AU Engineering

I4SWT Mandatory Exercise

# Air Traffic Monitoring

Team 16-1-6


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CI build jobs

Unit tests:
`http://ci1.ase.au.dk:8080/job/Team%2016-1-06%20ATM%20(Unit%20Test)`

Integration tests:
`http://ci1.ase.au.dk:8080/job/Team%2016-1-06%20ATM%20(Integration%20Test)`

Code metrics:
`http://ci1.ase.au.dk:8080/job/Team%2016-1-06%20ATM%20(Code%20Metrics)`

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# 1 Introduction

The purpose of this journal is to reflect upon the design, implementation and test of the Air Traffic Monitor system (ATM).
The exercise required not only a working system, but a special effort had to be made to obtain a generic design allowing unit- and integration-tests while also be simple to maintain if changes in the exercise requirements were to be made.

# 2 Design

As earlier stated the design of this solution was given thought as it had to be extensible and adaptive to changes in requirements and allow for easy testing. This section describes the process of obtaining such design and the outcome of the reflections.

## 2.1 Design considerations

An effort was made to design the system based on the five basic principles of object-oriented programming and design, SOLID. These principles applied to a system tend to make this maintainable and extendable.

To create abstraction from the provided .DLL and follow the Dependency-Inversion principle, the ATM makes use of a modified repository-pattern[1]. This allows for a quick change in the data-source to a database for example.

Another heavily used pattern is the Observer Pattern[2], it is in charge of notifying observers about data change, making it possible to only update the user-interface whenever new data is present.

Two sequence-diagrams for the back-end can be seen in figure 0.1 and 0.2. The repository-pattern is used to connect the two sequence-diagrams, thereby connecting the monitor to the data-source, in this case the provided .dll.

The Console Application follows the Single Responsibility to a certain degree, where our Notification- and MonitoredTrackInfoDisplayer only has one responsibilty; Formatting data to construct a List of strings. The way those two classes are implemented involves The Open/Closed principle as well. They both use an interface IRenderable; It opens several advantages towards test-, maintain- and extendability, and as well an easier code to read.

[1] https://msdn.microsoft.com/en-us/library/ff649690.aspx
[2] https://msdn.microsoft.com/en-us/library/ee850490.aspx

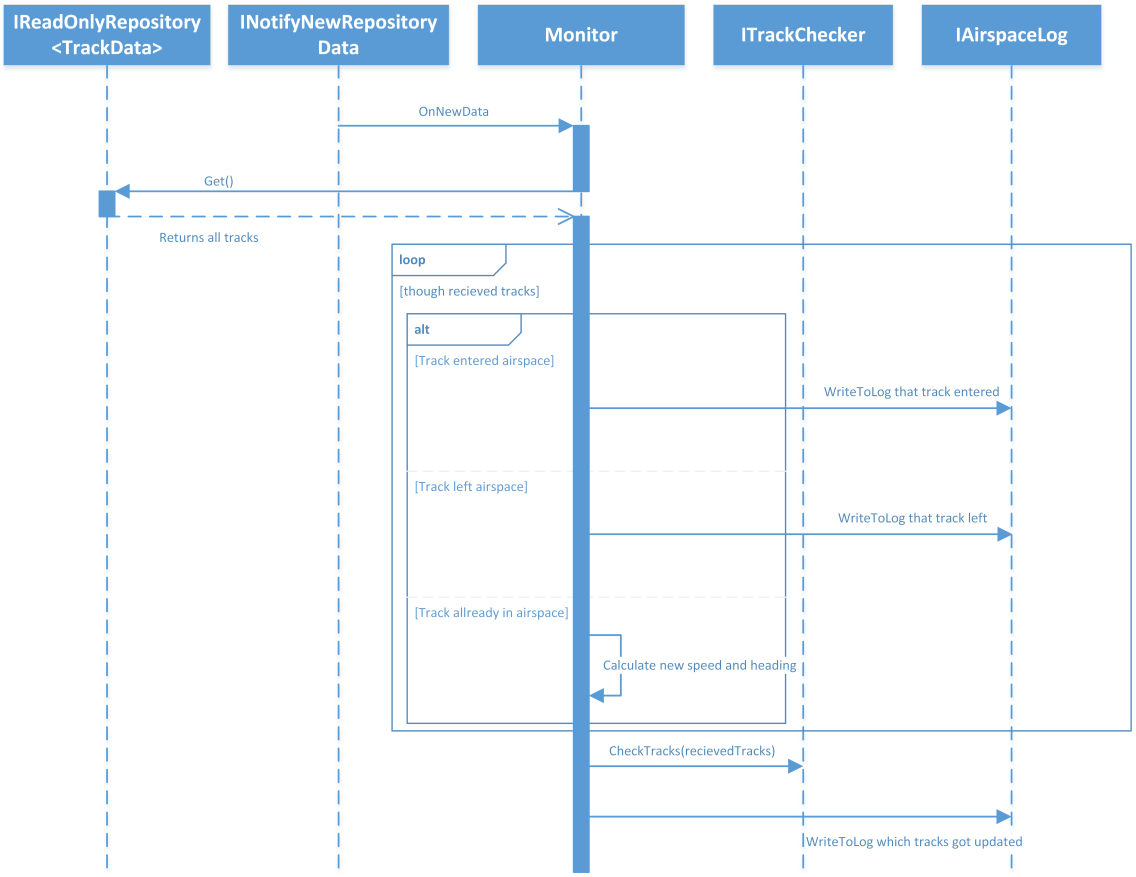


***Figure 0.1.*** Sequence diagram for monitor

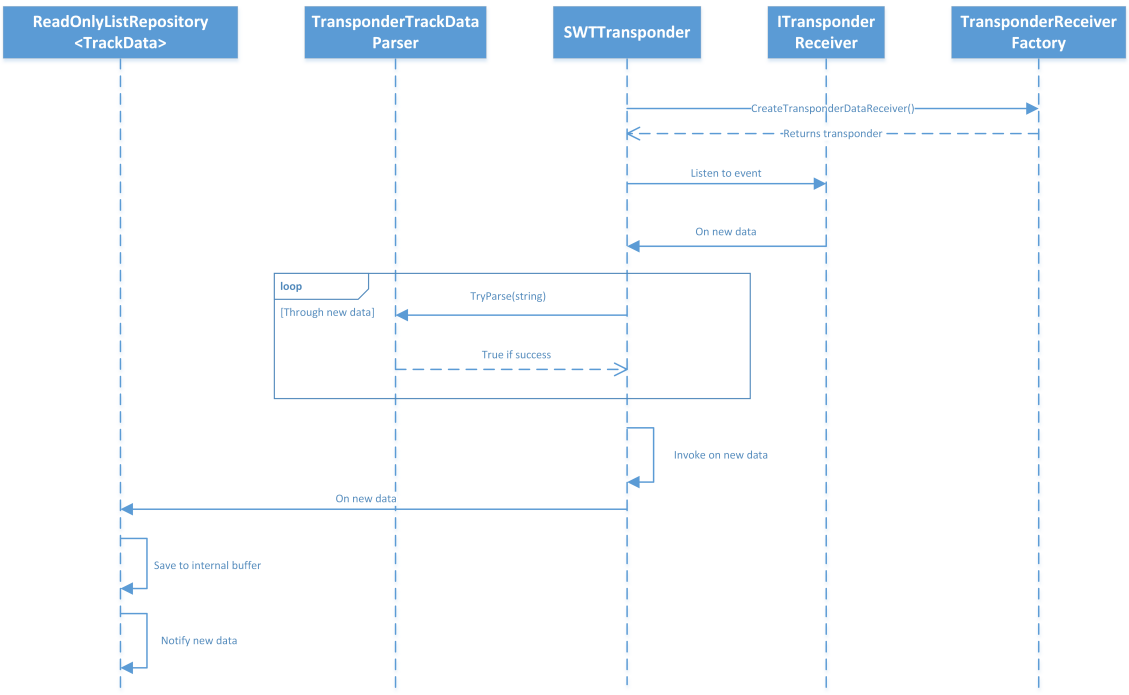


***Figure 0.2.*** Sequence diagram for data acquisition from the transponder .DLL

### 2.2 Implementation

The modification made to the repository-pattern only allows for reads in the repository, the interface can be seen in the 'IReadOnlyRepository', then an implementation of the interface can be seen in 'ReadOnlyListRepository', allowing reads from an in-memory list, but it could also be a database or another data-source.

A choice was made to only include the provided .dll in the UI project, thereby keeping the core-project clean of any unneeded dependencies. So if a change were to be made in the .dll, the core does not need to be recompiled and thereby avoiding redeployment to any of clients distributed that may not need the update.

## 3 Test

This section describes how testing supported the software development of the ATM system.

### 3.1 Unit Test

The software development was closely followed by unit tests to ensure the code reacted as intended and as the requirements demanded.

As reviewed in the I4SWT course multiple practices for writing unit tests exist. In this assignment both *Test Driven Development (TDD)* and *Feature Driven Development (FDD)* were used.

TDD is an agile practice where test should be written before the implementation. This ensures that no code which has not been tested is written. The development cycle tend to be short and the practice encourages simple design in the code.

FDD is the opposite of TDD in where the implementation is written before the tests. Thus the functionality is in focus and the programmers can later decide the satisfying amount of tests. This practice was used more extensively than the TDD as it is less time consuming to implement the features. A drawback was that the focus does not lay with the tests, which could be written at such late time where finding a bug could be a larger inconvenience, than if it was found during the writing of the feature.

### 3.2 Integration Test

Integration testing is the process where the individual software modules are combined and tested as a group. This is to be done after the unit tests have passed.

Preparation for integration testing lies in documenting the modules in a dependency tree as shown in figure 0.3.

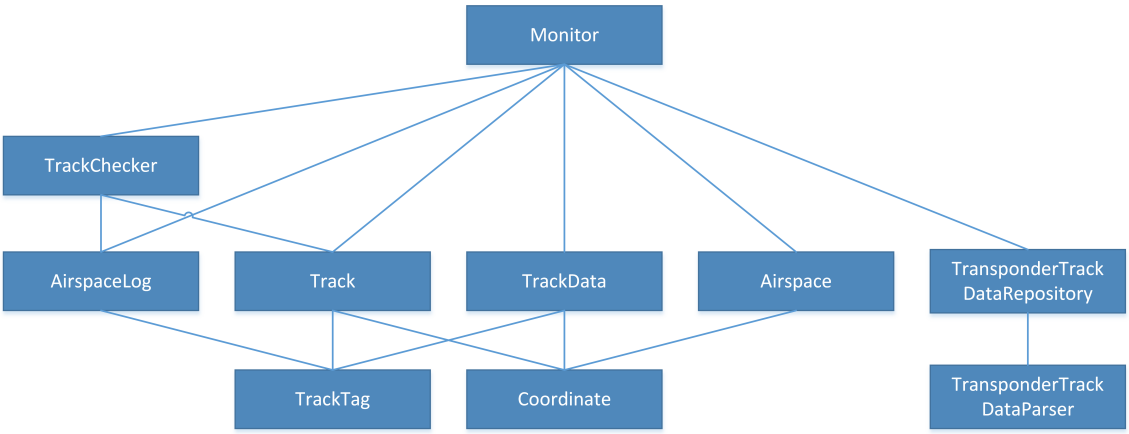


***Figure 0.3.*** Dependency tree for ATM

The Dependency tree shows the integration and inter-dependence of the different classes. We have chosen to use a bottom-up integration. The choice behind this is that a lot of the integration test lies in the unit test for the ATM.

Since the provided .dll provides 'random' data, the choice was made to not including this in integrations-tests, since it could be a couple of minutes before a separation happened, creating long test-suite execution times.

## 3.3 Jenkins

Jenkins[3] is a server-side software package that enabled continuous integration(CI) on a given project. On the ATM, when code gets pushed to the repository Jenkins will first run a build on all of the unit-tests, if this succeeds, Jenkins will subsequent run integration-tests. Once approved it will finally run code metrics, where both maintainability-index and FxCop violations will calculated. As the software began to work some effort was put into fixing the FxCop violations. As seen in figure 0.4 it was brought down to an acceptable level.

[3] `https://jenkins.io/`

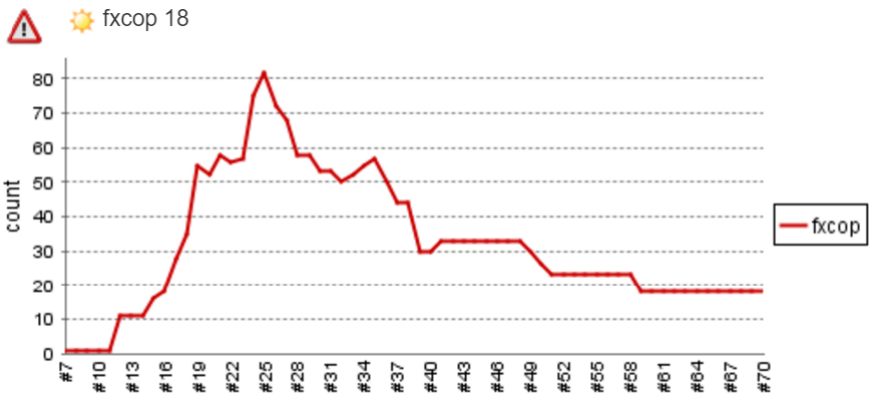


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***Figure 0.4.*** FxCop violations during the process

# 4 Teamwork

In this section the teamwork is described. The requirements were 3-4 people in a group and no more than two persons should share a computer while programming. Another requirement was the use of *Continuous Integration*, which allows the developers push code to a shared build server, that in-turn builds and tests the software multiple times during the development process.

## 4.1 Strategies

Earlier experience from working with strategies from *Extreme Programming* in the course I4SWD, let to the assumption that it could be suitable to use for the software development of the Air Traffic Monitor too.
One of these strategies was *Pair programming*. Code is then written by pairs which share the workstation. One will be in control of the keyboard and write the code while the other will watch the code and work towards the best implementation. The pair switches place every now and then. This ensures that both programmers are engaged in the software.

## 4.2 Continuous integration

As the group was divided into two pairs of developers each working on classes of their own, the continuous integration helped the two groups to gain a shared understanding on the software development progress.
Another benefit was the automatic generated code coverage report and software quality metrics which were used to determine whether the written software and tests were satisfying. If not, it was easy to gather information where the code standards should be optimized for better statistics.
As with every other git project a version history was obtained making it simple to revert to a previous build if changes caused a broken build.

# 5 Conclusion

The process of developing the Air Traffic Monitoring system and compile this journal was made in two weeks. During these weeks multiple strategies from the courses I4SWT and I4SWD were used to satisfy the requirements given.
At all times during the design, implementation and testing, it was ensured that every module should follow the SOLID principles used in agile development. It was given that the requirements could be changed at a time which potentially could cause a major need for re-implementing the system.
Even though it might have taken longer to develop the ATM knowing the possibility of a requirement change, it worked as a great way to motivate reflections upon the design of the system. Furthermore being able to try the different unit testing practices on a larger scale and compare these has been interesting.