# Applying Acceptance Test Driven Development to a Problem Based Learning Academic Real-Time System

## 11TH INTERNATIONAL CONFERENCE ON INFORMATION TECHNOLOGY : NEW GENERATIONS

# Authors

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# Summary

- Introduction
- Case Study: Unauthorized Access and Fraud
- Methodology
- TDD
- Test Results
- Conclusion

# Introduction

- Financial institutions lose annually billions of dollars resulting from unauthorized access and fraud on electronic commerce transactions.
- Computer systems are susceptible to defects
- Agile methods have TDD as one of their principles
- Problem Based Learning (PBL) reveals unseen potentials and provides a dynamic learning process.

# Introduction

- This paper presents
  - **Test Driven Development** applied to a computer system prototype using **Problem Based Learning** in an **Interdisciplinary** environment
  - The PBL is a Case Study about **Unauthorized Access and Fraud**

# Case Study – Unauthorized Access and Fraud

- Academic scope
- Involving unauthorized access and fraud
- Prototype of a Real-Time Embedded System for Unauthorized Access Control and Fraud Detection (**SETRAIF**) was designed and developed

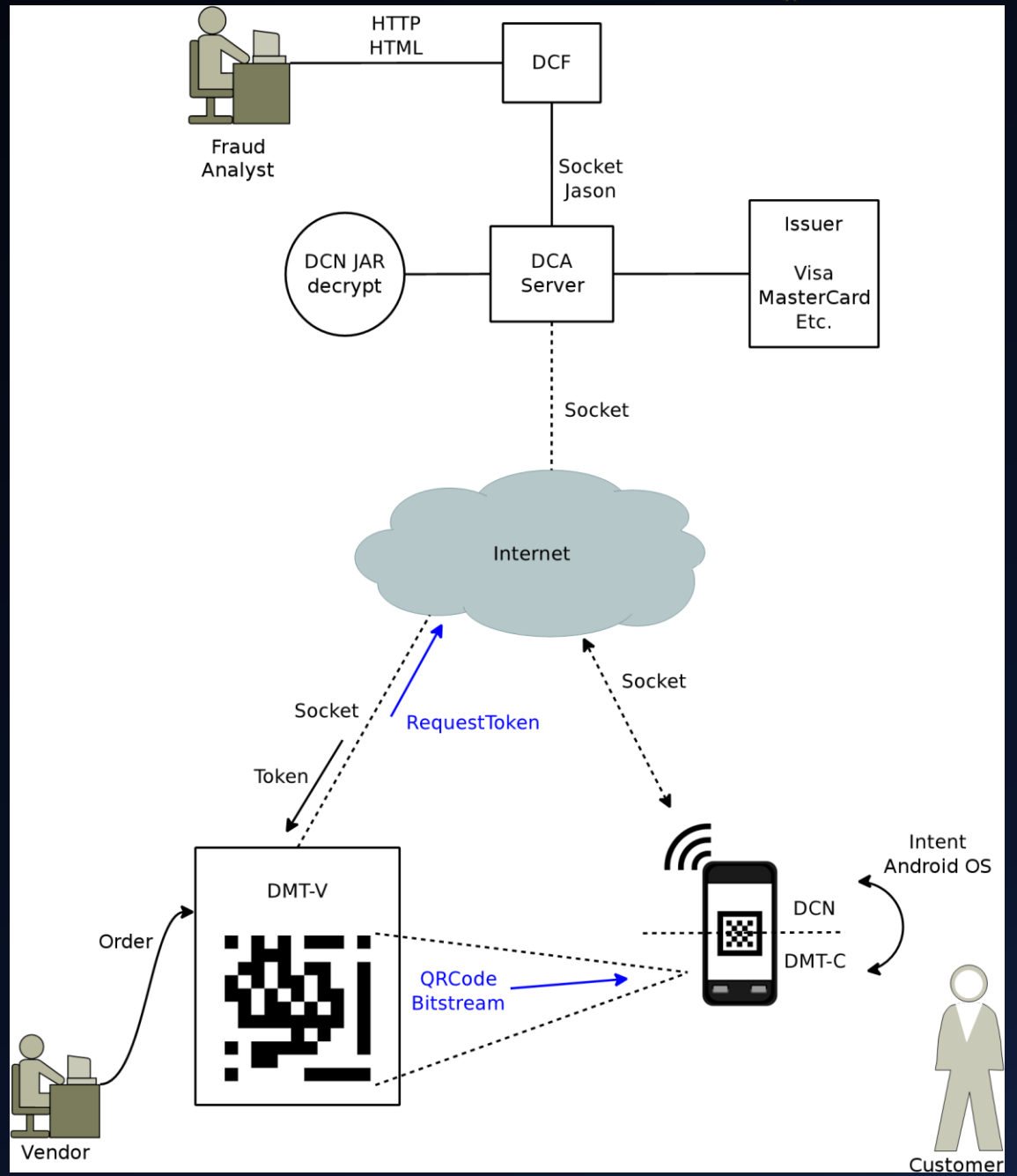
# SETRAIF - Real-Time Embedded System for Unauthorized Access Control and Fraud Detection

Transactions Mobile Device (DMT)

Cloud Communication Device (DCN)

Access Control Device (DCA)

Fraud Control Device (DCF)



# SETRAIF - Real-Time Embedded System for Unauthorized Access Control and Fraud Detection

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The DMT provides electronic transactions
- The customer module (DMT-C)
- The vendor module (DMT-V).

First, the customer gets the product's information by QR Code and electronically communicates his or her buying interest to the vendor.

Subsequently, the DMT-V module acquires the data of the product, customer, vendor, and geolocation.

The DMT-V asks the DCN for authorization (via token) to sell the product. If it is confirmed, the order is released to the customer.

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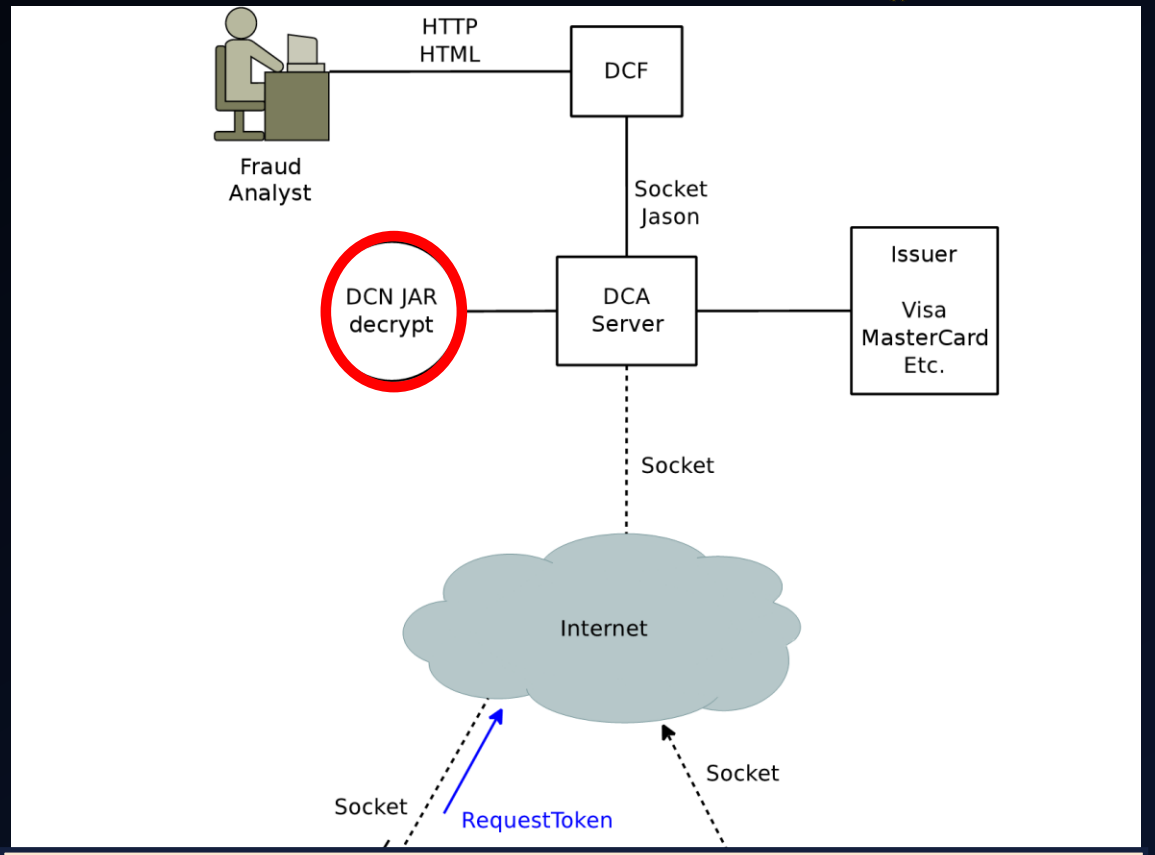


The DCN, which is a communication layer with the Internet (cloud) on the customer device, provides the secure exchange (encrypted) of information between the DMT and the DCA.

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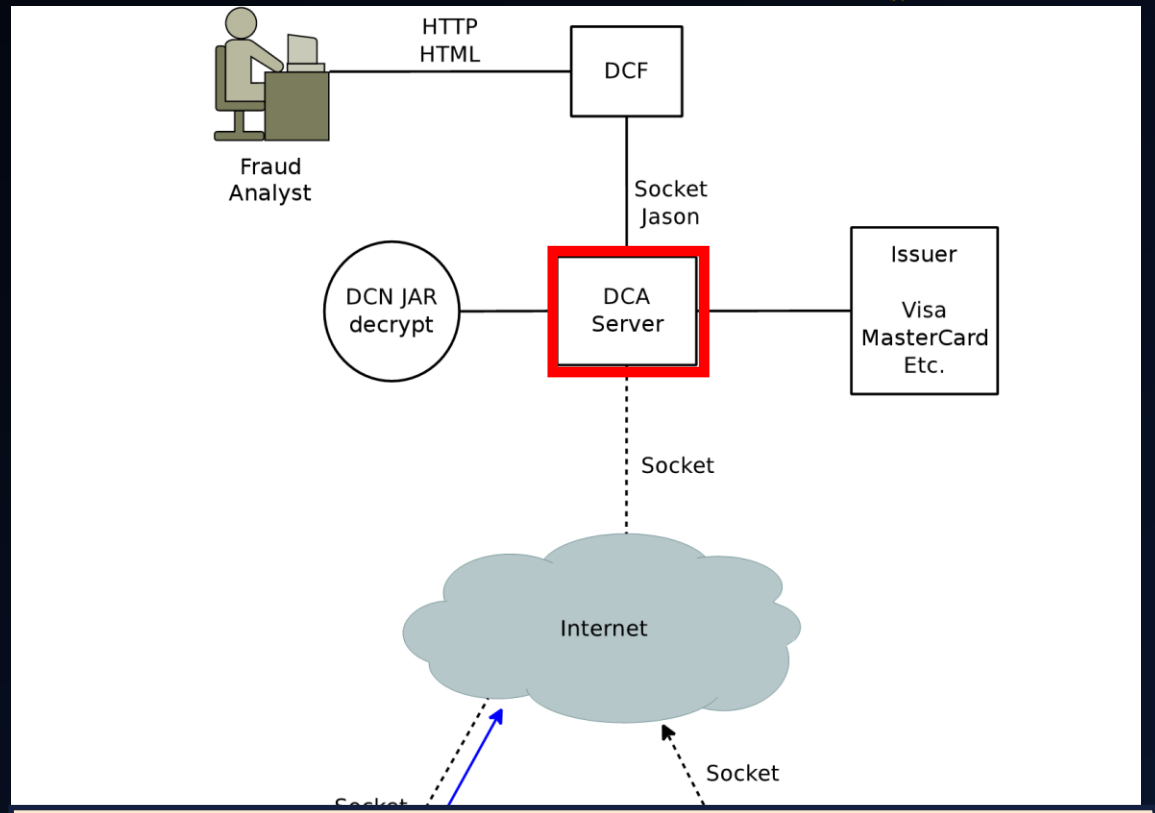


The DCA uses the information from the vendor and customer devices to validate or block access.

On success, the information is sent to the DCF and later to a credit card company.

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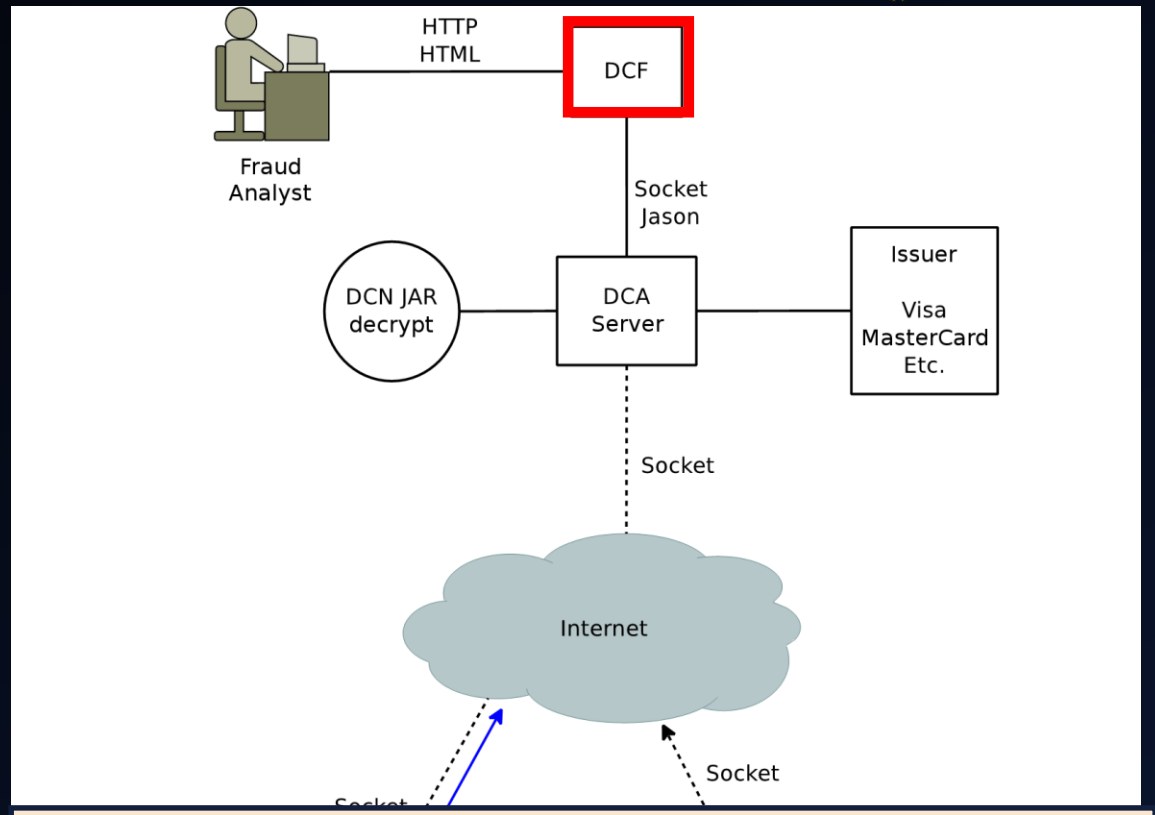



The DCF verifies the legitimacy of the transaction, quickly and reliably, based on the customer's behavior and geographic history, to reduce the risks from fraud for those involved.

# Case Study – SETRAIF

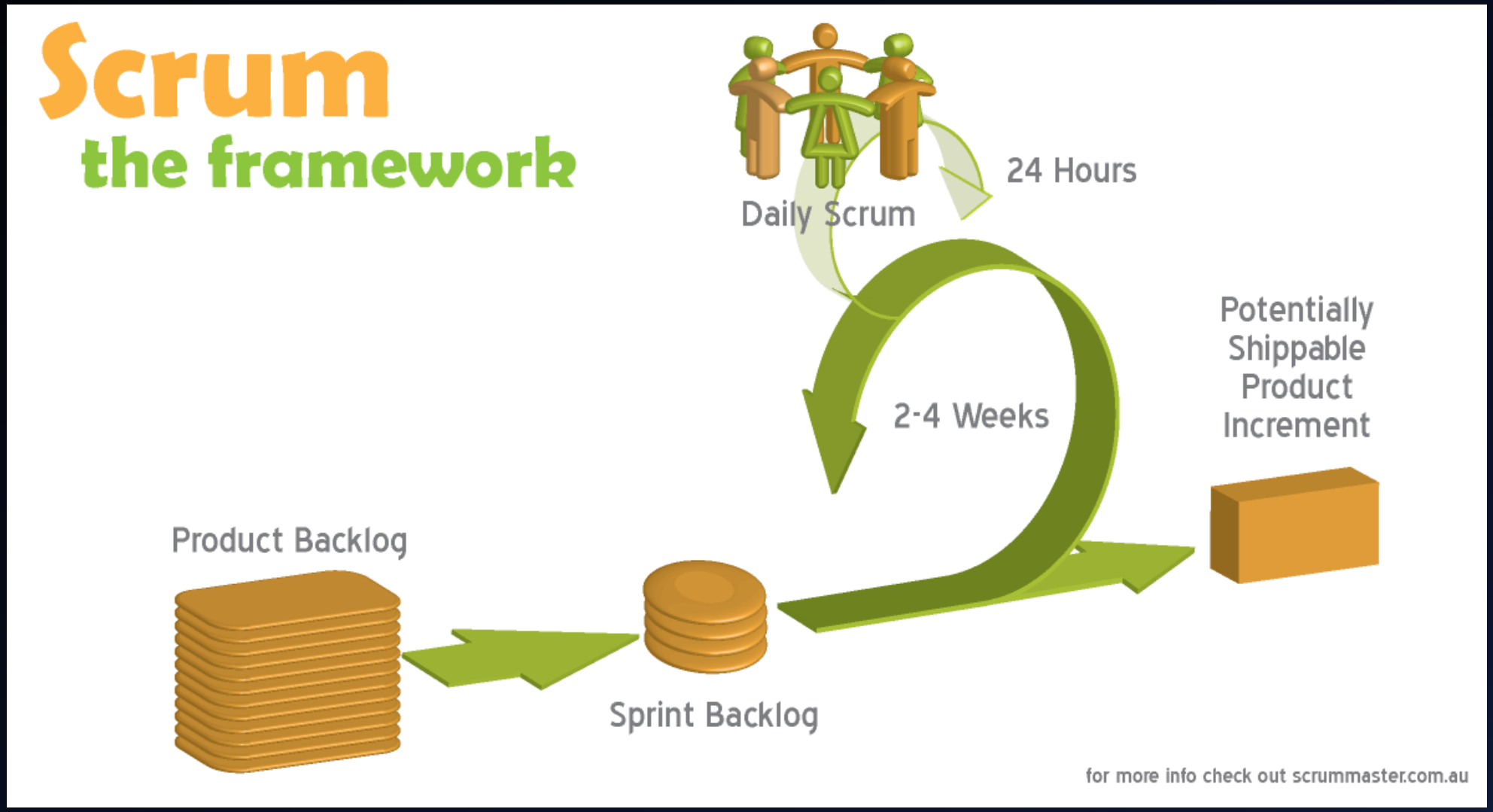
- Completed in 17 weeks
- Aeronautics Institute of Technology – ITA – Brazil
- Team
  - Professors and researchers
  - Students of the undergraduate program in computer engineering
  - Students of the graduate program in electrical engineering and computer engineering

# Case Study – SETRAIF

- Four courses contributed to the accomplishment of this project.

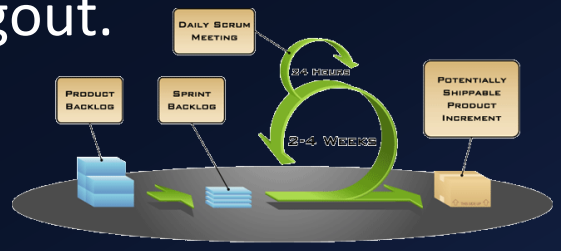
| | | | |
|---|---|---|---|
| CES-63 Embedded Systems (undergraduate course) | CE-235 Real-Time Embedded Systems | CE-230 Software Quality, Reliability, and Safety | CE-237 Advanced Topics in Software Testing |

# Methodology



# Methodology
# Scrum

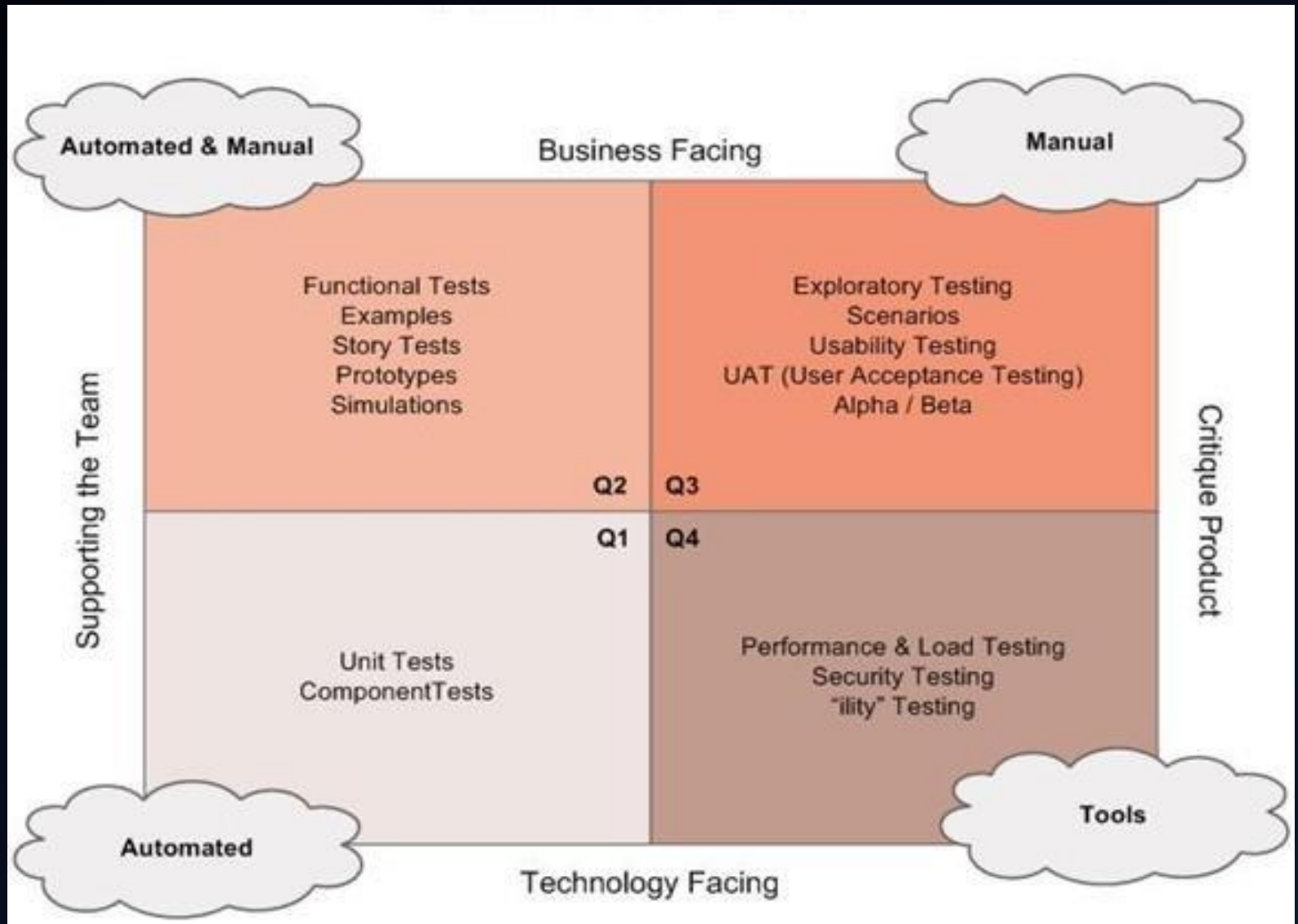
- Scope was reduced and two sprints of four weeks each were defined
- A student developer team was established for each one of the SETRAIF's devices
- Each team had a professor as a product owner and a scrum master represented by a student from the Real-Time Embedded Systems course
- INVEST (Independent, Negotiable, Valuable, Estimable, Small, and Testable) criteria was used to write the requirements into user stories
- Planning poker technique was used to measure the development effort
- Testing activities occurred in both sprints
- Use of collaborative tools for virtual meetings, like Google Hangout.



# TDD

- Quality is not equal to test.
- Quality is achieved by appropriately mixing the development and testing activities
- Testing must be an unavoidable aspect of development
- Two kinds of teams are usually identified:
  - customer team (e.g. business experts, product owners, product managers)
  - developer team (e.g. developers, testers)
- Testers must have technical and business knowledge

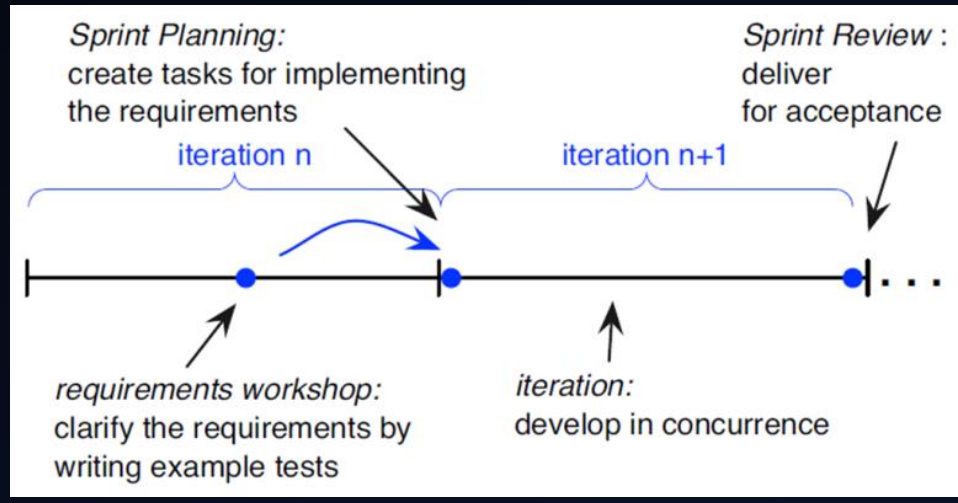
# Testing Strategy



# Testing Strategy

- We used:
  - Acceptance Test Driven Development (ATDD)
  - ATDD's artifacts and techniques, such as: charter, persona, scenarios, and use cases used for requirements clarification
  - Theme Screening and the Theme Scoring techniques enabled the prioritization.
  - Those techniques helped in the identification and documentation of complex business rules and in a significant reduction of test cases to achieve more efficient results.

ATDD steps mapped to Scrum



# Running Tests and Tests Results

- Automating and running test cases for the SETRAIF prototype in both sprints, during the unit testing, integration testing, system testing, and acceptance testing phases, in order to increase the product's quality
- Among the various tools used for this purpose, the prominent were:
  - Robot Framework
  - Selenium
  - Coverage

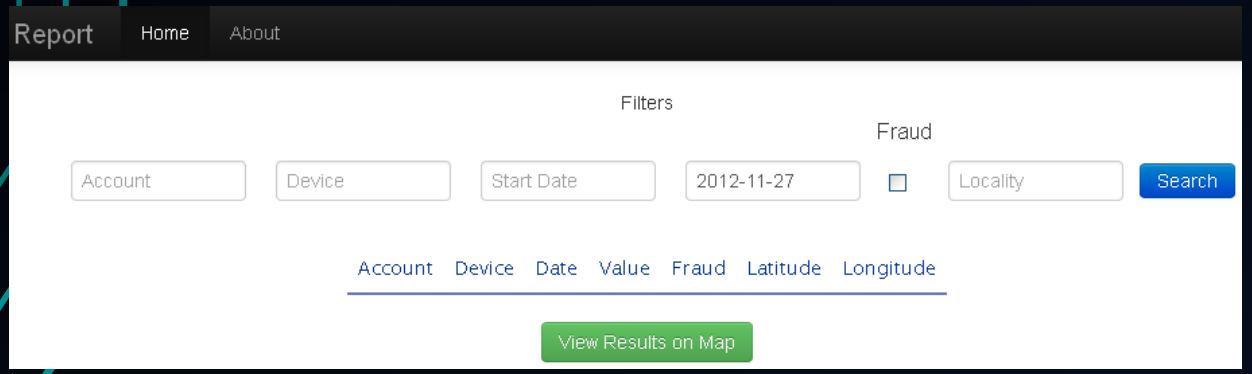
# Robot Framework

- BDD
  - Given
  - When
  - Then

| Setting | Value |
|---|---|
| Resource | resource.html |
| Test Teardown | Close Browser |

| Test Case | Step | Argument |
|---|---|---|
| Homepage | **When** the homepage is open | |
| | **Then** it is correctly shown | |
| Filtering Fields | **When** the homepage is open | |
| | **Then** the filtering fields are shown | |
| Valid Account | **Given** a valid account | 1001 |
| | **When** I click "Search" | |
| | **Then** the report is shown | |
| Invalid Account | **Given** an invalid account | X |
| | **When** I click "Search" | |
| | **Then** a message is shown | |
| Valid Start Date | **Given** a valid start date | 2012-11-27 |
| | **When** I click "Search" | |
| | **Then** the report is shown | |
| Invalid Start Date | **Given** an invalid start date | X |
| | **When** I click "Search" | |
| | **Then** a message is shown | |
| Valid End Date | **Given** a valid end date | 2012-11-27 |
| | **When** I click "Search" | |
| | **Then** the report is shown | |
| Invalid End Date | **Given** an invalid end date | X |
| | **When** I click "Search" | |
| | **Then** a message is shown | |

# Robot, Selenium and Coverage




REPORT
Generated
20121127 11:22:38 GMT-02:00
300 days 22 hours ago

## Report Tests Test Log

### Test Statistics

| Total Statistics | Total | Pass | Fail | Elapsed | Pass / Fail |
|---|---|---|---|---|---|
| Critical Tests | 8 | 4 | 4 | 00:01:59 | |
| All Tests | 8 | 4 | 4 | 00:01:59 | |

| Statistics by Tag | Total | Pass | Fail | Elapsed | Pass / Fail |
|---|---|---|---|---|---|
| No Tags | | | | | |

| Statistics by Suite | Total | Pass | Fail | Elapsed | Pass / Fail |
|---|---|---|---|---|---|
| Report Tests | 8 | 4 | 4 | 00:01:59 | |

### Test Execution Log

TEST SUITE: Report Tests — Expand All

Full Name: Report Tests
Source: C:\Documents and Settings\Administrador\Meus documentos\eclipse\setraif-dcf-master\htests\robot\report_tests.html
Start / End / Elapsed: 20121127 11:20:39.062 / 20121127 11:22:38.171 / 00:01:59.109
Status: 8 critical test, 4 passed, 4 failed
8 test total, 4 passed, 4 failed

- TEST CASE: Homepage — Expand All
- TEST CASE: Filtering Fields — Expand All
- TEST CASE: Valid Account — Expand All
- TEST CASE: Invalid Account — Expand All
- TEST CASE: Valid Start Date — Expand All
- TEST CASE: Invalid Start Date — Expand All
- TEST CASE: Valid End Date — Expand All
- TEST CASE: Invalid End Date — Expand All

# Tests Results

- The techniques used were:
  - Coding Style (CS);
  - Duplicated Code (DC);
  - Unit Testing (UT);
  - Coverage Analysis (CA);
  - Acceptance Testing (AT);
  - Load Testing (LT); and
  - Usability Testing (US).

| Test Approach | Quantity | Pass | Fails |
|---|---|---|---|
| CS | 4 | 0 (0%) | 4 (100%) |
| DC | 1 | 1 (100%) | 0 (0%) |
| UT | 21 | 17 (80.95%) | 4 (19.05%) |
| CA | 4 | 4 (100%) | 0 (0%) |
| AT | 14 | 9 (64.29%) | 5 (35.71%) |
| LT | 1 | 1 (100%) | 0 (0%) |
| US | 7 | 5 (71.43%) | 2 (28.57%) |

# Conclusion

- This paper has described a proposal for a TDD of a computer system prototype using PBL, in an interdisciplinary environment.
- Developing a computer system prototype with PBL requires dedication and commitment to overcome the various obstacles presented.
- The interdisciplinary approach provides that students, who do not know each other, exchange different knowledge and priorities.
- ATDD proved to be essential to the project, facilitating the requirements specification and it also an auxiliary mechanism for quality assurance.

# Acknowledgment


- We’d like to thank
  - Brazilian Aeronautics Institute of Technology (ITA),
  - Casimiro Montenegro Filho Foundation,
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- for supporting this challenge.


# Thank you!!!

Obrigado!