development and deployment processes are not yet finalized. For this purpose, was not possible for Pilot3 partners to provide feedback about readiness and compliance to INFINITECH Reference (Blueprint) Testbed Guidelines to be included in this version of the deliverable and therefore, it will be reported in the next and final version.

4.3.2 Pilot 4 - Testbed for Personalized Portfolio Management ("Why Private Banking cannot be for everyone?")

Pilot 4 ("Personalised Portfolio Management") is managed by PRIVE. It aims to develop and adapt an optimization algorithm and an artificial intelligence engine within the Privé Managers Wealth Management Platform to explore the possibilities of AI Based Portfolio construction for Wealth Management. This will enable the advisor/customer to use the "Prive Managers" Wealth Management Platform and to use its risk-profiling and investment proposal capabilities, starting from their personal risk-awareness.

4.3.2.1 Pilot 4 Testbed Deployment vs INFINITECH Reference (Blueprint) Testbed Guidelines

The Testbed for Pilot 4 will be hosted on an infrastructure owned by PRIVE Technologies Amazon Cloud in AWS, that will also be used for Pilot 4 operation. Pilot 4 response for readiness and compliance to INFINITECH Reference (Blueprint) Testbed Guidelines is described below:

Guideline # and Title	Guideline Description	Pilot Testbed AS-IS coverage vs guideline	Pilot Testbed AS-IS status vs guideline	Pilot Testbed TO-BE actions vs guideline (gap analysis)
1. Source Version Control	Each technology provider/contributor keeps their artefacts on target source version control service (gitlab.infinitech-h2020.eu) with dedicated group/project. On each project, the source code or instructions (e.g., a Docker file) about how to build Docker container images starting from built artefacts,should be placed.	No	Not Applicable as PRIVE provides API via Software as a Service; PRIVE of course uses a source code control service.	
2. Application packaging	All applications delivered or used as part of a pilot are built as Docker containers.	Yes	Confirmed; deployed on PRIVE's cloud, Software as a Service model, AWS or GCP.	
3. Artefacts' versioning	Delivered applications artefacts are published and versioned on the INFINITECH Harbor artifact repository: harbor.infinitech-h2020.eu	No	Not Applicable as PRIVE provides API via Software as a Service; APIs follow best practices wrt versioning (no braking changes, versioning, deprecation, decommission).	

4. Microservices architecture	Each Pilot use case application is developed following a microservices based approach and it's deployed on Kubernetes.	Yes	Confirmed; deployed on PRIVE's cloud, Software as a Service model, AWS Kubernetes or GCP Kubernetes.	
5. Automatic use case deployment	Each use case application can be deployed on Blueprint Kubernetes cluster, according to a provided Continuous Delivery pipeline configured on jenkins.infinitech-h2020.eu	No	Not Applicable as PRIVE provides API via Software as a Service. Prive applies CI/CD internally.	
6. Use of technology components building blocks	Technology components building blocks (provided by technical WPs 3-4-5) are pilot agnostic and instantiated per Use Case, so they are configured and instantiated within use case deployments.	No	Not Applicable as PRIVE provides API via Software as a Service; PRIVE's system is a multi-tenant Software as a Service API, hence this requirement can be met by configuring multiple tenants; Use case activation via configuration.	
7. Testbed	A Testbed is the set of resources (e.g., storage, network connection, compute resources) managed by an orchestrator (in practice a Kubernetes cluster) that deploys on demand applications for a specific application (use case).	No	Not Applicable as PRIVE provides API via Software as a Service.	
8. Sandbox	A sandbox refers to whatever is inside a Kubernetes namespace and provides a specific use case. As a fact, an integrated pilot solution might consist of several use cases, and therefore several sandboxes might be deployed within the same Kubernetes cluster.	No	Not Applicable as PRIVE provides API via Software as a Service; PRIVE's system is a multi-tenant Software as a Service API, hence this requirement can be met by running multiple tenants; Sandbox is a separate non-production environment.	

Table 5 – Pilot 4 Testbed Readiness vs INFINITECH Reference (Blueprint) Testbed Guidelines

4.3.3 Pilot 5b - Testbed for Business Financial Management (BFM) tools delivering a Smart Business Advise

Pilot 5b ("Business Financial Management (BFM) tools delivering a Smart Business Advise") is managed by BOC. It aims to provide Small and Medium sized enterprises (SMEs) clients of Bank of Cyprus with personalized business insights and recommendations on managing their financial health in the areas of cash flow management, continuous spending/cost analysis, budgeting, revenue review and VAT provisioning. To this aim, the available data will feed a set of AI powered Business Financial Management tools.

4.3.3.1 Pilot 5b Testbed Deployment vs INFINITECH Reference (Blueprint) Testbed Guidelines

Pilot 5b testbed will be accommodated by Bank of Cyprus (BOC), which is going to provide an AWS environment for the various pilot's components and operations. Also, the Testbed for Pilot 5b was selected as one of the two which will be used as PoC implementations of the INFINITECH (Blueprint) Testbed architecture. Based on the progress of Pilot5b Testbed Deployment made so far, the readiness regarding compliance to INFINITECH Reference (Blueprint) Testbed Guidelines is depicted below:

Guideline # and Title	Guideline Description	Pilot Testbed AS-IS coverage vs guideline	Pilot Testbed AS-IS status vs guideline	Pilot Testbed TO-BE actions vs guideline (gap analysis)
1. Source Version Control	Each technology provider/contributor keeps their artefacts on target source version control service (gitlab.infinitech-h2020.eu) with dedicated group/project. On each project, the source code or instructions (e.g., a Docker file) about how to build Docker container images starting from built artefacts, should be placed.	Partial	Pilots Kubernetes YAML files have been pushed to Gitlab, specific components source code of the 2 first applications (transaction categorization and cashflow prediction are not yet on Giltlab).	To be defined in a later stage of Pilot's development.
2. Application packaging	All applications delivered or used as part of a pilot are built as Docker containers.	Yes	All of the applications are built as docker containers.	Already compliant
3. Artefacts' versioning	Delivered applications artefacts are published and versioned on the INFINITECH Harbor artifact repository: harbor.infinitech-h2020.eu	Partial	The pilot artefacts will be published and versioned on the INFINITECH Harbor artefact repository.	If it is needed, a private registry will be discussed for some artefacts.
4. Microservices architecture	Each Pilot use case application is developed following a microservices based approach and it's deployed on Kubernetes.	Yes	The pilot application is developed following a microservices based approach.	Already compliant (Transaction categorizations and cashflow prediction)

5. Automatic use case deployment	Each use case application can be deployed on Blueprint Kubernetes cluster, according to a provided Continuous Delivery pipeline configured on jenkins.infinitech-h2020.eu	Partial	The CI/CD has been configured in terms of Jenkins file. Not yet finalized.	Will be finalized and tested after step 3.
6. Use of technology components building blocks	Technology components building blocks (provided by technical WPs 3-4-5) are pilot agnostic and instantiated per Use Case, so they are configured and instantiated within use case deployments.	Yes	The pilot utilizes the following tech tools: Infinistore (WP3), Kafka direct Injector (WP3).	Already compliant
7. Testbed	A Testbed is the set of resources (e.g., storage, network connection, compute resources) managed by an orchestrator (in practice a Kubernetes cluster) that deploys on demand applications for a specific application (use case).	No	The pilot has been tested locally, not yet deployed on testbed.	After steps 3 and 5
8. Sandbox	A sandbox refers to whatever is inside a Kubernetes namespace and provides a specific use case. As a fact, an integrated pilot solution might consist of several use cases, and therefore several sandboxes deployed within the same Kubernetes cluster.	No	The pilot has been tested locally, not yet deployed on testbed.	After steps 3 and 5 and 7

Table 6 – Pilot 5b Testbed Readiness vs INFINITECH Reference (Blueprint) Testbed Guidelines

4.3.4 Pilot 6 - Testbed for Personalized Closed-Loop Investment Portfolio Management for Retail Customers

Pilot 6 ("Personalized Closed-Loop Investment Portfolio Management for Retail Customers") is managed by NBG. Large customer datasets and large volumes of customer-related alternative data sources (e.g., social media, news feeds, on-line information) will be used to feed ML/DL algorithms. The latter will provide the account officers with personalized, effective, and context-aware investment recommendations for the retail customers of the bank.

4.3.4.1 Pilot 6 Testbed Deployment vs INFINITECH Reference (Blueprint) Testbed Guidelines

Pilot 6 testbed will be hosted on MS-Azure private cloud infrastructure provided by NBG, as part of the infrastructure managed from NBG Group IT division, based on a strategic partnership that the bank already has

with Microsoft Hellas. Below is available Pilot 6 response for adoption of main guidelines of INFINITECH Reference (Blueprint) Testbed Guidelines:

Guideline # and Title	Guideline Description	Pilot Testbed AS-IS coverage vs guideline	Pilot Testbed AS-IS status vs guideline	Pilot Testbed TO-BE actions vs guideline (gap analysis)
1. Source Version Control	Each technology provider/contributor keeps their artefacts on target source version control service (gitlab.infinitech-h2020.eu) with dedicated group/project. On each project , the source code or instructions (e.g., a Docker file) about how to build Docker container images starting from built artefacts, should be placed.	No	Currently developed artefacts are deployed using private source version control service and not INFINITECH GitLab. As NBG will not disclose AI algorithms developed as part of the project a pre-compiled libraries/binary GitLab deployment will be followed.	INFINITECH Gitlab to be used in a later stage of Pilot's development until M25.
2. Application packaging	All applications delivered or used as part of a pilot are built as Docker containers.	No	All of the applications are built as separate components.	All Pilots components will be deployed as Docker Components until M25 of the Project.
3. Artefacts' versioning	Delivered applications artefacts are published and versioned on the INFINITECH Harbor artifact repository: harbor.infinitech-h2020.eu	No	Currently developed artefacts are not published on INFINITECH Harbor artifact repository.	INFINITECH Harbor artifact repository to be used in a later stage of Pilot's development until M25.
4. Microservices architecture	Each Pilot use case application is developed following a microservices based approach and it's deployed on Kubernetes.	Partial	All the components being developed as part of the project are already or will be deployed following microservices approach and Kubernetes deployment.	Will be finalized and tested within M25
5. Automatic use case deployment	Each use case application can be deployed on Blueprint Kubernetes cluster, according to a provided Continuous Delivery pipeline configured on jenkins.infinitech-h2020.eu	Partial	The CI/CD will be configured in terms of Jenkins file. Not yet finalized.	Will be finalized and tested within M25
6. Use of technology components building blocks	Technology components building blocks (provided by technical WPs 3-4-5) are pilot agnostic and instantiated per Use Case, so they are configured and instantiated within use case deployments.	Yes	The pilot utilizes the following tech tools: Infinistore (WP3), Data Collection (WP5).	Already compliant

7. Testbed	A Testbed is the set of resources (e.g., storage, network connection, compute resources) managed by an orchestrator (in practice a Kubernetes cluster) that deploys on demands applications for a specific application (use case).	Partial	The pilot is already being deployed using MS-Azure infrastructure provided from NBG. Kubernetes orchestrator is under design and deployment strategy definition from NBG Group Cloud Team.	Kubernetes is planned to be fully deployed within M25
8. Sandbox	A sandbox refers to whatever is inside a Kubernetes namespace and provides a specific use case. As a fact, an integrated pilot solution might consist of several use cases, and therefore several sandboxes deployed within the same Kubernetes cluster.	Partial	The pilot's sandbox is already deployed using MS-Azure infrastructure provided from NBG, usage of Kubernetes namespace will be used, as long as the Kubernetes Orchestrator deployment strategy and Kubernetes Cluster will be decided and deployed from NBG Group Cloud Team.	Kubernetes is planned to be fully deployed within M25.

Table 7 – Pilot 6 Testbed Readiness vs INFINITECH Reference (Blueprint) Testbed Guidelines

4.4 Testbeds for Predictive Financial Crime and Fraud Detection

4.4.1 Pilot 7 - Avoiding Financial Crime

Pilot 7 ("Operation Whitetail - Avoiding Financial Crime") is managed by CXB. Due to the recent change of the involved pilot partners, it is currently under development. The goal of Pilot 7 is to explore a more accurate, comprehensive and near real-time pictures of suspicious behavior in Financial Crime, Fraud, and cyber-physical attacks having the final objective of stealing the bank customers' identity and money. The bank's internal as well as external data sources will be used to produce data giving insight to the financial crime risk score. This may include a risk score, customer data, transaction patterns and details.

4.4.1.1 Pilot 7 Testbed Deployment vs INFINITECH Reference (Blueprint) Testbed Guidelines

Pilot 7 Testbed will be a hybrid cloud deployment that will be hosted on-premise for the bank's own purposes and data privacy and in the INFINITECH AWS cloud utilizing the INFINITECH components that will be used as part of the pilot implementation. Based on this hybrid deployment, the readiness and compliance to INFINITECH Reference (Blueprint) Testbed Guidelines, as well as the future steps, are described below:

Guideline # and Title	Guideline Description	Pilot Testbed AS-IS coverage vs guideline	Pilot Testbed AS-IS status vs guideline	Pilot Testbed TO-BE actions vs guideline (gap analysis)
1. Source Version Control	Each technology provider/contributor keeps their artefacts on target source version control service (gitlab.infinitech-h2020.eu) with dedicated group/project. On each project, the source code or instructions (e.g., a Docker file) about how to build Docker container images starting from built artefacts, should be placed.	No	The data collection and initial data preparation phases have recently finished. A local data analysis is needed first.	Once data analysis is performed with custom tools, open-source code will be released.
2. Application packaging	All applications delivered or used as part of a pilot are built as Docker containers.	No	The data collection and initial data preparation phases have recently finished. A local data analysis is needed first.	Once the model is developed, it will be packaged in docker.
3. Artefacts' versioning	Delivered applications artefacts are published and versioned on the INFINITECH Harbor artifact repository: harbor.infinitech-h2020.eu	No	Nothing to publish yet.	The resulting docker image will be published on harbour.infinitech-h2020.eu
4. Microservices architecture	Each Pilot use case application is developed following a microservices based approach and it is deployed on Kubernetes.	Yes	The model itself is one microservice.	
5. Automatic use case deployment	Each use case application can be deployed on Blueprint Kubernetes cluster, according to a provided Continuous Delivery pipeline configured on jenkins.infinitech-h2020.eu	No	The model has a small API and consists in only one microservice.	This will be done on-demand, as most if not all users will want to deploy on premise instead.
6. Use of technology components building blocks	Technology components building blocks (provided by technical WPs 3-4-5) are pilot agnostic and instantiated per Use Case, so they are configured and instantiated within use case deployments.	No	Those components are not needed in the pilot.	We are considering using the methods developed in INF-MLE-135 (the domain is different so it requires some adaptation.) We are evaluating the opportunity to use INF-INT-001."
7. Testbed	A Testbed is the set of resources (e.g., storage, network connection, compute resources) managed by an	No	Two approaches are being considered for the testbed deployment: Deploy the service over	Depending on the final decision, different timeframes are considered.

	orchestrator (in practice a Kubernetes cluster) that deploys on demands applications for a specific application (use case).		INFINITECH infrastructure and use it "as a Service" or deploy it on premises over the CXB's Garage Lab infrastructure.	Although deploying it "as a Service" requires the anonymisation of data to extract it outside the financial entity premises, a faster deployment is expected (31/10/2021). For its first deployment within CXB's Garage Lab the estimated time is end-2021.
8. Sandbox	A sandbox refers to whatever is inside a Kubernetes namespace and provides a specific use case. As a fact, an integrated pilot solution might consist of several use cases, and therefore several sandboxes might be deployed within the same Kubernetes cluster.	No	Analogously to the testbed, we are considering both options for the deployment of the sandboxes: Deploy the sandboxes over INFINITECH infrastructure and use them "as a Service" or deploy them on premises over the CXB's Garage Lab infrastructure.	Analogously to the testbed, depending on the final decision, different timeframes are considered. Sandbox deployment outside of CXB premises is also expected for (31/10/2021), while its first deployment within CXB's Garage Lab estimated time is end-2021.

Table 8 – Pilot 7 Testbed Readiness vs INFINITECH Reference (Blueprint) Testbed Guidelines

4.4.2 Pilot 8 - Testbed for Platform for Anti Money Laundering Supervision (PAMLS)

Pilot 8 ("Platform for Anti Money Laundering Supervision (PAMLS)") is managed by BOS. The objective of the pilot is to develop a platform named PAMLS, namely Platform for Anti-Money Laundering Supervision. PAMLS is supposed to improve the effectiveness of the existing supervisory activities in the area of anti-money laundering and combating financing of terrorism. To this aim, large quantity of data owned by BOS and other competent authorities (FIU) will be processed.

4.4.2.1 Pilot 8 Testbed Deployment vs INFINITECH Reference (Blueprint) Testbed Guidelines

The Testbed for Pilot 8 will be hosted on Bank of Slovenia (BOS) premises since, for security and compliance requirements, this is mandatory due to the fact that BOS is the central bank of Slovenia. The table below describes the level of readiness and also the planned actions that BOS intends to implement in order to be compliant with INFINITECH Reference (Blueprint) Testbed Guidelines:

Guideline # and Title	Guideline Description	Pilot Testbed AS-IS coverage vs guideline	Pilot Testbed AS-IS status vs guideline	Pilot Testbed TO-BE actions vs guideline (gap analysis)
1. Source Version Control	Each technology provider/contributor keepS their artefacts on target source version control service (gitlab.infinitech-h2020.eu) with dedicated group/project. On each project, the source code or instructions (e.g., a Docker file) about how to build Docker container images starting from built artefacts, should be placed.	Partial	Dockerfile, docker-compose and sourcecode for laboratory environment is available with instructions for local development and ingestion of historical data.	Orchestration and automatic ingestion of real time data
2. Application packaging	All applications delivered or used as part of a pilot are built as Docker containers.	Partial	Full application is partially unified and prepared to be used in docker.	Fully package everything into dockerfile, waiting for legal procedures around neo4j licensing.
3. Artefacts' versioning	Delivered applications artefacts are published and versioned on the INFINITECH Harbor artifact repository: harbor.infinitech-h2020.eu	No	Nothing	Prepare artefact files
4. Microservices architecture	Each Pilot use case application is developed following a microservices based approach and it is deployed on Kubernetes.	Partial	Components are architectured as microservices but not built as such yet.	Waiting for final real time data specification to prepare ingestion.
5. Automatic use case deployment	Each use case application can be deployed on Blueprint Kubernetes cluster, according to a provided Continuous Delivery pipeline configured on jenkins.infinitech-h2020.eu	No		Configure pipeline
6. Use of technology components building blocks	Technology components building blocks (provided by technical WPs 3-4-5) are pilot agnostic and instantiated per Use Case, so they are configured and instantiated within use case deployments.	Partial	Building blocks are pilot agnostic	Proper documentation, config and rewiring according to WP3-5
7. Testbed	A Testbed is the set of resources (e.g., storage, network connection, compute resources) managed by an orchestrator (in practice a Kubernetes cluster) that deploys on demands	Partial	Testbed is hosted at BOS premises, but Kubernetes Orchestrator will be deployed in a later stage.	To be defined in a later stage of Pilot's development

	applications for a specific application (use case).			
8. Sandbox	A sandbox refers to whatever is inside a Kubernetes namespace and provides a specific use case. As a fact, an integrated pilot solution might consist of several use cases, and therefore several sandboxes deployed within the same Kubernetes cluster.	Partial	Sandbox is hosted on Testbed at BOS premises, but Kubernetes Namespace will be deployed in a later stage on the relative Kubernetes cluster.	To be defined in a later stage of Pilot's development

Table 9 – Pilot 8 Testbed Readiness vs INFINITECH Reference (Blueprint) Testbed Guidelines

4.4.3 Pilot 9 - Testbed for Analysing Blockchain Transaction Graphs for Fraudulent Activities

Pilot 9 ("Analysing Blockchain Transaction Graphs for Fraudulent Activities") is managed by AKTIF. It aims to leverage HPC technologies to analyze huge blockchain graphs in order to detect fraudulent activities in crypto currency transactions.

4.4.3.1 Pilot 9 Testbed Deployment vs INFINITECH Reference (Blueprint) Testbed Guidelines

Testbed Pilot 9 is currently hosted on Amazon cloud where Ethereum raw blockchain data are stored. Pilot 9 readiness and compliance regarding deployment based on INFINITECH Reference (Blueprint) Testbed Guidelines are described below:

Guideline # and Title	Guideline Description	Pilot Testbed AS-IS coverage vs guideline	Pilot Testbed AS-IS status vs guideline	Pilot Testbed TO-BE actions vs guideline (gap analysis)
1. Source Version Control	Each technology provider/contributor keeps their artefacts on target source version control service (gitlab.infinitech-h2020.eu) with dedicated group/project. On each project, the source code or instructions (e.g., a Docker file) about how to build Docker container images starting from built artefacts, should be placed.	No	Currently, pilot's artefacts are not kept on Gitlab.	Pilot's artefacts will be pushed to gitlab.infinitech-h2020.eu
2. Application packaging	All applications delivered or used as part of a pilot are built as Docker containers.	No	Currently, applications are not built as Docker containers.	Docker containers will be available by M26.

3. Artefacts' versioning	Delivered applications artefacts are published and versioned on the INFINITECH Harbor artifact repository: harbor.infinitech-h2020.eu	No	Currently, pilot's artefacts are not published on the INFINITECH Harbor.	Pilot's artefacts will be uploaded to harbor.infinitech-h2020.eu
4. Microservices architecture	Each Pilot use case application is developed following a microservices based approach and it's deployed on Kubernetes.	No	Currently, pilot application is not deployed on Kubernetes.	Kubernetes deployment is planned for M26.
5. Automatic use case deployment	Each use case application can be deployed on Blueprint Kubernetes cluster, according to a provided Continuous Delivery pipeline configured on jenkins.infinitech-h2020.eu	No	Currently, pilot application is not deployed on Kubernetes.	CI/CD according to provided pipeline is planned for M30.
6. Use of technology components building blocks	Technology components building blocks (provided by technical WPs 3-4-5) are pilot agnostic and instantiated per Use Case, so they are configured and instantiated within use case deployments.	Yes	Currently, ERC20 Token implementation is being used in the pilot.	Technology components related to AI are planned to be used in the pilot.
7. Testbed	A Testbed is the set of resources (e.g., storage, network connection, compute resources) managed by an orchestrator (in practice a Kubernetes cluster) that deploys on demands applications for a specific application (use case).	Partial	The pilot is currently deployed in AWS	When the NOVA testbed is available, pilot's components will be migrated there
8. Sandbox	A sandbox refers to whatever is inside a Kubernetes namespace and provides a specific use case. As a fact, an integrated pilot solution might consist of several use cases, and therefore several sandboxes deployed within the same Kubernetes cluster.	Partial	The pilot is currently deployed in AWS	Sandbox at the NOVA testbed is planned to be used.

Table 10 – Pilot 9 Testbed Readiness vs INFINITECH Reference (Blueprint) Testbed Guidelines

4.4.4 Pilot 10 - Testbed for Real-time cybersecurity analytics on Financial Transactions' BigData

Pilot 10 ("Real-time cybersecurity analytics on financial transactions' data") is managed by PI partner. It aims to speed up the detection of suspected fraudulent transactions and to identify security-related anomalies while they are occurring. This objective can be pursued through the real-time analysis of the financial transactions of home and mobile banking systems.

4.4.4.1 Pilot 10 Testbed Deployment vs INFINITECH Reference (Blueprint) Testbed Guidelines

Testbed for Pilot 10 will be hosted on AWS environment that will be provided from ENG (Engineering) based on GFT's AWS Cloud infrastructure. The table below describes Pilot 10 Testbed deployment feedback regarding readiness to INFINITECH Reference (Blueprint) Testbed Guidelines:

Guideline # and Title	Guideline Description	Pilot Testbed AS-IS coverage vs guideline	Pilot Testbed AS-IS status vs guideline	Pilot Testbed TO-BE actions vs guideline (gap analysis)
1. Source Version Control	Each technology provider/contributor keeps their artefacts on target source version control service (gitlab.infinitech-h2020.eu) with dedicated group/project. On each project, the source code or instructions (e.g., a Docker file) about how to build Docker container images starting from built artefacts, should be placed.	No	Currently pilot's artefact is not under INFINITECH source version control, but it will be pushed to Gitlab (source code, Docker files, Kubernetes YAML files).	Compliant actions will be implemented within Pilot's deployment.
2. Application packaging	All applications delivered or used as part of a pilot are built as Docker containers.	Yes	The utilized pilot technologies are built as docker containers.	Compliance actions will be implemented within Pilot's deployment plan.
3. Artefacts' versioning	Delivered applications artefacts are published and versioned on the INFINITECH Harbor artifact repository: harbor.infinitech-h2020.eu	No	Currently pilot's builds are not under published on the INFINITECH Harbor, but they will be uploaded there.	Compliance actions will be implemented within Pilot's deployment plan.
4. Microservices architecture	Each Pilot use case application is developed following a microservices based approach and it is deployed on Kubernetes.	Yes	The pilot application is developed following a microservices based approach and it's deployed on Kubernetes.	Compliance actions will be implemented within Pilot's deployment plan (one use case).
5. Automatic use case deployment	Each use case application can be deployed on Blueprint Kubernetes cluster, according to a provided Continuous Delivery pipeline configured on jenkins.infinitech-h2020.eu	Partial	Concerning a tech tool under development within T4.6, the CI/CD will be configured properly. For the rest of the tools, we will have a hybrid deployment, therefore some components will be self-hosted and self-managed in pilot's premises.	Compliance actions will be implemented within Pilot's deployment plan (taking into account the hybrid scenario).

6. Use of technology components building blocks	Technology components building blocks (provided by technical WPs 3-4-5) are pilot agnostic and instantiated per Use Case, so they are configured and instantiated within use case deployments.	Yes	The pilot will use the following tech tools: Veesualive (WP4), Pseudoanonymizer (WP3), ALIDA (WP5).	Compliance actions will be implemented within Pilot's deployment plan (taking into account the hybrid scenario).
7. Testbed	A Testbed is the set of resources (e.g., storage, network connection, compute resources) managed by an orchestrator (in practice a Kubernetes cluster) that deploys on demand applications for a specific application (use case).	Yes	Components which are self-hosted and self-managed in pilot's premises are already managed by Kubernetes. The remaining tech tools will be deployed in AWS testbed.	Compliance actions will be implemented within Pilot's deployment plan (taking into account the hybrid scenario).
8. Sandbox	A sandbox refers to whatever is inside a Kubernetes namespace and provides a specific use case. As a fact, an integrated pilot solution might consist of several use cases, and therefore several sandboxes deployed within the same Kubernetes cluster.	Partial	A sandbox running into AWS will be configured according to its hybrid nature.	Compliance actions will be implemented within Pilot's deployment plan (taking into account the hybrid scenario).

Table 11 – Pilot 10 Testbed Readiness vs INFINITECH Reference (Blueprint) Testbed Guidelines

4.5 Testbeds for Personalized Usage-Based Insurance Pilots

4.5.1 Pilot 11 - Testbed for Personalized insurance products based on IoT connected vehicles

Pilot 11 aims to develop new services for driving insurance companies, based on the information gathered from connected vehicles, as an IoT ecosystem. Current driving insurance services try to reward good drivers against the "bad ones", but based on very static or historical information: driver's age, color of the car, incidents by year, etc. A new approach, with more dynamic, adapted and custom services is needed, where the pay-as-you-drive paradigm can be used, in a similar approach to the cloud ecosystem, where you pay-as-you-go, meaning the client only pays for the number of resources they consume. Complementary to this, a second service will help to detect possible fraud situations. Fraud causes not fair costs to the company that would indirectly affect the good/honest drivers.

4.5.1.1 Pilot 11 Testbed Deployment vs INFINITECH Reference (Blueprint) Testbed Guidelines

Pilot 11 Testbed will be hosted in NOVA Shared Testbed infrastructure as described in paragraph 3.1.3 above. Due to the fact that the NOVA infrastructure was deployed during April 2021, the status of readiness compared to INFINITECH Reference (Blueprint) Testbed Guidelines described below, is based on the deployment done using the infrastructure provided from other partners participating in the Pilot deployment (in our case, ATOS):

Guideline # and Title	Guideline Description	Pilot Testbed AS-IS coverage vs guideline	Pilot Testbed AS-IS status vs guideline	Pilot Testbed TO-BE actions vs guideline (gap analysis)
1. Source Version Control	Each technology provider/contributor keeps their artefacts on target source version control service (gitlab.infinitech-h2020.eu) with dedicated group/project. On each project, the source code or instructions (e.g., a Docker file) about how to build Docker container images starting from built artefacts, should be placed.	Partial	SmartFleet's components (code & instructions) are being uploaded into the corresponding Gitlab repository. AI models and trainers for fraud detection and driving profiling are still under development. Anonymiser tool (first version) already in Gitlab.	SmartFleet components and code fully updated (M20). AI components folder and structure to be created (M22). First versions of AI components (models and trainers) uploaded (M25).
2. Application packaging	All applications delivered or used as part of a pilot are built as Docker containers.	Yes	All SmartFleet components' docker images available. AI framework components built as docker containers. AI models and Trainers follow docker approach for their distribution.	Finalise and dockerise AI components (1st Version M25-M26)
3. Artefacts' versioning	Delivered applications artefacts are published and versioned on the INFINITECH Harbor artifact repository: harbor.infinitech-h2020.eu	Partial	SmartFleet framework is publishing. AI components to be published. Anonymiser tool already published (first version).	Smart Fleet completely published (M20) AI components (1st Version) to be published by M25.
4. Microservices architecture	Each Pilot use case application is developed following a microservices based approach and it's deployed on Kubernetes.	Yes	Micro-services and Kubernetes approach is followed to deploy/deliver all pilot's components and services.	Smart Fleet completely deployed. M20 AI framework to be deployed by M25. Services' first versions to be deployed in M25-M26.
5. Automatic use case deployment	Each use case application can be deployed on Blueprint Kubernetes cluster, according to a provided Continuous Delivery pipeline configured on jenkins.infinitech-h2020.eu	Yes	Micro-services and Kubernetes approach is followed to deploy/deliver all components.	Smart Fleet completely deployed M20. AI components to be deployed by M25-M26.

6. Use of technology components building blocks	Technology components building blocks (provided by technical WPs 3-4-5) are pilot agnostic and instantiated per Use Case, so they are configured and instantiated within use case deployments.	Partial	First version of AI models is currently under development. Models will be dockerized and deployed using docker-compose solutions. Anonymiser tool already follows this approach	Further analysis and improvement of AI models to be done. Models to be deployed on the Kubernetes premises (INF. Testbed) in M25. Finalise and integrate Anonymiser tool.
7. Testbed	A Testbed is the set of resources (e.g., storage, network connection, compute resources) managed by an orchestrator (in practice a Kubernetes cluster) that deploys on demand applications for a specific application (use case).	Yes	Currently, ATOS is managing its own testbed for P#11, aligned with INFINITECH guidelines, to check dokerisation, integration and deployment processes of all components. To be migrated to NOVA infrastructure.	Everything will be migrated into NOVA infrastructures when available (M25-26)
8. Sandbox	A sandbox refers to whatever is inside a Kubernetes namespace and provides a specific use case. As a fact, an integrated pilot solution might consist of several use cases, and therefore several sandboxes deployed within the same Kubernetes cluster.	Yes	Current datasets and AI models will me migrated to populate the INFINITECH P#11 Sandbox.	The sandbox at the NOVA testbed is planned to be finalised by M25.

Table 12 – Pilot 11 Testbed Readiness vs INFINITECH Reference (Blueprint) Testbed Guidelines

4.5.2 Pilot 12 - Testbed for Real World Data for Novel Health-Insurance products

Pilot 12 aims to develop new services for health insurance companies based on the information gathered from current or prospective clients. Current health insurance services take into account clients' medical history in a very static way. A new approach, with more dynamic, adapted and custom services is needed. Premiums are calculated dynamically based on clients' habits. Complementary to this, a second service will help to detect possible fraud's situation. Fraud causes unfair costs to the company that could indirectly affect the good/honest clients.

4.5.2.1 Pilot 12 Testbed Deployment vs INFINITECH Reference (Blueprint) Testbed Guidelines

Pilot 12 Testbed will also be hosted in NOVA Shared Testbed infrastructure as described in paragraph 3.1.3 above. Due to the fact that the NOVA infrastructure was deployed during April 2021, the status of readiness compared to INFINITECH Reference (Blueprint) Testbed Guidelines described below, is based on the deployment done so far utilizing infrastructure provided from other pilot's partners:

Guideline # and Title	Guideline Description	Pilot Testbed AS-IS coverage vs guideline	Pilot Testbed AS-IS status vs guideline	Pilot Testbed TO-BE actions vs guideline (gap analysis)
1. Source Version Control	Each technology provider/contributor keeps their artefacts on target source version control service (gitlab.infinitech-h2020.eu) with dedicated group/project. On each project, the code or instructions (e.g., a Docker file) about how to build Docker container images starting from built artefacts, should be placed.	Yes	Pilot 12 employs INFINITECH components and two dedicated components for its services. The risk assessment component is in Gitlab, the fraud detection is not implemented yet.	Implement fraud detection by M22. Have both services working on-line by M24.
2. Application packaging	All applications delivered or used as part of a pilot are built as Docker containers.	No	The components are not yet mature.	Docker container(s) will be available by M24.
3. Artefacts' versioning	Delivered applications artefacts are published and versioned on the INFINITECH Harbor artifact repository: harbor.infinitech-h2020.eu	No	The components are not yet mature.	Artefacts will start being published in M20.
4. Microservices architecture	Each Pilot use case application is developed following a microservices based approach and it's deployed on Kubernetes.	No	We do not plan to deliver an application (front-end) to the sandbox. The services will run there and will allow consumption of the data by 3rd-party apps, like the Healthentia portal app to be used by pilot 12.	Kubernetes deployment is scheduled for M25.
5. Automatic use case deployment	Each use case application can be deployed on Blueprint Kubernetes cluster, according to a provided Continuous Delivery pipeline configured on jenkins.infinitech-h2020.eu	No	See comment on microservices.	Once the NOVA testbed is made available (M20?) the pipeline will be followed.
6. Use of technology components building blocks	Technology components building blocks (provided by technical WPs 3-4-5) are pilot agnostic and instantiated per Use Case, so they are configured and instantiated within use case deployments.	Yes	UBITECH's data collection, GRADIANT's anonymization, ATOS's regulatory compliance tools and LeanXcale database are configured on temporary testbed.	Once the NOVA testbed is made available (M20?) the components will be installed there.
7. Testbed	A Testbed is the set of resources (e.g., storage, network connection, compute resources) managed by an orchestrator (in practice a Kubernetes cluster) that	Partial	A temporary testbed managed by Innovation Sprint is used until the formal one is made available.	Once the NOVA testbed is made available (M20?) the components will be installed there.

	deploys on demands applications for a specific application (use case).			
8. Sandbox	A sandbox refers to whatever is inside a Kubernetes namespace and provides a specific use case. As a fact, an integrated pilot solution might consist of several use cases, and therefore several sandboxes deployed within the same Kubernetes cluster.	Yes	Single sandbox in the testbed for pilot 12.	The sandbox at the NOVA testbed is planned to be finalised by M25.

Table 13 – Pilot 12 Testbed Readiness vs INFINITECH Reference (Blueprint) Testbed Guidelines

4.6 Testbeds for Configurable and Personalized Insurance Products for SMEs and Agro-Insurance

4.6.1 Pilot 13 - Testbed for Alternative/automated insurance risk selection - product recommendation for SME

Pilot 13 will implement an automation of the subscription process that helps insurance companies to reduce costs. In addition, it will enable the verification of the veracity of the data that has been entered with a double verification that avoids possible errors in the cost of the insurance premium. The monitoring and identification of real-time risk changes allows the company to know if the insurance cost really corresponds to the real risk of the SME or if it should increase or decrease it in order to adapt it to its current situation.

4.6.1.1 Pilot 13 Testbed Deployment vs INFINITECH Reference (Blueprint) Testbed Guidelines

Testbed for Pilot 13 will be also hosted in NOVA Shared Testbed infrastructure as described in paragraph 3.1.3 above. Due to the fact that the NOVA infrastructure was deployed during April 2021, the status of readiness compared to INFINITECH Reference (Blueprint) Testbed Guidelines described below, is based on the deployment done so far utilizing AWS resources to deploy the components that are part of the INFINITECH platform:

Guideline # and Title	Guideline Description	Pilot Testbed AS-IS coverage vs guideline	Pilot Testbed AS-IS status vs guideline	Pilot Testbed TO-BE actions vs guideline (gap analysis)
1. Source Version Control	Each technology provider/contributor keeps their artefacts on target source version control service (gitlab.infinitech-h2020.eu) with dedicated group/project. On each project, the source code or instructions (e.g., a	Yes	All software artefacts that will be deployed inside the sandbox are available in Gitlab.	Already compliant

	Docker file) about how to build Docker container images starting from built artefacts, should be placed.			
2. Application packaging	All applications delivered or used as part of a pilot are built as Docker containers.	Yes	All software artefacts that will be deployed inside the sandbox are built as Docker images.	Already compliant
3. Artefacts' versioning	Delivered applications artefacts are published and versioned on the INFINITECH Harbor artifact repository: harbor.infinitech-h2020.eu	Yes	The pilot artefacts are already published and versioned on the INFINITECH Harbor artefact repository.	Already compliant
4. Microservices architecture	Each Pilot use case application is developed following a microservices based approach and it's deployed on Kubernetes.	Yes	Although the architecture of this solution does not require a micro-service approach, it is deployed using Kubernetes and automate the instantiation of the solution via configuration parameters provided in as Kubernetes configmaps.	Already compliant
5. Automatic use case deployment	Each use case application can be deployed on Blueprint Kubernetes cluster, according to a provided Continuous Delivery pipeline configured on jenkins.infinitech-h2020.eu	Partial	We have already defined the CD pipeline, but never tested it, as the NOVA infrastructure was not available at the time this report was written.	It is planned to be defined once the NOVA testbed is available during the next few months.
6. Use of technology components building blocks	Technology components building blocks (provided by technical WPs 3-4-5) are pilot agnostic and instantiated per Use Case, so they are configured and instantiated within use case deployments.	Yes	This pilot relies on the INFINISTORE and related technologies, that are pilot agnostic and they can be configured by Kubernetes ConfigMaps to instantiate them according to the needs of each pilot.	Yes
7. Testbed	A Testbed is the set of resources (e.g., storage, network connection, compute resources) managed by an orchestrator (in practice a Kubernetes cluster) that deploys on demand applications for a specific application (use case).	Partial	A temporal solution has been currently adopted for the experimentation of this pilot using LXS (pilot tech proxy) internal infrastructure resources.	Migration from AWS to NOVA infrastructure is needed. It is planned to take place when the NOVA testbed will be available.
8. Sandbox	A sandbox refers to whatever is inside a Kubernetes namespace and provides a specific use	Partial	The Kubernetes manifest files for the deployment of the sandbox have	It will be solved once we start deploying to

	case. As a fact, an integrated pilot solution might consist of several use cases, and therefore several sandboxes deployed within the same Kubernetes cluster.		been already defined for this pilot. However, they have not been tested, as the NOVA testbed was not available at the time the report was written. We might need to explore how to allow the connectivity from outside to inside the sandbox deployed in NOVA, as the solutions that have been used for the reference AWS testbed might now be applicable.	the NOVA infrastructure.

Table 14 – Pilot 13 Testbed Readiness vs INFINITECH Reference (Blueprint) Testbed Guidelines

4.6.2 Pilot 14 - Testbed for Big Data and IoT for the Agricultural Insurance Industry

Pilot #14 will deliver a commercial service module that will enable insurance companies to exploit the untapped market potential of Agricultural Insurance (AgI), taking advantage of innovations in Earth Observation (EO), weather intelligence & ICT technology. EO will be used to develop the data products that will act as a complementary source to the information used by insurance companies to design their products and assess the risk of natural disasters. Weather intelligence based on data assimilation, numerical weather prediction and ensemble seasonal forecasting will be used to verify the occurrence of catastrophic weather events and to predict future perils that could threaten the portfolio of an agricultural insurance company. The INFINITECH AgI-module derived indices will allow and enable the agricultural insurance industry to enlarge its market, while delivering a larger portfolio of products at lower costs and serve areas, where classical insurance products could not be delivered.

4.6.2.1 Pilot 14 Testbed Deployment vs INFINITECH Reference (Blueprint) Testbed Guidelines

Testbed for Pilot 14 will also be hosted in NOVA Shared Testbed infrastructure as described in paragraph 3.1.3 above. Due to the fact that the NOVA infrastructure was deployed during April 2021, the status of readiness compared to INFINITECH Reference (Blueprint) Testbed Guidelines described below, is based on the fact that AgroApps is developing the entire infrastructure for the pilot's data products, based on the reference architecture starting from data collection from different sources, over processing and analytics, to user interface & data visualization:

Guideline # and Title	Guideline Description	Pilot Testbed AS-IS coverage vs guideline	Pilot Testbed AS-IS status vs guideline	Pilot Testbed TO-BE actions vs guideline (gap analysis)
1. Source Version Control	Each technology provider/contributor keeps their artefacts on target source version control service (gitlab.infinitech-h2020.eu) with dedicated group/project. On each project, the source code or instructions (e.g., a Docker file) about how to build Docker container images starting from built artefacts, should be placed.	No	Nothing	Pilot 14 supports Source Version Control by holding its own GitLab server (AgroApps private GitLab server). Pilot 14 source code is proprietary.
2. Application packaging	All applications delivered or used as part of a pilot are built as Docker containers.	Yes	Pilot 14 AgI module is deployed by using docker containers.	nothing
3. Artefacts' versioning	Delivered applications artefacts are published and versioned on the INFINITECH Harbor artifact repository: harbor.infinitech-h2020.eu	No	No	-
4. Microservices architecture	Each Pilot use case application is developed following a microservices based approach and it's deployed on Kubernetes.	Partial	AgI module Components have been deployed as microservices.	Will prepare the images for the WiE component provided that Kubernetes cluster supports MPI and singularity.
5. Automatic use case deployment	Each use case application can be deployed on Blueprint Kubernetes cluster, according to a provided Continuous Delivery pipeline configured on jenkins.infinitech-h2020.eu	No	-	-
6. Use of technology components building blocks	Technology components building blocks (provided by technical WPs 3-4-5) are pilot agnostic and instantiated per Use Case, so they are configured and instantiated within use case deployments	No	No	Could potentially use the blockchain component.
7. Testbed	A Testbed is the set of resources (e.g., storage, network connection, compute resources) managed by an orchestrator (in practice a Kubernetes cluster) that deploys on demand applications for a specific application (use case).	Partial	Required Scripts for the orchestrator are ready for the WiE component.	To be defined in a later stage of Pilot Deployment (Blueprint for orchestrator)

8. Sandbox	A sandbox refers to whatever is inside a Kubernetes namespace and provides a specific use case. As a fact, an integrated pilot solution might consist of several use cases, and therefore several sandboxes deployed within the same Kubernetes cluster.	Partial	To be defined in a later stage of Pilot Deployment.	To be defined in a later stage of Pilot Deployment, when NOVA infrastructure will be fully available.

Table 15 – Pilot 14 Testbed Readiness vs INFINITECH Reference (Blueprint) Testbed Guidelines

5 Testbeds & Sandboxes Implementation Upgrade strategy

A summary feedback of the as-is status provided from all pilots regarding readiness and compliance to INFINITECH Reference (Blueprint) Testbed Guidelines for deployment of the Testbeds on which each Pilot will be hosted, is depicted in the table below:

Pilot	Testbed Hosting	INFINITECH Reference (Blueprint) Testbed Guidelines							
		#1 Source Version Control	#2 Application packaging	#3 Artefacts' versioning	#4 Microservices architecture	#5 Automatic use case deployment	#6 Use of technology components building blocks	#7 Testbed	#8 Sandbox
1 (BANKIA)	AWS Private	Partial	Yes	Partial	Yes	Partial	Yes	Yes	Yes
2 (JRC)	NOVA	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Yes
15 (ALILAB)	AWS	Partial	Partial	Partial	Partial	Partial	Partial	Partial	Partial
3 (BPFI)[1]	NOVA	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4 (PRIVE)	AWS Private	No	Yes	No	Yes	No	No	No	No
5b (BOC)	AWS	Partial	Yes	Partial	Yes	Partial	Yes	No	No
6 (NBG)	MS-Azure	No	No	No	Partial	Partial	Yes	Partial	Partial
7 (CXB)	Hybrid On-premise & AWS	No	No	No	Yes	No	No	No	No
8 (BOS)	On-Premise	Partial	Partial	No	Partial	No	Partial	Partial	Partial
9 (AKTIF)	AWS	No	No	No	No	No	Yes	Partial	Partial
10 (PI)	AWS	No	Yes	No	Yes	Partial	Yes	Yes	Partial
11 (ATOS)	NOVA	Partial	Yes	Partial	Yes	Yes	Partial	Yes	Yes
12 (SILO)	NOVA	Yes	No	No	No	No	Yes	Partial	Yes
13 (WEA)	NOVA	Yes	Yes	Yes	Yes	Partial	Yes	Partial	Partial
14 (GEN)	NOVA	No	Yes	No	Partial	No	No	Partial	Partial

Table 16 – Pilots Testbed Readiness vs INFINITECH Reference (Blueprint) Testbed Guidelines

The conclusions based on the above table are:

a) The majority of the Testbeds (except the ones that will use NOVA Shared Testbed) will be Cloud based and will also be based on AWS Cloud (Private or Public) which is similar to the INFINITECH Reference (Blueprint) Testbed Guidelines for deployment.

[1] As Pilot 3 is under restructuring phase, no feedback is provided. N/A: Not Available.

b) Even though two (2) of the Pilots are being selected for being the "examples" of INFINITECH Reference (Blueprint) Testbed deployment, there also other Pilots' Testbeds that are deployed in a way that will be easily transformed to the "Blueprint" guidelines based on their migration plan reported.

c) There are specific Pilots (e.g., PRIVE) that based on the fact that the related development is targeting on expanding the capabilities of existing software solutions, will not be able to follow INFINITECH Reference (Blueprint) Testbed guidelines.

d) Most of the Pilots currently neither using to store their artefacts on target INFINITECH source version control service (gitlab.infinitech-h2020.eu) nor published and versioned them on the INFINITECH Harbor artifact repository: harbor.infinitech-h2020.eu, but have plans to do that if it is permitted by their IPR, so it is expected usage will be exploit.

e) For the majority of the Pilots all the applications delivered or used, are built as Docker containers.

f) Kubernetes orchestration for Testbed and Sandbox deployment is not fully adopted from all Pilots' deployments, but it is planned to be applied based on the maturity of each pilot deployment and also the availability of the relative infrastructure (for the NOVA Shared Testbed deployed Pilots).

Based on the above results, in order for all (or the majority) the Pilots to adopt INFINITECH Reference (Blueprint) Testbed Guidelines, the following actions are proposed to be adopted:

a) All Tech proxies and/or partners participating in each Pilot to be informed about the main guidelines that are required to be followed and include in their roadmap a plan to take the necessary actions and milestones that all "Blueprint" guidelines will be adopted. In case that each Pilot due to technical or other reasons is required not to follow the guidelines, to report the main reasons that this is not possible. All the above will be collected and stored in INFINITECH Central Repository (Gitlab) as reference technical documentation.
b) As the access to INFINITECH Gitlab & Harbor Repository are deployed in AWS, it is required that each partner that wants to have access to them, signs the relative Side Letter already provided from GFT. At the moment not all Pilots' Partners have signed the Side Letter, so this issue is needed to be resolved firstly, in order to grant access to the AWS infrastructure where the INFINITECH code and image repositories have been deployed.
c) All Pilots Tech Proxies will be required to inform each Pilot's technical partners to read the Blueprint guidelines for the INFINITECH way of deployment and the relative video presentation (webinar) that is available in the following INFINITECH Google Drive folder: https://drive.google.com/drive/u/3/folders/1qNVQhuMIEjU3Ug8tVIEWCzowtnlaY5xs
d) Regarding Kubernetes orchestration requirements (Cluster, Namespaces and Pods) for Testbeds and Sandbox deployment, based on HPE technical partner recommendations, all Pilots' will deploy or adopt it to the highest possible degree. For this purpose, INFINITECH already adopted collaborative tools (e.g., Slack) where all the required resources have or may be asked to get access in order that the necessary technical support is made available to all partners. Also, for Pilots that will be hosted in NOVA Shared Testbed, the related Reference (Blueprint) Testbed deployment guidelines are included in the deliverable D6.10 - Sandboxes for FinTech/InsuranceTech Innovators – I [4].

6 Conclusions and next steps

The scope of task T6.1 is the analysis of the existing testbeds (i.e., testbeds of incumbent organizations) in terms of their existing resources and gaps for supporting BigData, IoT, AI experimentation in-line with the INFINITECH approach and the provision of the necessary feedback in order to specify the ways they have to be extended in terms of hardware and/or software resources, based on the progress of the pilot development and execution.

The current version of the deliverable reported the as-is status regarding the readiness and compliance of the relative infrastructure (hardware & software) deployments from each pilot, compared to the Reference (Blueprint) Testbed Guidelines already described and deployed by the Consortium, as well as the planned actions or modifications that will be performed within the next months of each pilot deployment plan.

Also, a list of actions that all Pilots will be required to follow in order to adopt the "INFINITECH" way of each pilot's components development has been provided, in order for all the Pilots to follow a similar way of Testbed and Sandbox deployment, utilizing Dockerized developed components and following Kubernetes Orchestration.

As we have identified that a few Pilots, based on the feedback provided, may not have followed the INFINITECH Reference (Blueprint) Testbed guidelines, it will be required by the INFINITECH Technical partners to evaluate this deviation and to report accordingly, as well as to propose alternative ways that could be used.

For the Pilots hosted in the NOVA Shared Testbed, as long as the relative infrastructure is installed and available, a migration process will be performed in order for the relevant Pilots to be deployed in the final infrastructure (as currently temporary one is used) following the reference (Blueprint) Testbed deployed guidelines already available.

Based on the maturity of development of all Pilots and the adoption of INFINITECH Reference (Blueprint) Testbed Guidelines that will be further enhanced in the future deliverables of WP6, it will be necessary for all Pilot's to adjust their hardware and/or software resources to be compliant in order for all the related tools, procedures, deployment and support procedures to be unified. The testbeds and the relative sandboxes and deployment process will be enhanced accordingly, using the feedback of the partners that will be responsible for the provision of the relative technical support, as part of the rest of WP6 activities.

We expect that the updated information about the progress of all INFINITECH Pilots regarding the adoption and compliance to INFINITECH Reference (Blueprint) Testbed deployment, based on the actions already described above, will be included in the final version of this deliverable that will be issued in M30 of the INFINITECH Project.

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