Just in Time

ICT Risk:

Focus on Thread-Led Penetration Testing (TLPT)

August 2025

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Executive Summary

- **Threat-Led Penetration Testing** (TLPT) represents a cornerstone of the European Union's strategy to enhance the cyber resilience of financial institutions. Mandated by the **Digital Operational Resilience Act (DORA)** and operationalized through the **TIBER-EU** framework, TLPT simulates sophisticated cyberattacks based on real-world threat intelligence to assess an entity's ability to detect, respond to, and recover from advanced threats.
- The testing process is structured in three phases: **preparation**, **execution**, and **closure,** and involves multiple actors, including independent providers, internal defenders, and coordinating authorities. Tests must be conducted at least every three years and are subject to strict oversight by national and European supervisory bodies.
- By integrating TLPT into the broader ICT risk management lifecycle, financial entities not only meet regulatory obligations but also **strengthen their operational resilience,** improve third-party risk oversight, and foster a **proactive cybersecurity culture at the governance level.**

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Keywords: TLPT, DORA, TIBER-EU, Third-Party risk, Cyber risk

01

Introduction

TLPT Regulatory Framework under DORA and the TIBER-EU

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DORA: the European Regulatory Framework

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TLPT: a Comparative Analysis of RTS DORA and TIBER-EU

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TLPT Regulatory Framework under DORA and the TIBER-EU

Threat-Led Penetration Testing (TLPT) constitutes an advanced ethical-hacking **framework** governed by the **Digital Operational Resilience Act** (DORA - EU 2022/2554) and **Delegated Regulation (EU) 2025/1190**, which establish its **applicability** criteria, **methodological** requirements, and **modalities of cooperation** between **supervisory authorities** and financial-sector entities. The **TIBER-EU** framework, referenced in **Articles 26–27** of **DORA** and **transposed** in Italy as **TIBER-IT**, provides a **Europe-wide benchmark** for the scoping, threat-intelligence, **red-team execution**, and remediation-planning phases, **thereby** ensuring consistency and comparability of tests across **Member States**.

TIBER-EU (2018)

- **Core Principles**: independence of service **providers**, **confidentiality** of **test operations**, security of systems under test, and **realism of threat scenarios**.
- Clear **delineation** of **testing** roles with specific **responsibilities**.
- It simulates **intelligence-driven** adversarial scenarios based on **real-world Tactics**, **Techniques**, and **Procedures** (TTPs) to assess operational response.
- It follows a structured **lifecycle** comprising scoping, **Threat Intelligence Reporting**, controlled test execution, and remediation planning.
- **Harmonization** of common **European standards** to facilitate the **cross-border** acceptance of test results.

DORA (2022)

- It identifies financial **institutions and critical ICT** service providers that are subject to **digital operational resilience** requirements.
- It mandates an **ICT risk-management framework**, incident-**notification** procedures to **competent** authorities within predefined **timeframes**, and periodic compliance assessments.
- It requires **resilience** testing, including Threat-Led Penetration Testing, on a **triennial basis**, with structured **governance** mechanisms, **regulatory** oversight, and **sanctions**.
- The **supervision** of the testing phases is **entrusted** to national and **European authorities** vested with **inspection** and **sanctioning powers**.

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TIBER-EU: the European Framework for Advanced Cyber Resilience Assessment

The **TIBER-EU** framework is a **standardized methodology** developed by the **European Central Bank** to enhance the **cyber resilience** of the **financial sector** against sophisticated cyber threats. **Introduced in 2018**, TIBER-EU aims to **harmonize** advanced **testing practices** across **EU** member states and to foster collaboration among **competent authorities**, financial institutions, and service providers.

Objectives

- **Reconstruct**, under controlled laboratory conditions, the tactics, **techniques**, and procedures (**TTPs**) associated with sophisticated **APT** groups by leveraging targeted threat **intelligence** and **realistic** operational scenarios.
- **Quantify performance metrics**, such as the mean time-to-detect and mean **time-to-contain** an incident, and evaluate their functional impact on **essential operational activities**.
- Evaluate the **effectiveness of escalation**, communication, and decision-making protocols under **cyber-stress** conditions, including simulated insider-threat scenarios.
- **Generate empirical** evidence to inform the drafting of a **Resilience Improvement Plan** aimed at **addressing identified** gaps in personnel, **processes**, and **technologies**.

Phases

- **Threat Intelligence**: systematic aggregation and analysis of OSINT, HUMINT, and SIGINT to identify Advanced Persistent Threat TTPs, culminating in the production of a Threat Intelligence Report (TIR) and the delineation of realistic attack scenarios.
- **Test Execution**: the Red Team executes stealth attack campaigns outlined in the TIR, while the White Team provides real-time oversight to facilitate an end-to-end evaluation of detection, response, and recovery capabilities.
- **Closure Phase**: debriefing sessions with supervisory authorities and internal governance bodies, preparation of the Red Team Test Report, and development of the Resilience Improvement Plan, detailing corrective actions and follow-up performance indicators.

Governance

- The **TIBER-EU** framework ensures the active involvement of competent authorities (such as the **European Central Bank** and designated national regulators) to guarantee **methodological consistency**, regulatory oversight, and validation of test outcomes. Its cross-border design enables harmonized implementation across **EU Member States**, fostering public-private cooperation and providing **structured support** to significant entities (e.g., systemically important banks, critical market infrastructures, and insurance providers) in **managing cyber resilience** in accordance with common European cybersecurity standards.
- The **authorities** participate in the validation of the test scope, the review of the TIR, and the final assessment of the **results**, contributing to the formulation of cyber resilience enhancement plans harmonized across all **EU Member States**.

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DORA: the European Regulatory Framework

The **DORA**, which entered into force in **January 2025**, establishes a unified **regulatory** framework designed to ensure that all **financial** entities within the European Union can effectively **manage risks** related to information and communication technologies. The importance of DORA is reaffirmed by the **European Supervisory Authorities** (EBA, EIOPA, ESMA), which have established **technical standards** and guidelines for the correct and **harmonised** implementation of its provisions.

DORA

The **DORA**[1] establishes a unified **regulatory framework** designed to ensure that all financial entities within the **European Union** can effectively manage risks related to **information and communication technologies.**

The regulation is structured around five core pillars:

- **ICT risk management** through a governance framework proportionate to the size and complexity of the bank
- **Mandatory** timely **reporting** of **IT security incidents**
- **Conducting** operational resilience tests, including **Threat-Led Penetration Tests** (TLPTs)
- Enhanced **supervision of critical third-party** ICT service providers
- **Promotion of voluntary sharing** of cyber-threat intelligence among authorized entities

1 RTS

The **first Regulatory Technical Standard (RTS)** package under DORA was issued in **January 2024** by the three **European Supervisory Authorities** (EBA, EIOPA, ESMA).

It delineates the technical and implementing standards for the following DORA articles:

- **Article 15 and 16**: RTS on the ICT risk management framework and the simplified ICT risk management framework.
- **Article 18**: RTS on the criteria for classifying ICT-related incidents and significant cyber threats, including materiality thresholds and proportionate calibration measures based on the size and risk profile of the financial entity.
- **Article 28**: Implementing Technical Standards on harmonised templates for maintaining the register of contractual information with third-party ICT service providers.

2 RTS

The **second RTS** package under the Digital Operational Resilience Act (DORA) was issued by the three **European Supervisory Authorities** (EBA, EIOPA and ESMA) in **July 2024**.

It elaborates and provides interpretative guidance for the following DORA articles:

- **Article 20**: Specifications for the content, format, templates, and timelines for reporting material ICT-related incidents and significant cyber threats.
- **Article 32**: Harmonisation of the conditions enabling supervisory activities for critical third-party ICT service providers (CTPPs).
- **Article 26**: Specifications of the methodological and organisational requirements for conducting Threat-Led Penetration Tests (TLPT).

[1]For a deeper analysis, we suggest:
- D.Esposito; M.Cecchin; B.Ghilardi; Digital Operational Resilience Act – DORA; JiT; Feb 2023
- N.Mazzoni; G.Campaniolo; A.M.Frontera; ICT Risk: Focus on DORA; JiT; June 2025

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DORA RTS: Focus on Testing and Attack Simulations

The **DORA RTS** on advanced digital operational resilience testing **define rigorous requirements** and **structured methodologies for security testing**, with an emphasis on threat-informed and intelligence-led attack simulations. **Tests must encompass the entire digital perimeter** (including critical infrastructure, core applications, and third-party providers) to **detect systemic vulnerabilities and assess preparedness** to manage complex incidents.

The RTS specifies the operational procedures for conducting advanced testing, including controlled attack simulations (TLPT). These tests must be designed to replicate realistic threat scenarios based on up-to-date intelligence and conducted by independent, qualified teams.

Periodicity

Advanced **tests** must be conducted at **least every three years**, unless otherwise stipulated by the competent authorities according to the organization's risk profile.

Technique

The use of methodologies recognized at the European level, such as the TIBER-EU framework, is **required to ensure coherence**, **traceability** and **repeatability** of the tests.

Validation

Test results must be **documented**, **analyzed** and **reviewed** by management and internal control bodies, with the objective of integrating the findings into continuous improvement plans.

A distinctive element of advanced testing is the **mandatory engagement** of **external red teams**, selected according to criteria of independence, experience, and certification. These teams simulate **sophisticated attacks**, testing the organization's ability to detect, contain, and respond to persistent, targeted threats. Their contribution is essential for **validating** the **effectiveness** of **security controls** and **strengthening** the overall **defensive posture**.

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TLPT: a Comparative Analysis of RTS DORA and TIBER-EU

Under the **EU regulatory** framework, **TLPT** activities are governed by **two primary structures**: the voluntary **TIBER-EU** framework and the binding **RTS** introduced by **DORA**. The transition from **TIBER-EU** to the **RTS** under **DORA** reflects a regulatory **maturation** from a flexible, **exploratory approach** to a **harmonized** and **enforceable** framework. While TIBER-EU laid the **groundwork** for **intelligence-led testing practices**, DORA **consolidates** these **principles** into a unified **regulatory** architecture, enhancing the **cyber resilience** and **supervisory consistency** of the **European** financial sector. The comparative **table** highlights the principal **differences** in **scope**, **governance**, and **regulatory integration**.

Dimension	TIBER-EU	RTS (DORA)
Legal Nature	Voluntary framework	Legally binding regulatory standards
Applicability	National or cross-border financial entities	All financial entities under DORA scope
Regulatory Oversight	Coordinated by national competent authorities	Centralized oversight by European supervisory authorities
Threat Intelligence Integration	Recommended but not uniformly enforced	Mandatory and embedded in the testing lifecycle
Provider Qualification	General recommendations	Strict eligibility and independence criteria for TLPT providers
Risk Management Integration	Often treated as a standalone exercise	Fully integrated into the ICT risk management lifecycle
Reporting Obligations	Limited and jurisdiction-dependent	Harmonized reporting and notification duties across the EU

02

Testing Process

Main Participant in the TLPT

General Overview

Preparation Phase

Testing Phase

Closure Phase

Testing Process 1/5

Main Participant in the TLPT

Threat-Led Penetration Testing (**TLPT**) is a **structured approach** to evaluating the **resilience of financial institutions** against advanced cyber threats. It involves **specialized teams** with **defined roles** working together to ensure the confidentiality, integrity, and effectiveness of the process. This framework enables threat simulation, defense assessment, and strategic oversight, helping institutions identify vulnerabilities and **enhance** their **cybersecurity posture**.

1. **TLPT cyber team:** It is composed primarily of **test managers** who are responsible for **overseeing, planning**, and **coordinating individual TLPT exercises**. The TCT acts as the single point of contact for all test-related communications, ensures the **validation** of **key decisions** and **supports financial entities** throughout the testing process.

2. **The control team (White team):** It manages the TLPT on **behalf of the financial entity**, covering **procurement, risk assessment,** and **daily test coordination**. The control team lead should have the necessary mandate within the financial entity to **guide all the aspects of the test**, without compromising the secrecy of the test

3. **Blue Team:** It is made up of those employees that are **defending the financial entity** against simulated or real cyber threat while not knowing that they are tested. It is responsible for **drafting the BT Report** (Blue Team report), a **technical document detailing**, for each tested threat scenario, the **defensive actions** carried out by the Blue Team during the testing activities.

4. **Threat intelligence (TI) provider:** It is an **external provide**r whose services have been acquired by the control team. It **gathers targeted information** on the entity, emulating the search that would be performed by an experienced hacker and provides this information to the entity in the form of a **TI Report**

5. **Testers (Red Team):** It could be an **internal/external supplier** whose services have been acquired by the control team. Its objective is to **attempt to violate the entity's security safeguards**, following a strict and ethical red teaming methodology.

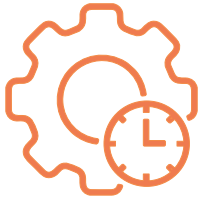
Testing Process 2/5

General Overview

The overall **TLPT** process consists of **three main steps**: of three key phases**: Preparation**, where scope and teams are defined; **Testing**, involving threat intelligence and red teaming; and **Closure**, focused on reporting, remediation, and regulatory attestation. This process is **fully aligned** with the one described in the **TIBER-EU framework**

Preparation

During this phase, the **control team is established, the scope is defined**, and threat **intelligence providers** and **testers are selected** and, if necessary, procured.
A key to TLPT success is early preparation. **Authorities** should **inform** financial entities of the **TLPT requirement** well in advance of the actual test and request a **designated contact** to ensure **confidentiality**. **Entities** are also **encouraged** to **engage early** with **threat intelligence providers** and **assess internal testing resources** as soon as they know they fall under the TLPT obligation in Article 26 of DORA.



Testing

The process is divided into a **threat intelligence phase**, which results in the **development of scenario**s that will later be **tested during the red teaming phase**.
The active **red teaming exercise** must **last at least 12 weeks**, a duration necessary to realistically simulate the behavior of stealthy threat actors.
However, the precise **length** of each test will be **adjusted** in **coordination** with the **TLPT authorities**, considering the specific context of each test, such as the characteristics of the financial entity involved, or whether the test includes an ICT service provider or multiple financial institutions.

Closure

At this stage, the TLPT is disclosed to the blue team, and **both red and blue teams draft their respective reports.** Then, they engage in a purple teaming session to review and discuss key offensive and defensive actions.
The **financial entity prepares a summary report** and a **remediation plan**, which are submitted to the **TLPT authority**. Finally, the **authority issues** an attestation confirming that the **TLPT** was **conducted** in line with the **regulation**, specifying the critical or important functions that were tested.

Testing Process 3/5

Preparation Phase

The preparation phase consists of **four stages**. It starts with i) **pre-launch meeting**, which is followed by ii) **procurement**, iii) **scoping** and finally iv) **launch meeting**

The **White Team Leader (WTL)** holds a pre-launch meeting with the **Test Team Manager (TTM)** and selected **White Team (WT)** members to review key aspects of the TLPT. The **TTM outlines** the **testing process**, **roles** and **responsibilities**, **security protocols**, **contractual terms**, and **test planning**. Relevant guidance documents may also be discussed. To ensure secure and open communication, all parties, including WT members and **Threat Intelligence (TI)** and **Red Team (RT)** providers, should sign a Non-Disclosure Agreement (NDA).

The WT begins **procuring TI** and **RT services**, either after or alongside the pre-launch meeting, based on the **Test Coordination Team's (TCT) decision**. Providers must meet strict due diligence criteria and be independent third parties. The process follows TIBER-EU Procurement Guidelines and includes issuing a **Request for Proposal (RFP)**, evaluating offers, and signing contracts covering security, confidentiality, and prohibited actions.
Once complete, the **WT confirms compliance** with the **relevant guidelines**.

The scoping phase defines the scope of the TLPT and **identifies critical functions** (CFs) to be tested. **WT** and **TTM collaborate** using tools like Business Impact Analysis and threat reports.
The **WT** drafts a **Scope Specification document** with test objectives ("flags"), which are reviewed and finalized in a scoping meeting. The **scope** must be **approved** at **Board level**.
If procurement is complete, TI and RT providers may participate; otherwise, a follow-up meeting is held.

The **launch meeting** brings together **all key stakeholders** (including the Test Team Manager, White Team, and TI/RT providers) to align on the **TLPT process**, expectations, and the draft project plan. Its purpose is to **clarify responsibilities, scheduling**, and **execution.** Once procurement is complete and contracts are in place, the **White Team** prepares a **draft project plan** covering logistics, test objectives, scope, timeline, risk management, and communication. This plan is shared before the meeting.

Pre-launch meeting → Procurement → Scoping → Launch Meeting

Testing Process 4/5

Testing Phase

The testing phase begins once the scope is defined, providers are selected, and all parties are informed of their roles. The Threat Intelligence (TI) provider collects information to develop realistic threat scenarios, which the Red Team (RT) uses to create the TLPT. This phase is characterized by 3 processes:
i) **Targeted Threat Intelligence (TTI) and identification of threat scenarios (ITS);** ii) **Red teaming test planning** and iii) **Red teaming test execution**

TTI and ITS

The Threat Intelligence (TI) Provider develops a **tailored TTI Report** using sources like the Generic Threat Landscape (GTL) and internal collaboration. This report **outlines potential attack surfaces** and **threat scenarios**. It is reviewed by the White Team (WT), Threat Test Manager (TTM), and Red Team (RT) Provider to ensure accuracy and adjust test flags if needed, with possible input from national security agencies. Once validated, the RT Provider drafts the **Red Team Test Plan**, aligning it with the defined scope. A joint workshop may be held to finalize scenarios, flags, mitigations, and timelines. Both the TTI Report and Test Plan are then finalized and remain strictly confidential.

Red teaming test planning

Following the TTI phase, the Red Team (**RT**) Provider **plans** and **executes** the **TLPT** on systems supporting critical functions, typically over 10–12 weeks. Using the TTI and GTL Reports, the RT **simulates realistic attacks** based on real threat actors, possibly including a special 'Scenario X' for emerging threats. The White Team (WT) monitors the test, provides support, and can halt it if necessary. The TI Provider may offer ongoing intelligence. All actions must be ethical, controlled, and avoid operational or financial disruption.

Red teaming test execution

The **TLP**T should **start** soon **after the TTI Report**, adapting to the test's complexity. The Red Team executes **stealthy, threat-based attacks**, with flexibility to deviate from the plan when needed, including 'Scenario X' for emerging threats. If blocked, the White Team (WT) and Threat Test Manager (TTM) may provide controlled support. The **WT monitors progres**s, ensures documentation, especially for flag capture, and can stop the test at any time. Regular updates and coordination are essential, while the Blue Team remains unaware. A draft **Red Team Test Report** is **delivered within two weeks** of test completion.

Testing Process 5/5

Closure Phase

The closure phase of TLPT **marks the final stage of the process** and typically **lasts around four weeks**. It involves all key stakeholders, including the Blue Team (BT), which is informed of the test only after its execution. The main objective of this phase is to **analyze the test results, identify lessons learned,** and **implement improvements to enhance the entity's cyber resilience**.

01 **Red Team Test Report:** The RT Provider prepares a **detailed report** within two weeks of test completion. It outlines the **attack scenarios**, **techniques used**, **results achieved**, and r**ecommendations** for **improving** detection, response, and overall security posture.

02 **Blue Team Report:** The BT documents its defensive actions during the test. This report is **essential** for the replay workshop and helps **assess** the **effectiveness** of the entity's detection and response capabilities.

03 **Replay Workshop :** A collaborative session between the RT Provider and BT, often conducted as a Purple Team exercise. It involves **replaying attack scenarios**, **analyzing** both **offensive** and **defensive actions**, and **identifying areas for improvement**. The RT Provider also shares insights on what could have been achieved with more time or resources, simulating real-world attacker behavior.

04 **360-Degree Feedback Meeting:** Organized by the TTM, this meeting includes the WT, BT, TCT, and the TI and RT Providers. It serves as a platform for mutual feedback on the entire TLPT process. Participants **discuss** what **worked well**, what **could be improved**, and **share suggestions** for future exercises. A 360-degree Feedback Report may be shared anonymously with the TKC to support continuous improvement of the framework.

05 **Remediation Plan:** Developed by the WT with input from the TI and RT Providers and approved by the entity's board, this plan **outlines corrective actions** to address the **vulnerabilities** identified during the test. The TTM is informed of the plan and may monitor its implementation.

06 **Test Summary Report:** A high-level, non-technical summary of the test**, based on all documentation produced** during the process. It excludes sensitive technical details and is shared with the TCT and, if agreed, with other relevant authorities.

07 **Final Attestation:** Once all reports are finalized and the Remediation Plan is approved, the entity's board and the TI/RT Providers sign an **attestation confirming** that the **test was conducted** in accordance with **TIBER-EU requirements**. This is submitted to the TTM.

03

Final Remarks

Role of European Supervisory Authorities in TLPT

Strategic Implications for Banks

Final Remarks 1/2

Role of European Supervisory Authorities in TLPT

The European supervisory authorities (EBA, EIOPA, ESMA, together with the European Central Bank) are tasked with defining and updating the technical standards for the execution of **Threat-Led Penetration Testing** (TLPT) under DORA. In this capacity, they develop **RTS** that delineate the criteria for entity **scope identification**, the minimum qualifications for **threat-intelligence** and **red-teaming providers**, and the **methodological parameters** for test scoping, execution, and closure.

Management and coordination of Threat-Led Penetration Testing

- The **RTS** under **DORA** constitute the national and European **reference framework** for **TLPT**. **Designated authorities**, in **cooperation** with the **TIBER Cyber Team**, leverage the RTS to:
  - **Approve exercise scoping** and **define the Rules of Engagement**
  - **Oversee** and **monitor** the entire **testing process**
  - **Validate** the **final Red Team Test Report** and the **remediation plan**
- Consistent adoption of the RTS ensures **methodological uniformity**, **operational security**, and **effective accountability**, while also promoting mutual recognition of test results across Europe.

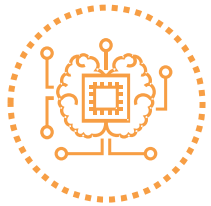
- National and European **competent authorities**, vested with inspection and sanctioning powers, **oversee compliance** with **TLPT requirements** under the TIBER-EU/TIBER-IT framework.
- Through formal assessment and inspection procedures, they verify the **proper execution of scoping, threat-intelligence gathering**, **red-teaming,** and **remediation phases**. In cases of non-compliance, they may impose sanctions commensurate with the severity of the violations.
- A **mutual-recognition mechanism** ensures that test **results generated** in one Member State **are accepted** in others, **avoiding duplication** and **resource inefficiency**. This guarantees a **consistent, comparable,** and **rigorous application** of the digital resilience framework throughout the European Union.

Oversight and inspection of the execution procedures for Threat-Led Penetration Testing

Final Remarks 2/2

Strategic Implications for Banks

The implementation of **TLPT** under the **DORA** represents a **strategic shift** for financial institutions. It not only **enhances cybersecurity posture** but also **aligns operational resilience** with **regulatory expectations**. Banks planning to adopt TLPT face several **strategic implications** that can enhance their cyber efficiency.



Enhanced Digital Resilience

TLPT helps banks **proactively identify** and **mitigate vulnerabilities** across systems, processes, and third-party dependencies

Strategic Regulatory Alignment

Conducting TLPT in line with TIBER-EU ensures **compliance with DORA** and **strengthens institutional credibility.**

Third-Party Risk Management

Banks can **assess** and **integrate critical ICT providers** into resilience testing, improving supply chain security

Security Culture and Continuous Learning

TLPT **fosters collaboration between** internal **teams** and external testers, promoting a culture of security awareness.

Technology Investment and Prioritization

Implementing TLPT **drives investment** in monitoring tools, automation, and threat intelligence capabilities

Governance and Board Accountability

The board is directly responsible for ICT resilience, making TLPT a **strategic oversight tool.**

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