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Research Alliance

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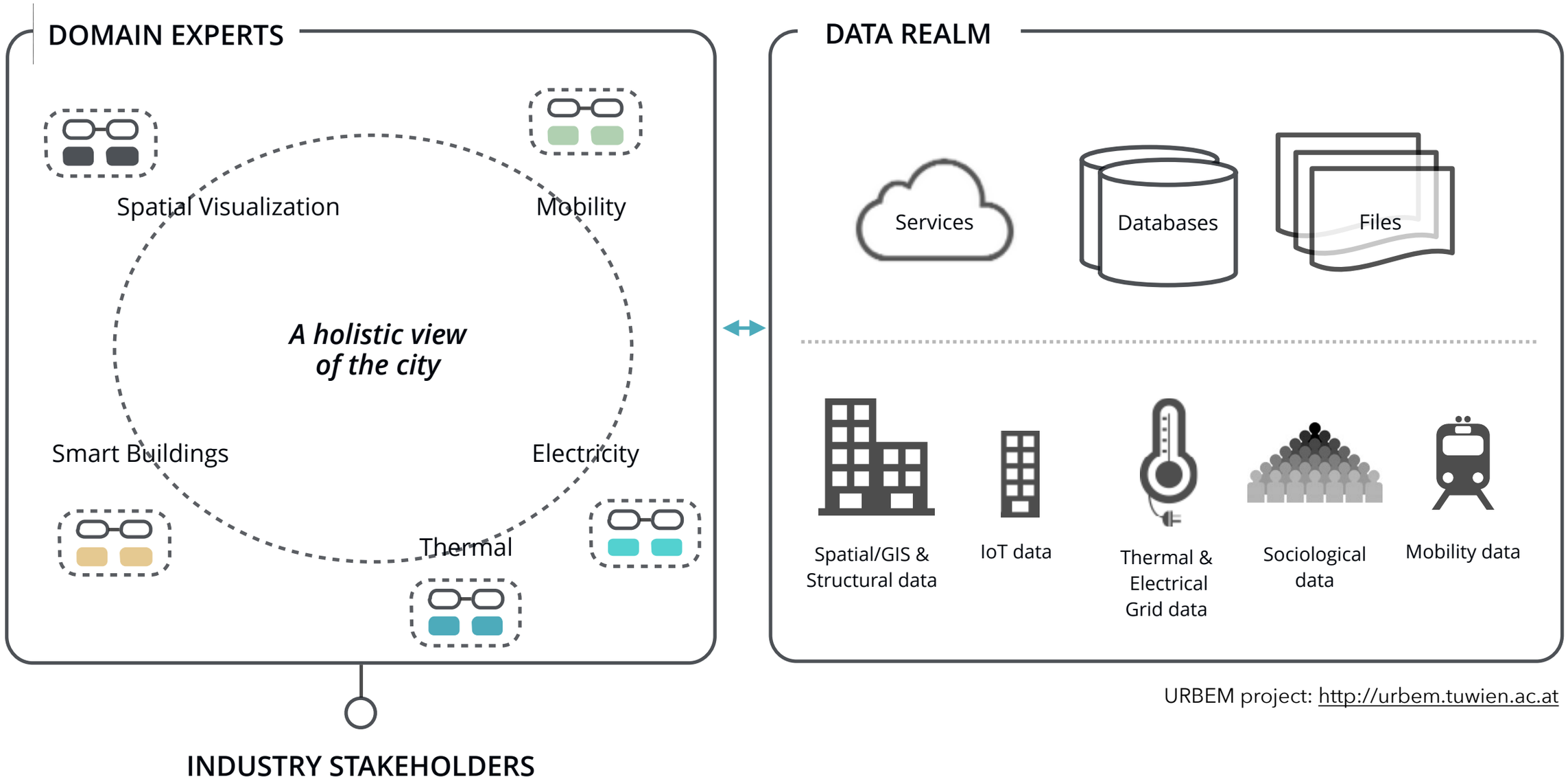
DRain: An Engine for Quality-of-Result driven Process-based Data Analytics

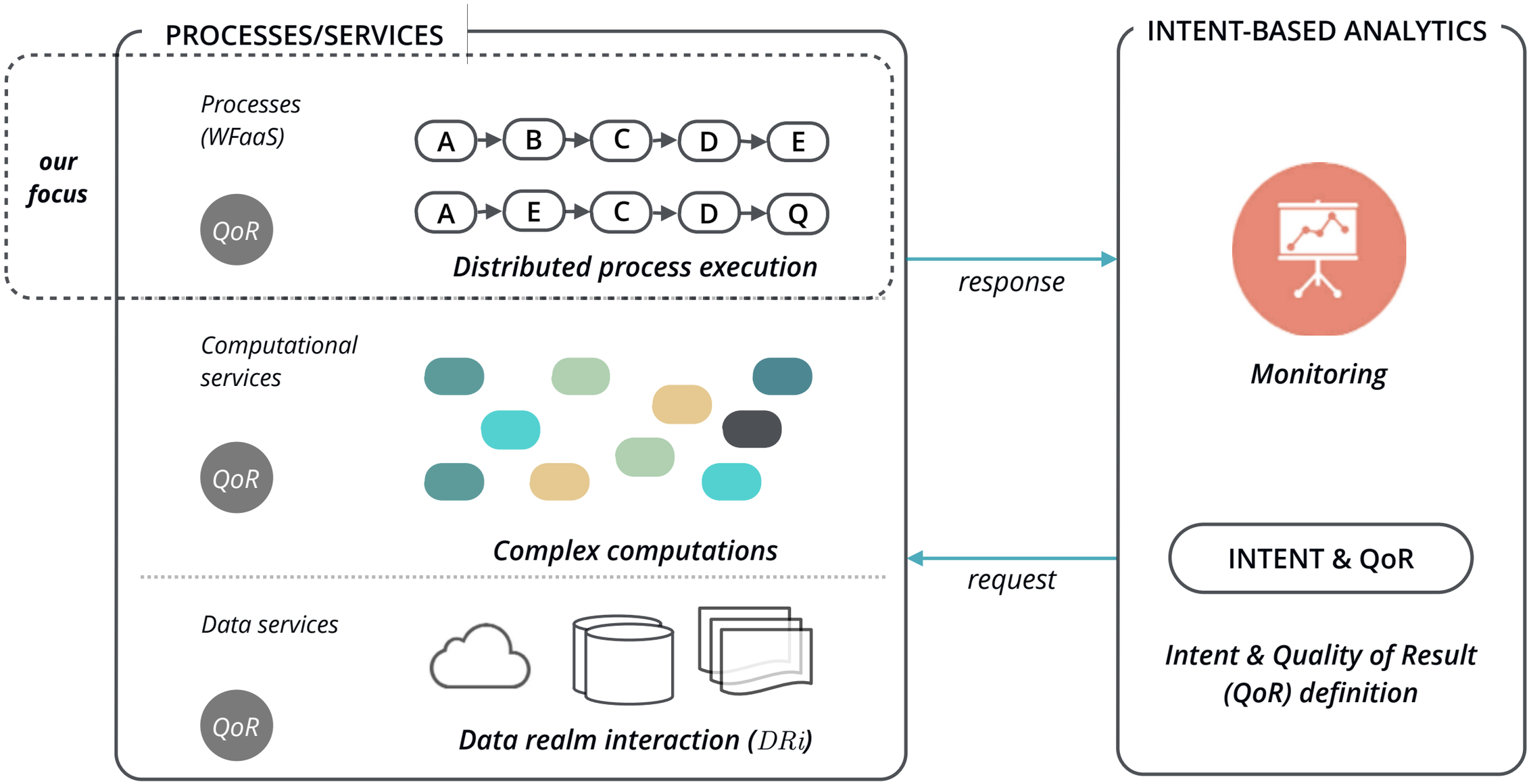
The URBEM Scenario



URBEM project: http://urbem.tuwien.ac.at

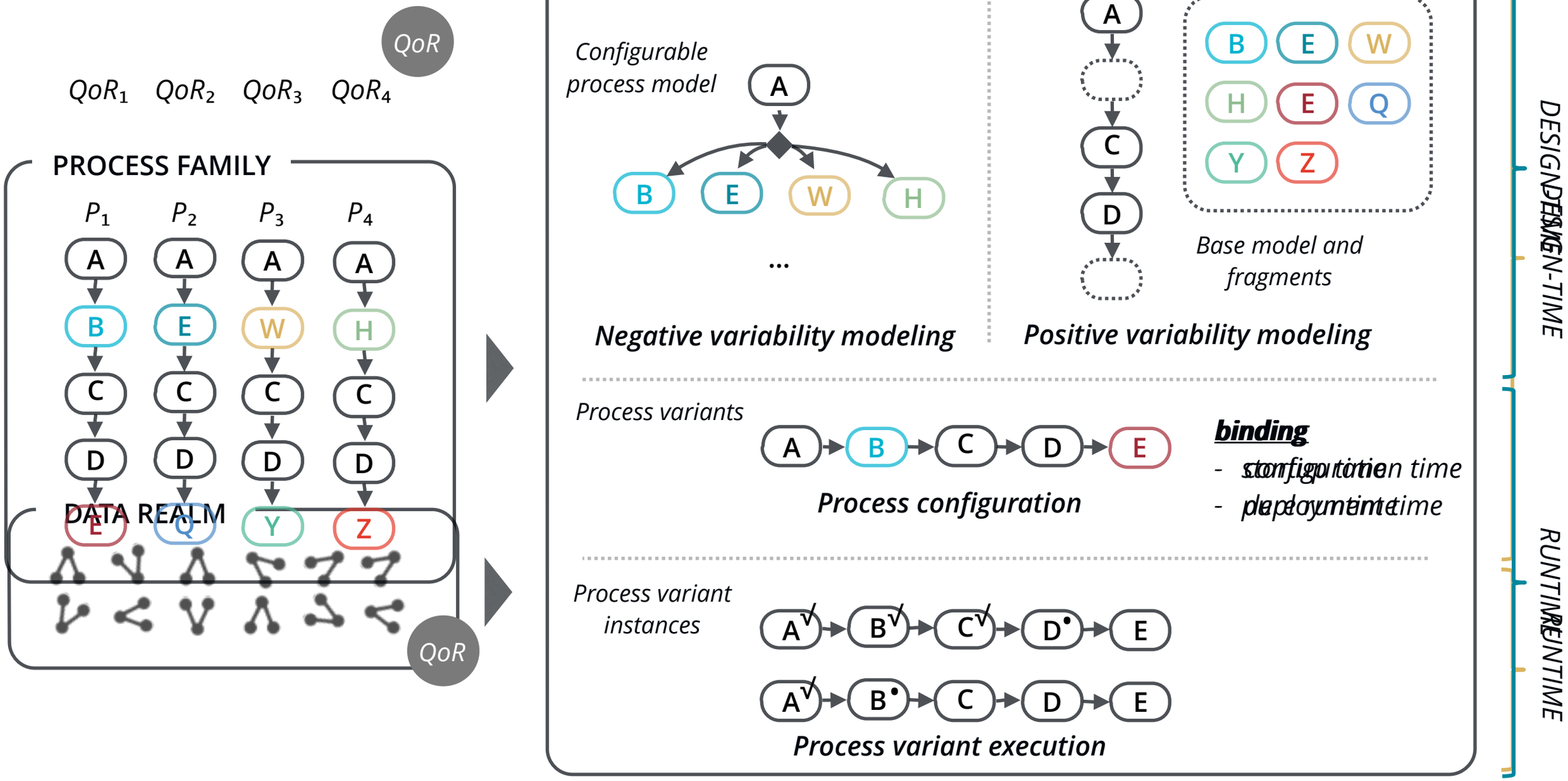
Free from isolation and integrated into the city.

Motivation



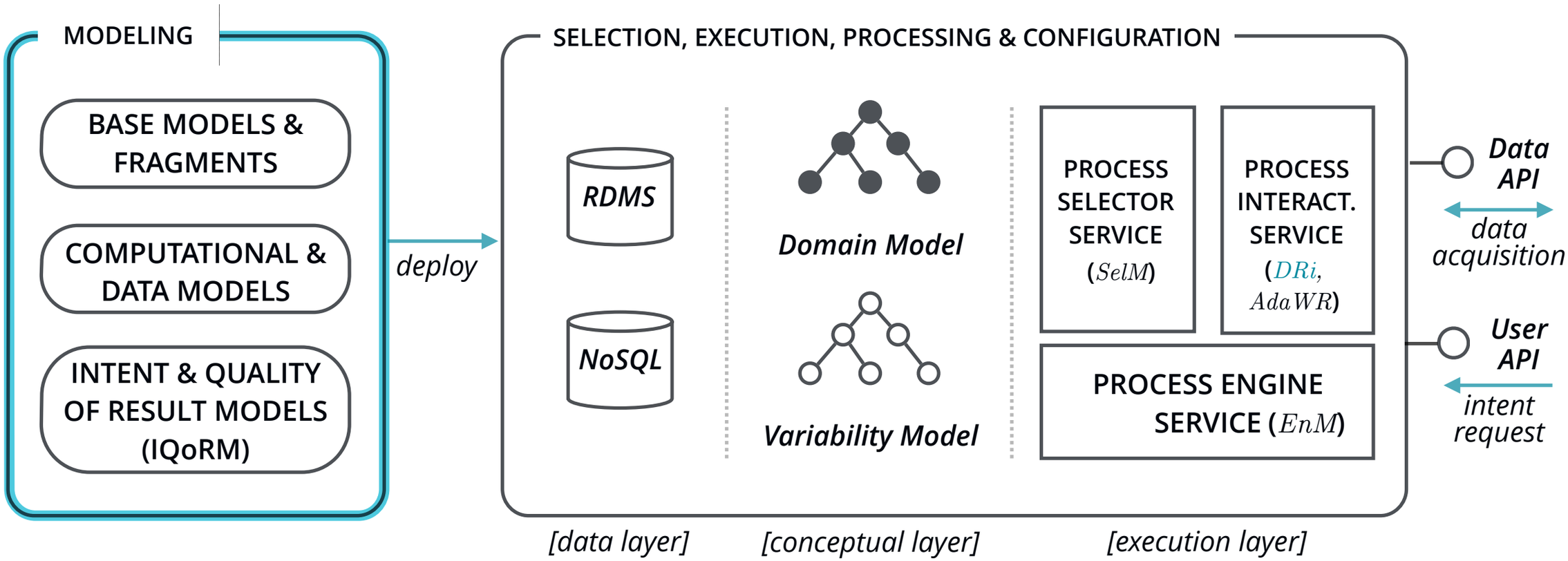
Processes/services can offer the same functionality, each with the associated QoR parameters.

Process Configuration



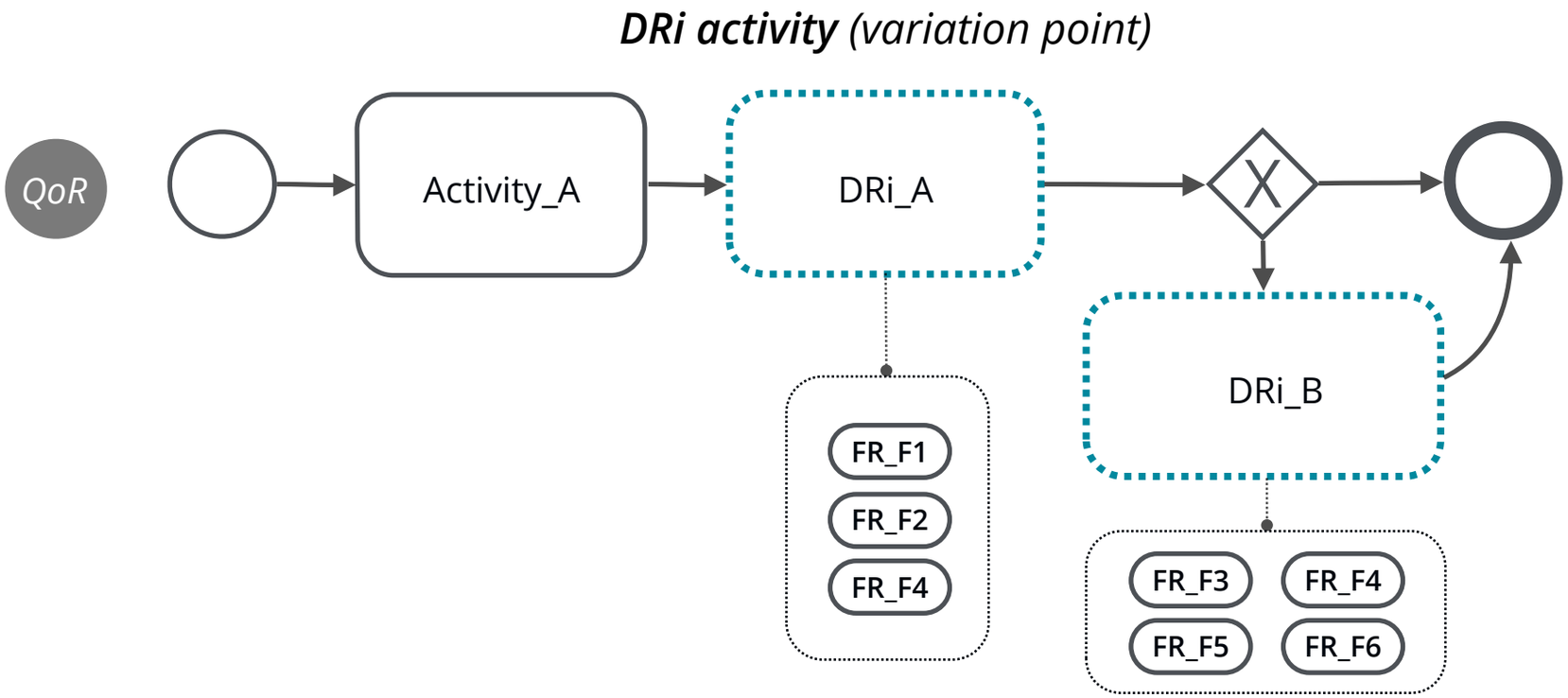
Legend: √ Completed | • Enabled

The DRain Framework: Overview



DRain: *QoR-driven selection and configuration of data-aware processes*

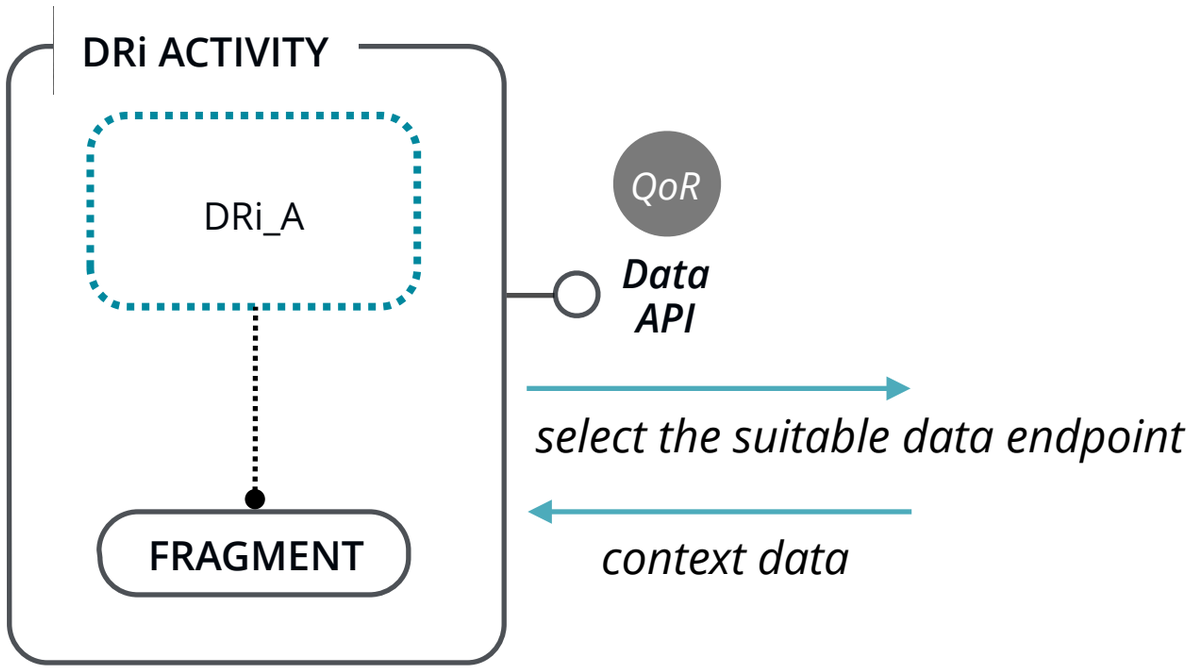
Base Model & Fragment



A ***base model*** represents the commonality shared by a process family in a particular domain. DRi activities (variation points) enable QoR-driven late binding.

A ***fragment*** describes a single variant realization option for each variation point within a particular base model.

DRi activity

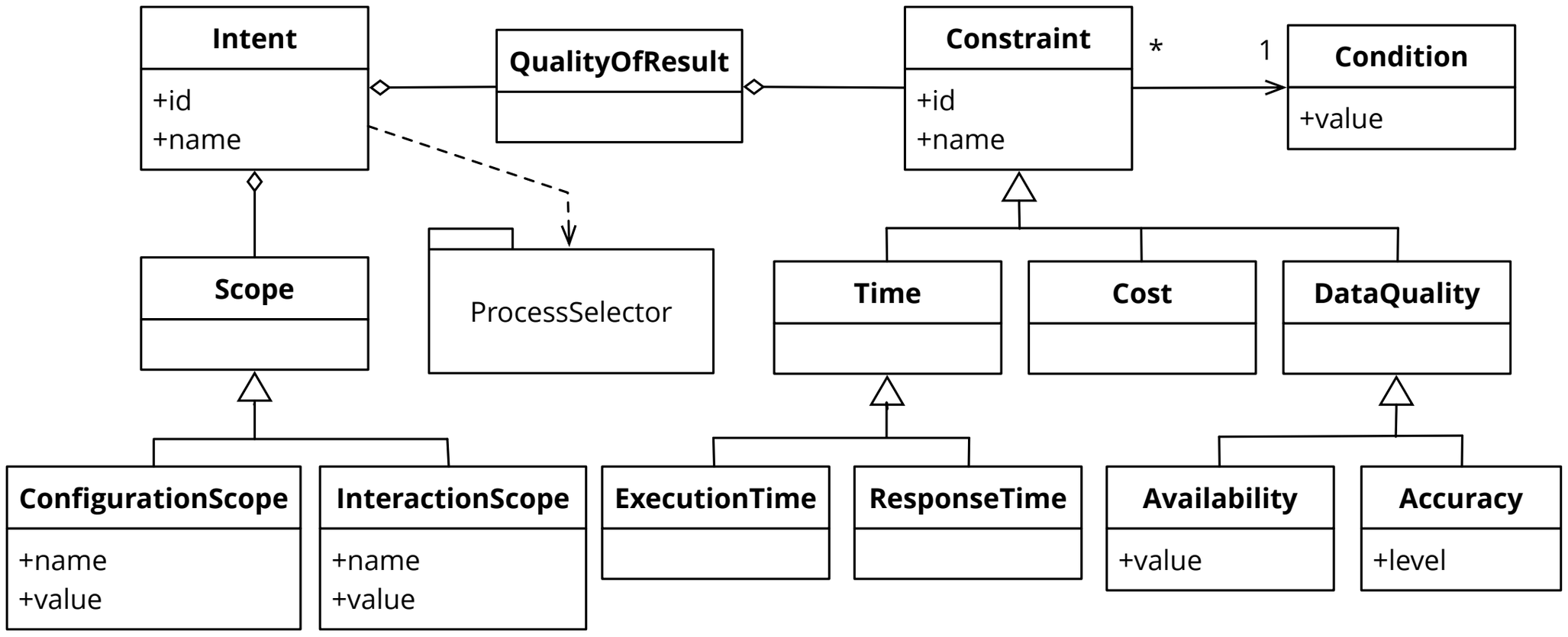


During operation

DRi activities indicate possible points in a base model and/or fragment where data interaction and fragment binding occur (fragment selection based on context data).

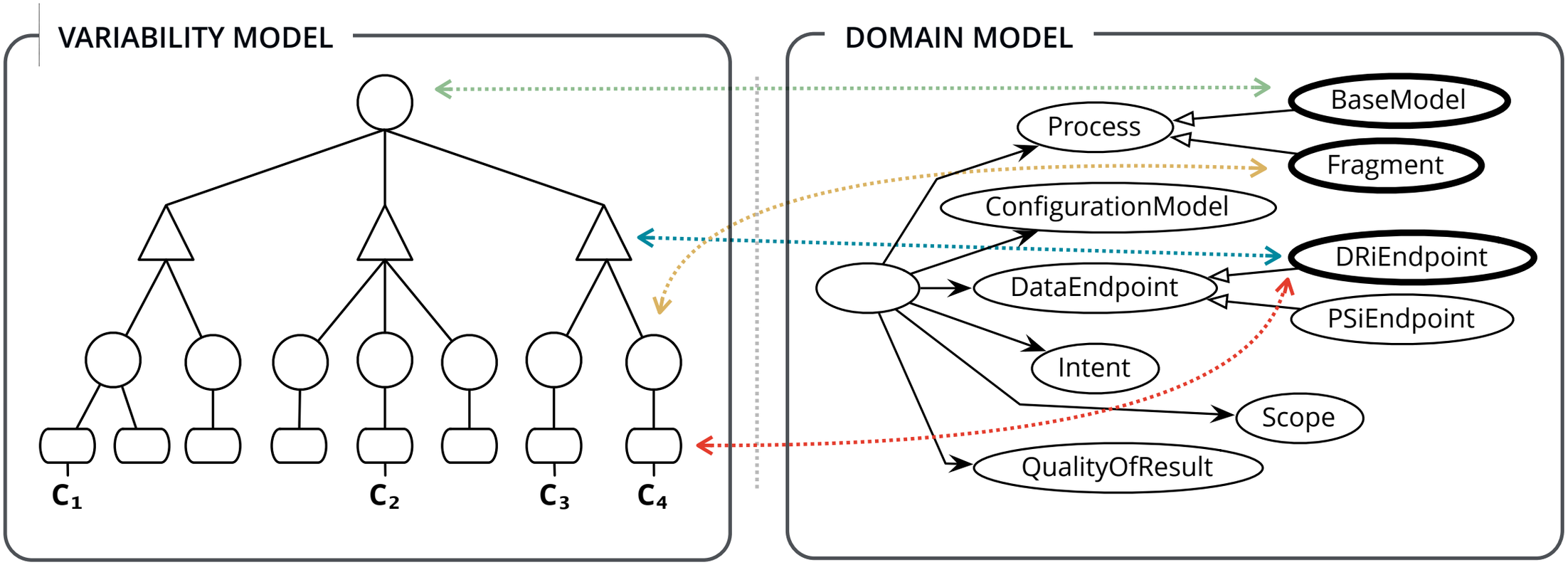
- ***DRi*** activities are automatically determined at runtime in subsequent QoR-driven data interactions.

IQoRM



Intent and Quality of Result Model (IQoRM): It is used to construct a data analytics task and its strategy, and thus represents constraints for the desired behaviour.

Variability & Domain Models



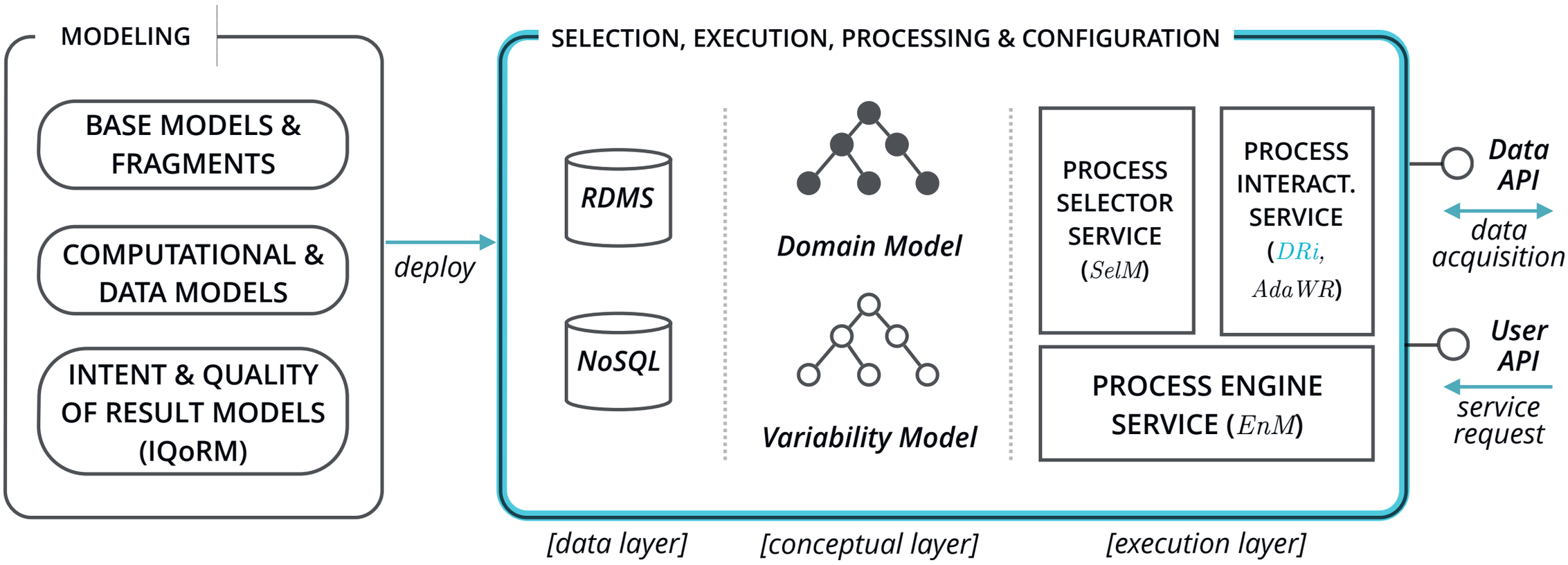
All configuration alternatives

The domain knowledge and semantics

Mappings

- ◯ feature names are mapped to ***BaseModel*** (—) and ***Fragment*** (—) individuals ***hasProcessKey*** data property.
- △ variation point features are linked to ***hasServiceName*** data property of ***DataEndpoint*** (—) individual.
- ▭ configuration model attributes are related to data model variables from each ***DataEndpoint*** (—).

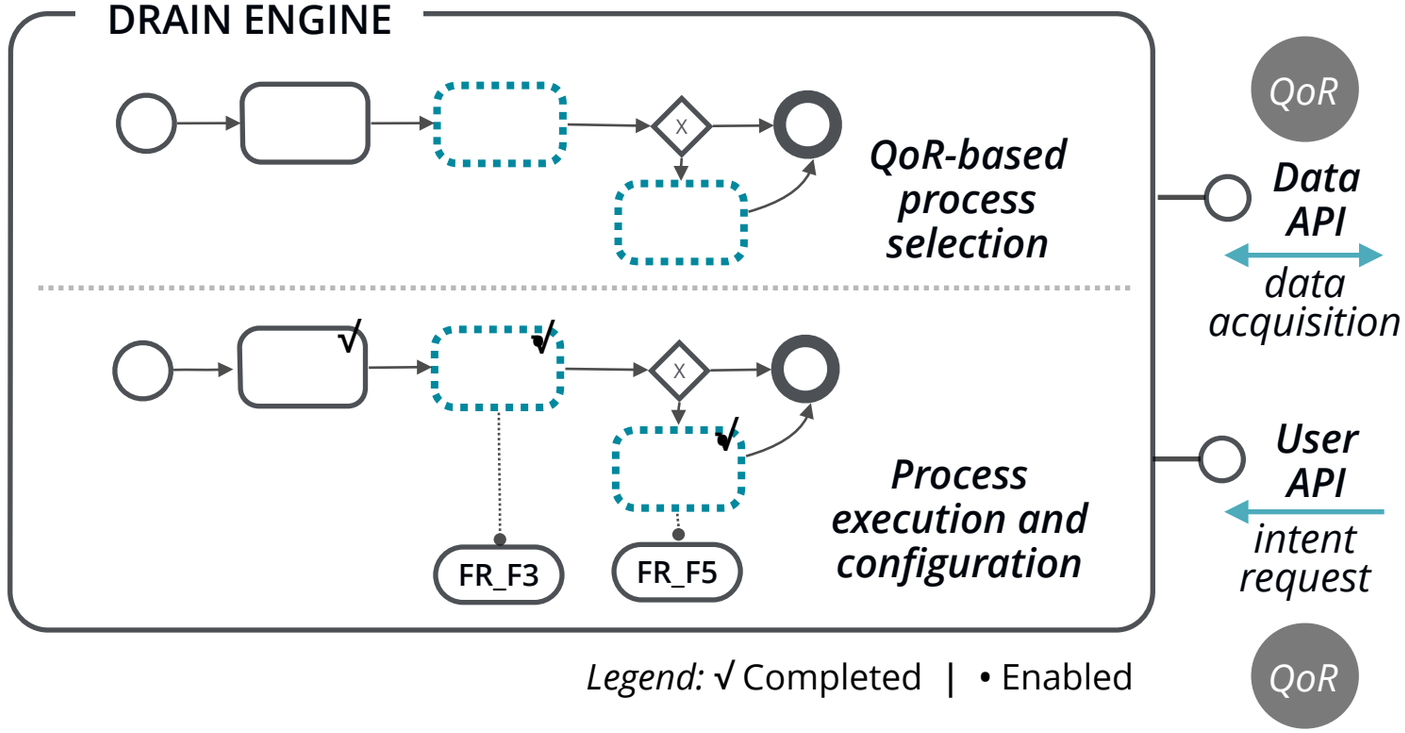
The DRain Approach: Overview



DRain: *QoR-driven selection and configuration of data-aware processes*

Selection, Execution, Processing & Configuration

QoR-driven Process Config.
(1) Intent request
(2) QoR-based base model selection
(3) Analytics process execution
(4) QoR-based data endpoint selection
(5) Context data gathering
(6) DRi resolution (fragment binding)



RESOLUTION STRATEGIES: How to proceed with different base model and data endpoint choices?

- **no-solution**
  - No solution for the given QoR.
- **one-solution**
  - One solution for the given QoR.
- **n-solutions**
  - More than one solution. Not sure what to choose? In this case, we adopt a simple ***get-first*** solution.

Evaluation

PROVIDED MODELS

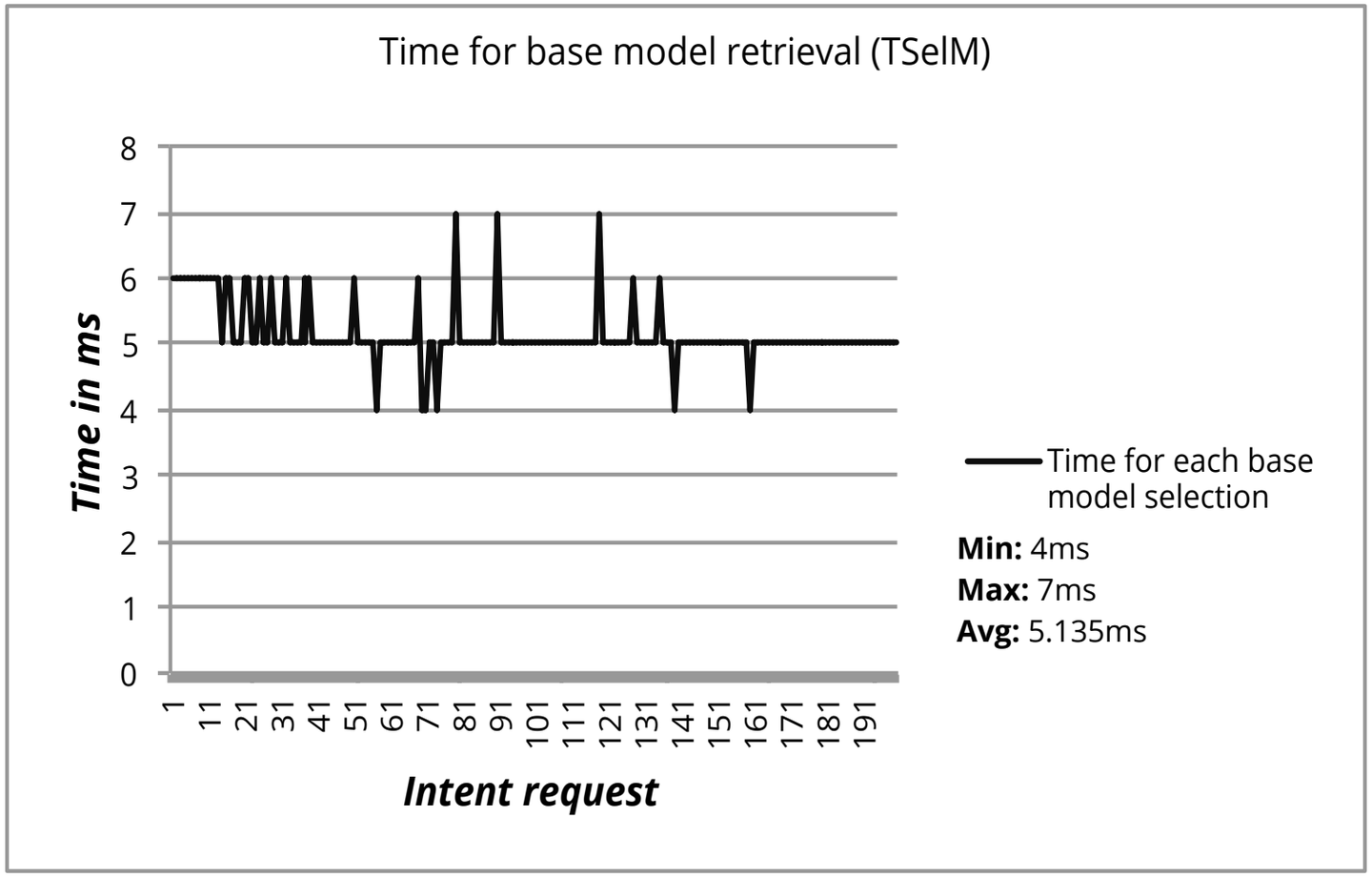
- 30 base models were created, each with ***4 DRi activities and different time and cost constraints*** for a synthetic URBEM scenario.
  - Each DRi activity contained ***2 fragments, providing each data endpoint different data quality (availability and accuracy)***.
  - ***24 data endpoints*** with different QoR and ***5 data values*** were parsed in each data interaction (DRi activity).

METRICS

- The aim was to ***assess the computation time*** of the engine.
  - ***Time for base model retrieval (TSelM):*** This metric measures the time required for intent-driven and QoR-based base model searching.
  - ***Time for data endpoint retrieval (TDRi):*** This metric defines the timespan from DRi activity initialisation to the moment when the process interaction service finds a suitable data endpoint for the given QoR and invoked the particular REST resource to collect data.
  - ***Time for fragment solving (TAdaWR):*** This metrics measures the time required to establish context values and find a suitable fragment once data is gathered from a REST resource.

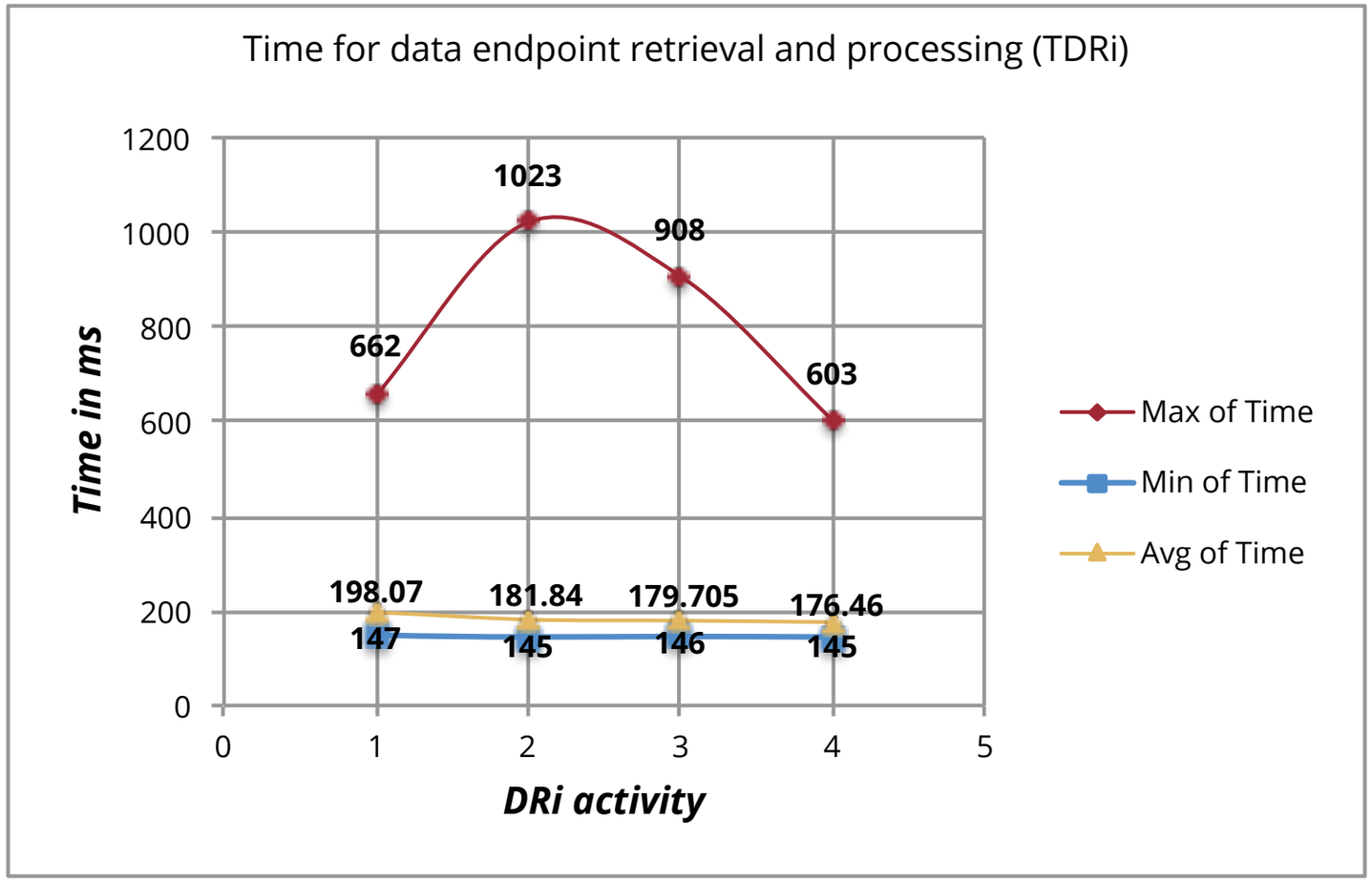
- ***200 intent-requests*** were processed.
  - On a13-inch MacBook Air with 8GB 1600 MHz DDR3 RAM, and Core i7 running @2 GHz
  - *get-first* strategy was enabled as default n-solutions strategy.

Evaluation: TSelM



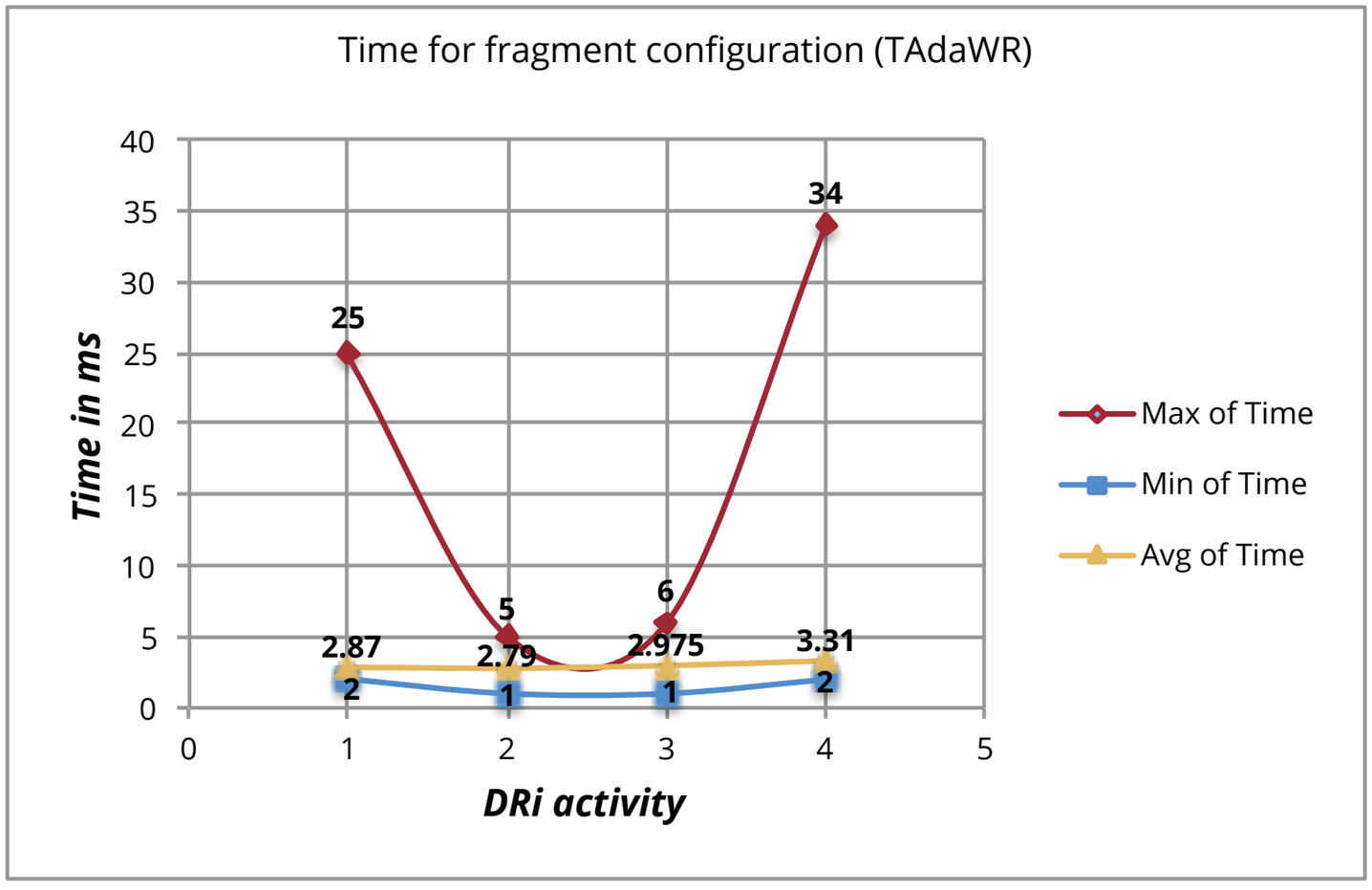
The difference between the minimum and maximum time required for a base model retrieval based on a user-defined QoR is about ***3ms.***

Evaluation: TDRi



The average time for data endpoint selection and processing is reasonable at ***184.019ms***.

Evaluation: TAdaWR



The average time required to complete the runtime configuration (for processing context values and determining a fragment choice) is about ***2.986ms***.

Issues

- **Error handling:** How can we guarantee the correct intent request execution?
- **Strong validation:** Assessment in a complex URBEM scenario.

Summary

- Context-aware and data-intensive environments require ***abstractions to select relevant analytic processes*** (exposed as WFaaS) and data endpoints ***based on user-defined QoR,*** and flexibility in terms of ***runtime process configuration.***

- The ***framework is capable of QoR-driven runtime process configuration***, with reasonable selection, processing and configuration performance.
  - Employing a high-level IQoRM.

- Evaluation cases diverse and ***large scale, but not ideal***.
  - Still good indication.

Future Work

- **Industrial** empirical evaluation (URBEM).
- **Adapt the IQoRM** for a more domain-specific environment.
- Adopt r**anking and selection algorithms/dimensions** using QoR.

Thank you!

Questions?

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