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From: Denisa Dinca

Subject: FinTPc Tracker - architecture

Software Architecture
Project: TOSS Benchmarking Tool
Release: FinTPc Tracker
Version: 3.0

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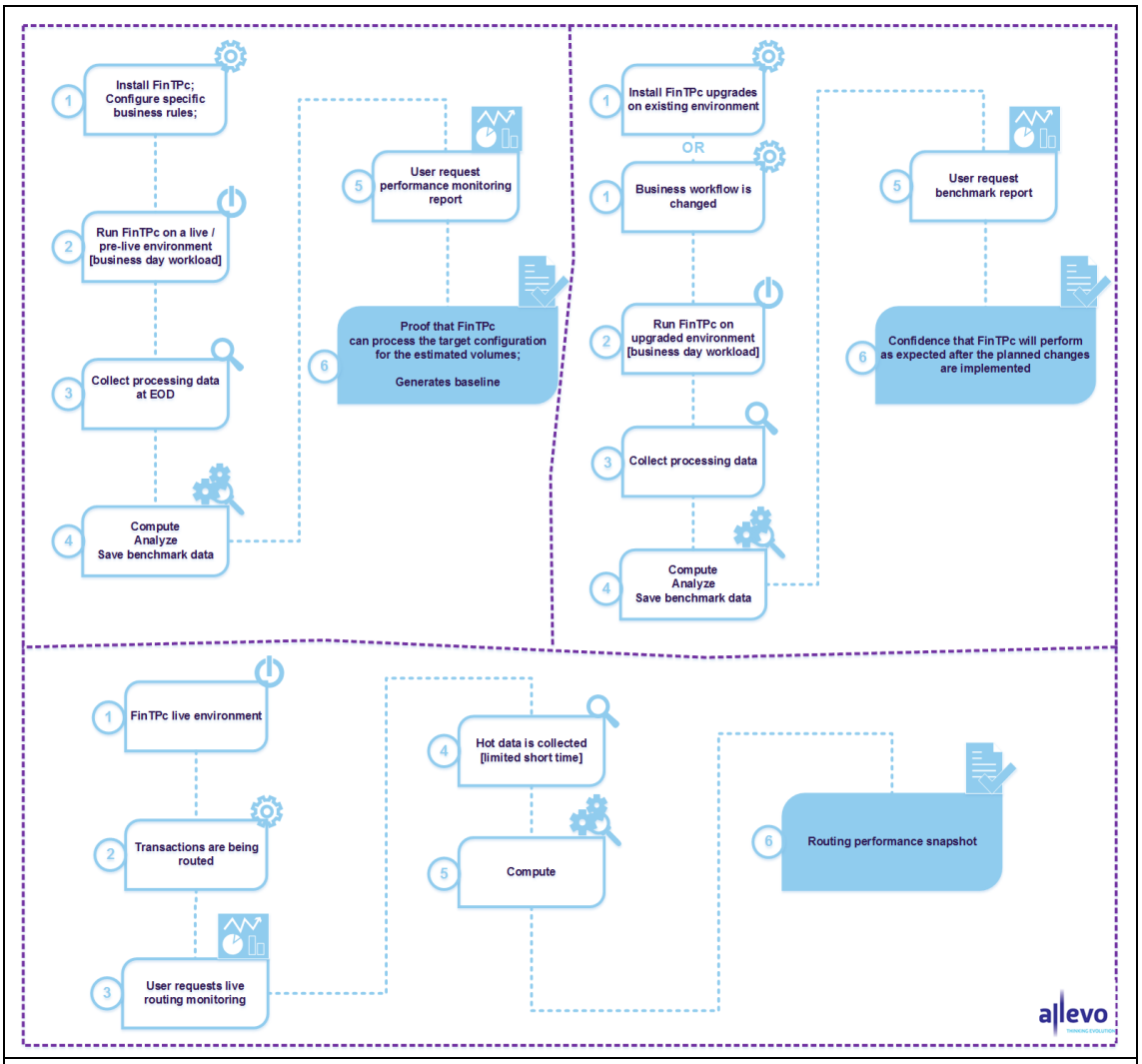
1 Introduction

FinTPc Tracker is a benchmarking tool that performs relevant performance analysis for FinTPc application.

FinTPc Tracker provides relevant performance analysis that assists technical teams in investigating performance issues and in validating a combination of deployment architectures (hardware and software) and operational architectures (different flows and configurations). The role of FinTPc Tracker is to provide benchmarking reports for technical personnel that ensure validation and confidence for the FinTPc deployment solution.



FinTPc Tracker::product overview

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1.1 Intended audience

Architects

Developers

Testers

Implementers

Sales and Marketing

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1.2 Project backgound

FinTPc Tracker provides performance reports required by those who administer the FinTPc application and provides the possibility to add a monitoring capability for a critical production environment.

Built in natively in FinTPc, it allows:

- Performance measuring environment configuration for:
  - All financial transactions included in performance evaluation;
  - Data sets corresponding to external communication channels and back-office / ERP systems;
  - Defining intermediate measurement points;
  - Depending on the complexity - defining, importing and editing performance evaluation scenarios;
  - Depending on complexity - defining, importing and editing data sets;
- Monitor and control the measurement;
- Record and report measurement results;
- support for investigating components that introduce additional latencies;
- Develop a complexity matrix that takes into account routing rules, technologies and other parameters that influence the performance;
- Archives the history of measurement results together with the context in which they are performed (configuration, software versions, data set versions);

Notes

- must be periodically updated for compliance with the new regulations and the new applicable financial standards;
- depending on the architecture of each corporation, must allow easy installation and configuration on any FinTPc platform - production, backup, pre-production or testing;
- FinTPc Tracker is an open source application published on GitHub under the GPLV3 license as well as FinTPc;

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2 Architecture

The IEEE[1] recommendation defines an architecture as the fundamental organization of a system embodied in its components, their relationships to each other and to the environment and the principles guiding its design and evolution. Architectures represent the abstraction used to understand any system and also form the basis for a shared understanding to all its stakeholders.

Application architecture seeks to build a bridge between business requirements and technical requirements by understanding use cases, and then finding ways to implement those use cases in the software.

An architectural overview is aimed at providing a shared understanding of the architecture across a broad range of people including the developers, marketing, management and possibly potential end-users. An architectural overview is ideally produced early in the development lifecycle and serves as the starting point for the development. An architectural overview should be at a high level of abstraction. All the major functionalities and components of the architecture should be described but the descriptions may lack detail and precision as they often use natural language rather than formal notations.

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[1] Institute of Electrical and Electronics Engineers

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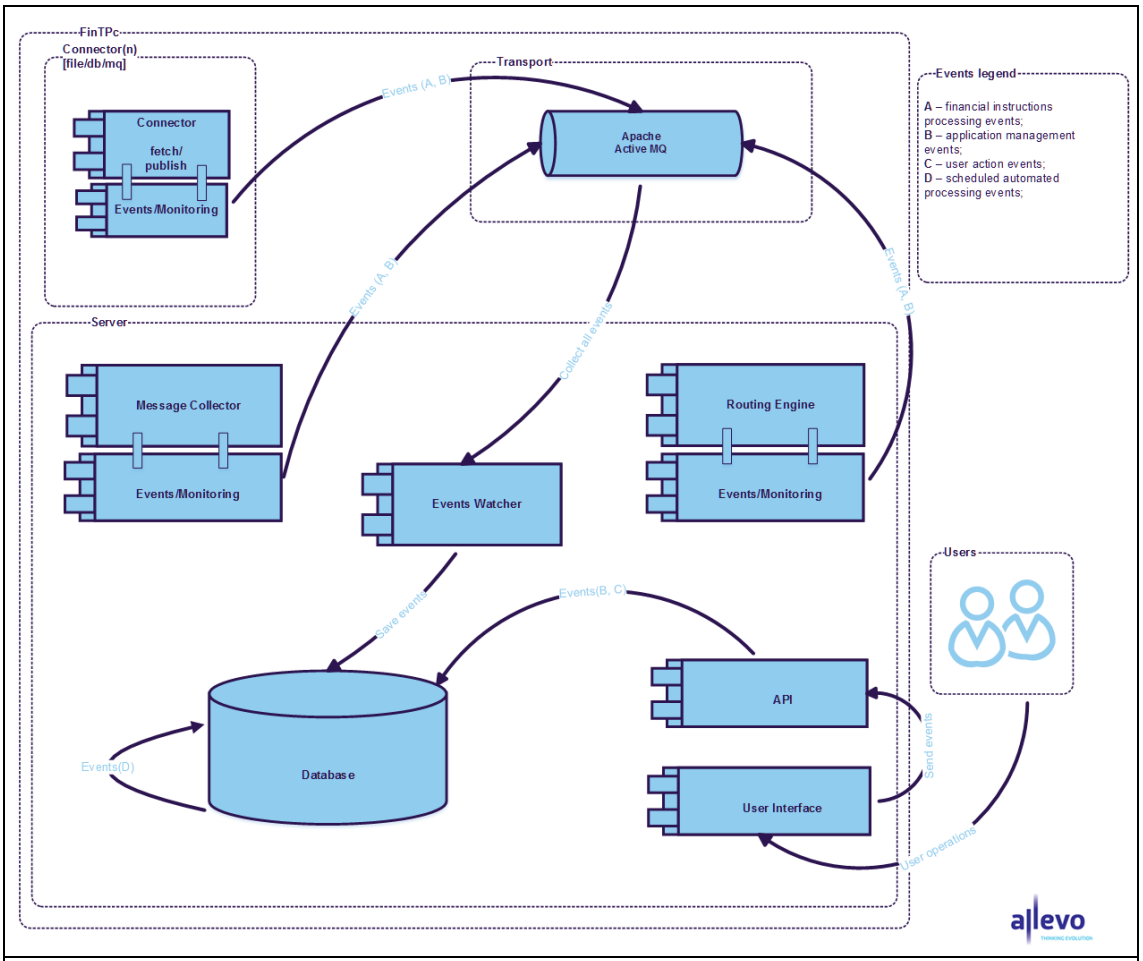
2.1 Logical architecture

2.1.1 Overview

The FinTPc Tracker is designed to evaluate and monitor the following metrics: the financial transactions processing rate and the computational resources performance.

The first one will be measured and computed based on the generated application internal events. FinTPc application events include: financial transactions processing events, application management events, user action events (upon financial transactions or other objects) and scheduled automated processing events. These events' metadata consists of relevant inputs that can be used when computing different performance metrics based on financial transactions volumes on a time axis. Therefor the flow of the events through the application is very important and represents the starting point when designing the architecture. The diagram below explains this data flow between FinTPc components. All these records are stored structured in the application database.



FinTPc::Internal events flow

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The events generated by FinTPc application can be categorized into four categories, depending on how critical the issue is; these are detailed in the following table:

Info	Informational events that require no action; instead these may bring financial transactions processing insights.
Warning	Indicate a potential issue; the action result may be altered.
Error	Indicates a processing failure; the action could not obtain a final result. Leads to an immediate alert and a responsive investigation.

Besides their type, the events share a set of properties and information that become very important when designing a benchmarking tool. Events structure is based on following information:

Unique event identifier	Based on an proprietary FinTPc algorithm;
Source	The name of the main component generating the event;
Event type	Indicating how critical this issue is;
Timestamp	The timestamp of the event;
Event message	A standard short message guiding to the action behind;
Exception / error short description	If the logged action ended because of an error;
Action short description	A short description of the logged action; even sub-actions included;
Event class	Category of events grouped by their subject and specific action;
Financial transaction identifier	Only if the logged action addresses a processing action of a financial transaction;

The amount of FinTPc *Connectors* configured in the application implementation depends on business requirements and interfacing applications. Regardless of the chosen architecture, each of these connectors must have a dedicated thread designed for logging connector events and sending them to a common events queue configured in the transportation component – AMQ. The actions logged by connectors are financial transactions processing actions and the corresponding events show whether those were successfully collected and transported to destination.

The *Message Collector* component also has a dedicated thread logging its main actions and then sending them to a common events queue configured into the transportation component. These events refer to the status of processing mechanism, the result of transporting the financial transactions from the transport component to FinTPc storage, the database.

The *Routing Engine*'s events / monitoring thread collects events that include: routing actions – between internal queues or towards external queues (defined into the transport component), validation actions or routing definitions loading. The events containing routing action data also contain important additional information that show a history tracking of all transformations applied on a given financial transaction.

The *Events Watcher* collects all the events described above from the AMQ queue and inserts them to the FinTPc storage – the database.

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The *User Interface* component audits user actions, from different configurations to financial transactions operations. These events are stored in the database by the FinTP API component.

Some of the available actions that operate financial transactions may be scheduled to run automatically, skipping the user intervention. Those related events are saved directly by the *Database* component.

All the events described above are stored into the same database table located in the business data dedicated schema. Those events that are subject of actions that operate financial transactions assure traceability and offer the possibility of real time monitoring.

In conclusion, input data that may be used to monitor financial transactions processing performance is available in the application data store and contains significant information.

The second evaluated metric is going to be measured based on external data that is extracted after analyzing hardware and software performance on the application environment. The main performance indicators that have to be monitored during processing are CPU, disk I/O and network traffic. This data may be extracted from operating system log files.

Data for both these metrics will be collected via two specific data collectors – *Processing Events Collector* and *Resource Statistics Collector*.

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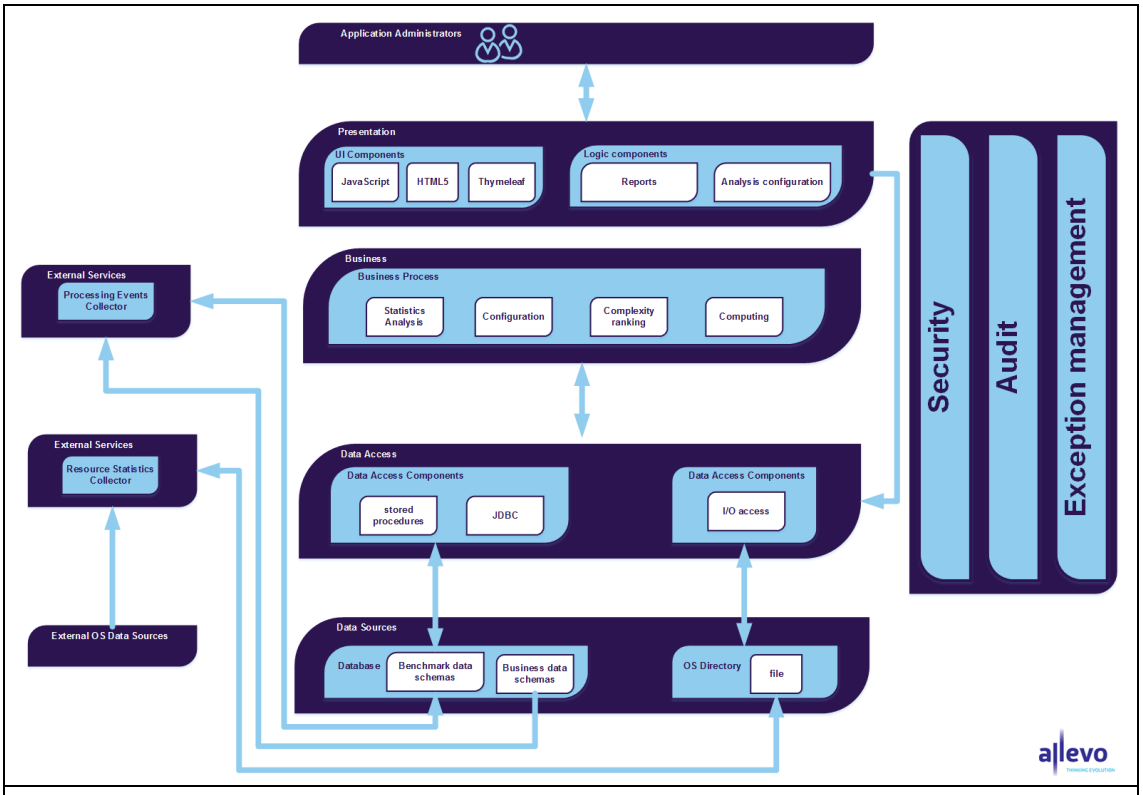
2.1.2 Logical layered architecture



FinTPc Tracker:: logical layered architecture

The upper diagram describes a layered architecture style of this module.

The components of the *Presentation* layer access the information via the *Data Access* layer in order to be available on user request. The mentioned UI components are used to display information and also accept user input.

The *Business* layer components represent the core functionalities of the system and encapsulate business logic. The business process is built base on functionalities like Statistics Analysis, monitoring Configurations, Complexity rating and Computing metrics. All these functions manipulate financial transactions related events. This layer has access to information and stores information communicating to the *Data Access* layer.

The *Data Access* layer provides different ways of retrieving and sending information from and to the data sources (that may be internal – database or external). Business layer pushes data into specific database schema and is fed from FinTPc database schema. Computational data is accessed directly from file.

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The cross cutting concerns identified are the following: Security, Audit and Exception Management. These will be addressed on most layers.

2.1.3 Internal mechanisms

2.1.3.1 Performance metrics on computational resources logs

The Resource Statistics Collector defined in the Logical architecture is represented by an external Monitoring Computing Performance Tool integrated into the FinTPc Tracker module. The main constraint of this tool is that it has to be compliant to the GPLv3 licensing model.

2.1.3.2 Benchmarking and performance monitoring reports

General report

This dashboard groups reported data by defined business areas. In order to accomplish this, there must be followed the routing message type – business area association that is stored in the configuration schema of the database.

The processing time is calculated based on the events generated by all the components that contribute to one's given routing message processing phase through the FinTPc application. These events are directly correlated to their routing messages by a correlation identifier. The processing time is defined by the period of time between the first and last event timestamps, after being sorted. In order to have a continuous interval, the known start and possible ending events must be defined. The important measuring points are as follows, chronologically ordered:

- The event stating that the processing phase has started; [mandatory] – applies to Connectors, Message Collector and Routing engine components;
- The events stating different phases of the processing; [optional] – applies to Routing engine component; are to be ignored;
- The events stating that the processing phase has been completed, either waiting for user action, encountered an error or ended successfully; [mandatory] - Connectors, Message Collector and Routing engine components;

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- processing time may be calculated only using those events directly related to routed messages;
- every component must register at least two events, one marking the starting point of the process and one marking the completion;

Specific report – Component

Building this dashboard implies identifying those measuring points and their specific events that make possible computing the performance for specific application components:

1. FinTPc BackOffice connector component – there may be defined one or more connectors and each may have associated one or more services, each of them sharing distinct names; all measurements are to be made for each of those services;

2. FinTPc External connector – there may be defined one or more connectors and each may have associated one or more services, each of them sharing distinct names; all measurements are to be made for each of those services;

3. FinTPc Message Collector – there may be defined one or more message collectors, each of them sharing distinct names; all measurements are to be made for each of those services;

4. Routing Engine

In order to obtain routing messages performance indicators at each component level, the same behavior of generating events must be followed and listed below chronologically:

- The event stating that the processing phase has started; [mandatory] – applies to Connectors, Message Collector and Routing engine components;

- The events stating different phases of the processing; [optional] – applies to Routing engine component; are to be ignored;

- The events stating that the processing phase has been completed, either waiting for user action, encountered an error or ended successfully; [mandatory] - Connectors, Message Collector and Routing engine components;

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Notes:

- processing time may be calculated only using those events directly related to routed messages (may be either financial transactions or different types of correlated replies);
- processing indicators related to connectors should be divided into fetcher and publisher;
- every component must register at least two events, one marking the starting point of the process and one marking the completion;

Specific report – Live Performance

This report is based exclusively on the information retrieved from the existing routing jobs assigned to the Routing Engine component at one given moment. This report offers a specific view on how performant is the financial transaction routing process of the application in a short limit of time.

For a limited period of time (maximum 60 seconds), the routing jobs shall be traced in order to build this performance dashboard. This tracing mechanism collects the following information:

- the number of existing routing jobs in the specific database table when starting the trace mode (either proposed or in progress);
- the number of existing routing jobs in the specific database table when closing the trace mode (either proposed or in progress);
- the number of routing jobs that have been completed during tracing period;
- a snapshot of existing routing jobs in the specific database table when starting the trace mode (either proposed or in progress) along with processing type information;
- a snapshot of existing routing jobs in the specific database table when closing the trace mode (either proposed or in progress) along with processing type information;
- a snapshot of routing jobs that have been completed during tracing period; along with processing type information;

2.1.3.3 The complexity of workflows

The *complexity of workflows summary* may be used by users when analyzing the benchmarking or monitoring reports in order to have a full view of the processing context. It is used just for information purpose as it will not alter in any way the reporting data. The user reading these reports will be able to establish a correlation between the obtained financial transaction processing rate and the values in the workflows complexity summary. It also makes it easier - when comparing different versions of benchmarking reports - to identify possible differences.

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Note: This correlation makes sense just for the processing rate reported by business areas and for those reported for the Routing Engine component.

It is recommended that for every new business flow to be configured in the application to have a predefined routing schema (used just for testing purpose). This basic routing schema contains only mandatory actions that make the flow functional and represent and ideal model. Based on this model, a baseline performance ratio is calculated given the least possible complexity of the workflow. From this moment on, any value deviation in the processing rate may be easily correlated to business required alterations applied to the routing schema. A growth in the complexity matrix values may be found also in the processing rate; if not, then other advanced investigations are required.

Technically, a workflow inside FinTPc application is represented by one routing schema, given all its routing rules, actions and other custom options available. Any financial transaction (referred as routing message inside the application) processed by FinTPc follows these steps: first is collected by the dedicated connector component, formatted according to future processing needs and then passed to the routing stage – where the Routing Engine component processes it according to defined business rules declared in the routing schema; when the routing stage is completed, the routing message is collected by one dedicated connector that may also apply some transformations on it and then pass it towards destination external applications.

The complexity summary contains items related to the processing stage executed by the Routing Engine component and described above.

The diagram below shows the components defining one given routing schema and their relationship. It also classifies all available options and properties into categories, making it easier to identify those that add complexity to the workflow when processing reaches their level; it represents the starting point in defining the layout and content of routing complexity matrix. Each final leaf is going to be analyzed regarding its potential complexity ratio contribution to the routing rule.

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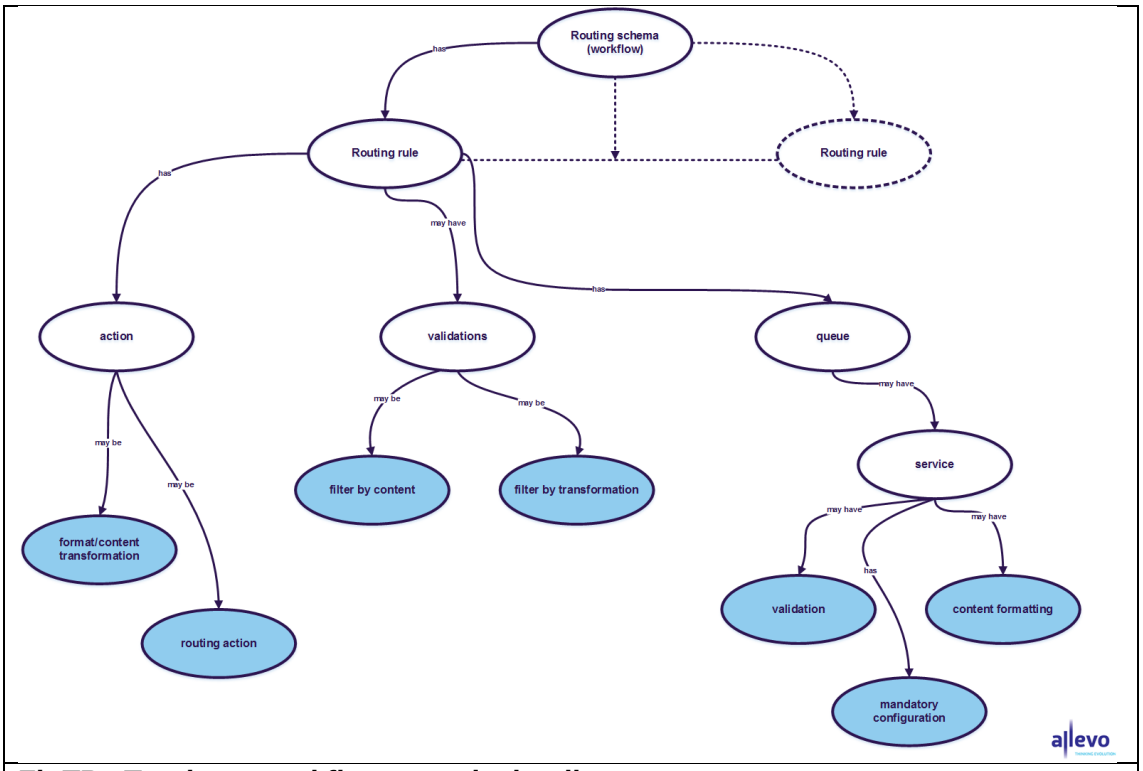

FinTPc Tracker:: workflow complexity diagram

Each routing rule defined must have configured an *action*, a *queue* and it may have additional *validations* configured.

Available actions can be grouped into two categories:

Category	Content	Note
format / content transformation (of the routing message)	Enrich* ChangeValueDate TransformMessage**	Have a moderate - high impact on routing schema complexity; their frequency is important; *its frequency is not important, should be separated when computing; **if transformations that use Web Services calls (based on naming conventions described in *FinTPc detailed architecture*) are found, then Disclaimer a disclaimer message is reported – because their impact is important;

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routing actions	SendReply Aggregate ChangeHoldStatus Complete MoveTo ReactivateOriginal	Have low impact on routing schema complexity;

Any routing rule is defined on a given queue. These queues may be entry or exit queues regarding the overall flow of one routing message in the application (collected from corporate back office applications and delivered to other external ones – banking applications and vice versa). For those both ends queues have attached specific services that allow configurations like:

Category	Content	Note
validation options	Duplicate detection Schema validation	Have a moderate impact on routing schema complexity;
content formatting (of the routing message)	Structure formatting Content operations (character replacements)	Have a low impact on routing schema complexity;
mandatory configurations	Transportation configurations	These do not add overall complexity to the work flow and will be ignored;

Validations that may be configured at routing rule level are grouped into two categories:

Category	Content	Note
filter routing messages by rules based on their content	xpath filter Keyword based filter IsAck/IsNack/IsReply	Have a low impact on routing schema complexity;
filter routing messages by rules based transformation results	Validate	Have a moderate impact on routing schema complexity;

The processing events collector, via database scheduled job, is designed to collect daily data following the above analysis and then store it in order to be available for reporting. The database storage structures and reporting methods must cover the following matrix and additional information:

	Routing schema component	Low impact items	Moderate impact items	High impact items
Routing schema(i) [no. of total routing rules]	action			
	validation			
	service			

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.				
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Routing schema(n) [no. of total routing rules]	action			
	validation			
	service			

Additional information:

- Web Service calls disclaimer
- Live data routing messages count (findata.routedmessages)

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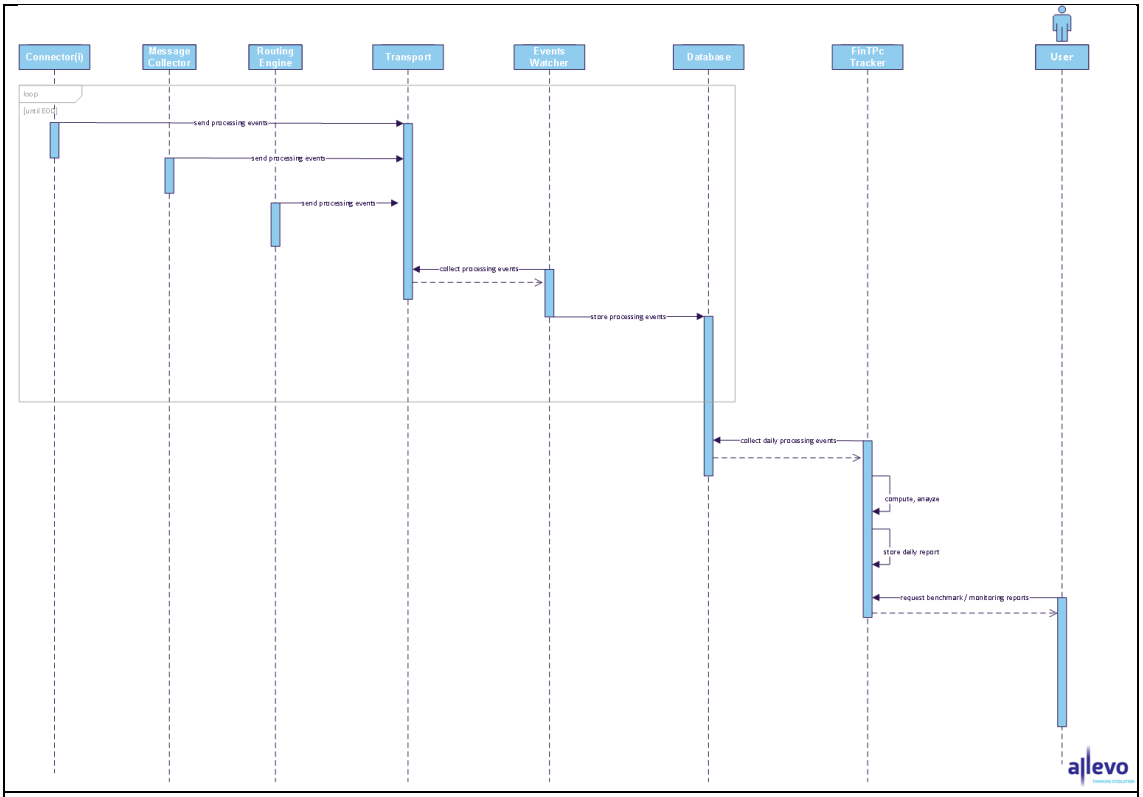
Attn.: Allevo

From: Denisa Dinca

Subject: FinTPc Tracker - architecture

2.1.4 Component interaction model

The diagram below shows the basic interaction actions between the identified application components for a generic scenario. The sample scenario consists of an end to end flow of generated events while processing payment transactions – from the moment these are generated to the moment these are collected and analyzed by the FinTPc Tracker module and then delivered to the user.



FinTPc Tracker:: UML sequence diagram – component interaction model

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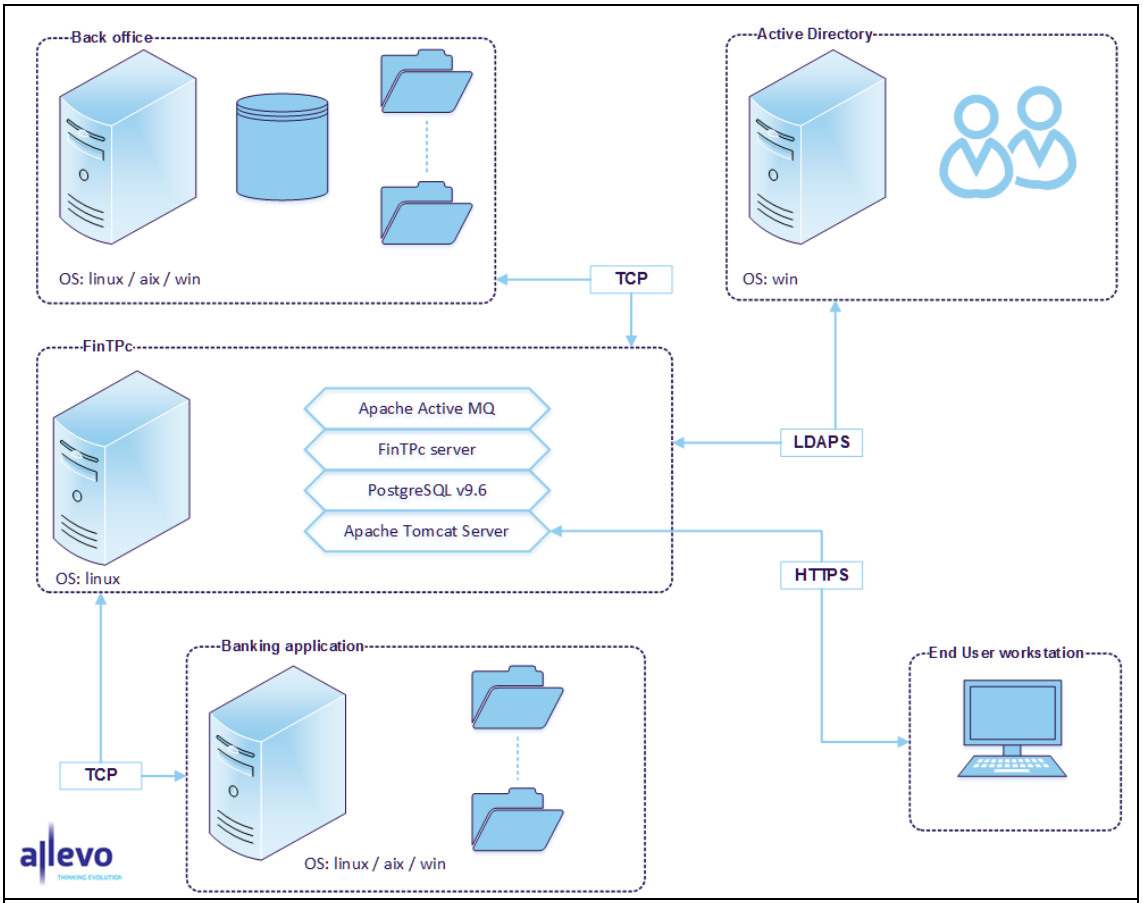
2.2 Physical architecture

FinTPc Tracker has to be able to run on all architectures[2] supported by FinTPc, being designed and built as a module of the main application.



FinTPc::physical architecture

[2] FinTPc's physical architecture is detailed in the *FinTPc – architecture* document.

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2.3 Technology selection

The distribution model of FinTPc project is open source. Therefor the major architectural and technological constraint is represented by the compliance of FinTPc code and any other embedded product or library with GPL v3 license model. The design and implementation stage will include also advanced scanning procedures in order to be able to certify this license compliance.[3]

FinTPc Tracker has to be compliant to the same technological constraints already covered by FinTPc, being designed and built as a module of the main application.

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[3] For a complete description, see the FinTPc – architecture documents.

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