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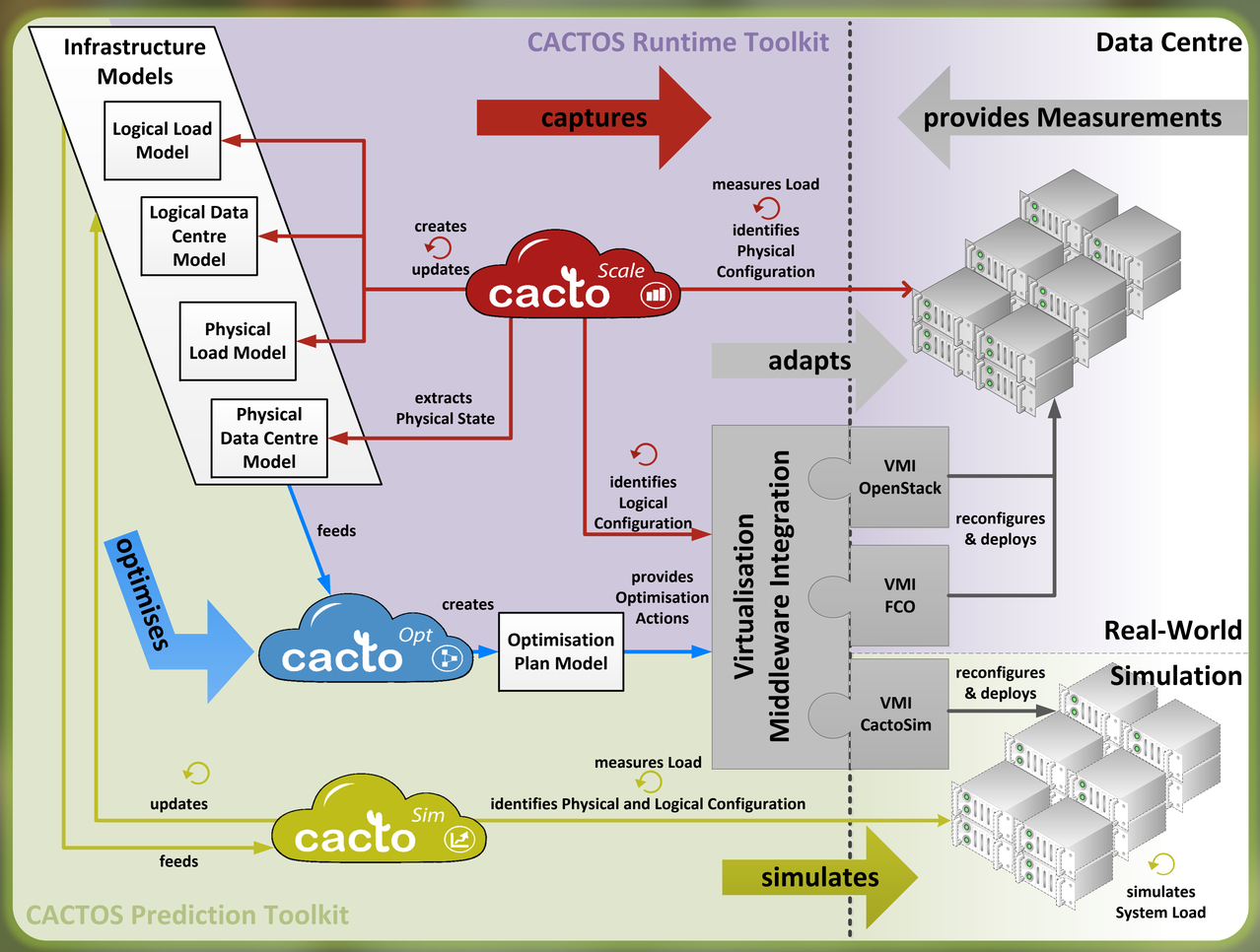
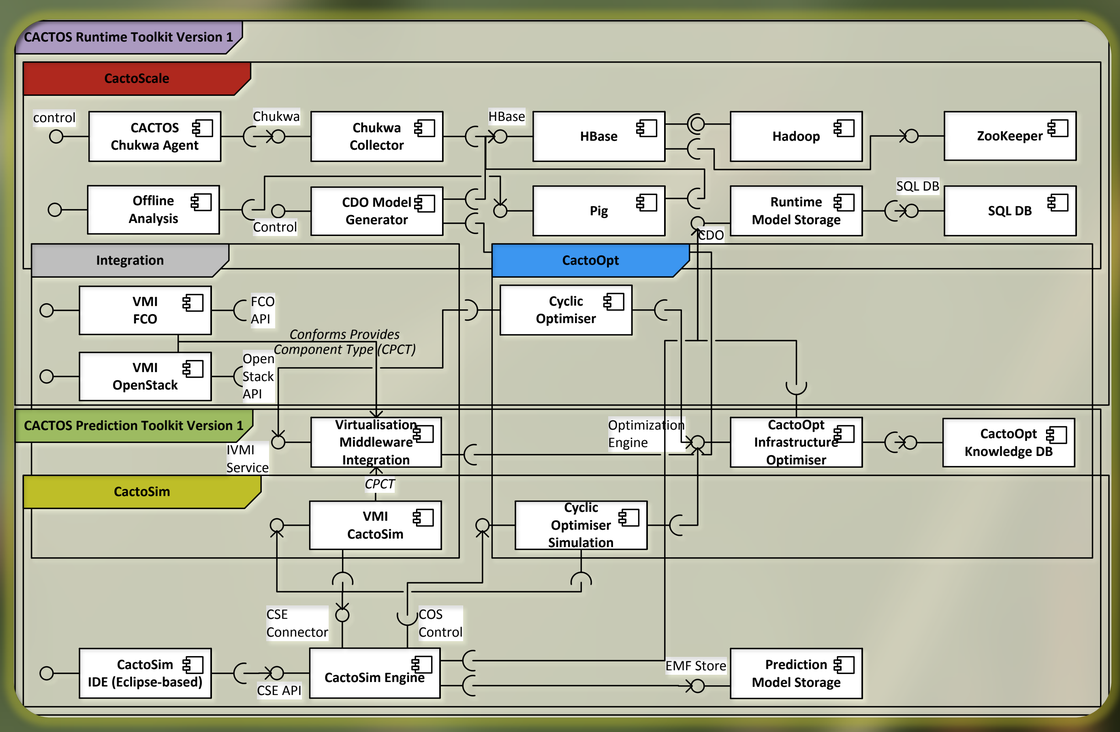
# Towards an Optimisation-Aware Data Centre Prediction Toolkit

Management of cloud applications and data centre resources has become increasingly complex, due in large part to a substantial increase in the degree of heterogeneity and scale. Topology optimisation tools and algorithms currently in use for optimal placement of applications across such heterogeneous resources are typically trial-and-error based. Predicions enable the evaluation of such optimisation algorithms and their complex interactions towards better reasoning at decision time, e.g. optimising for a specific trade-off.

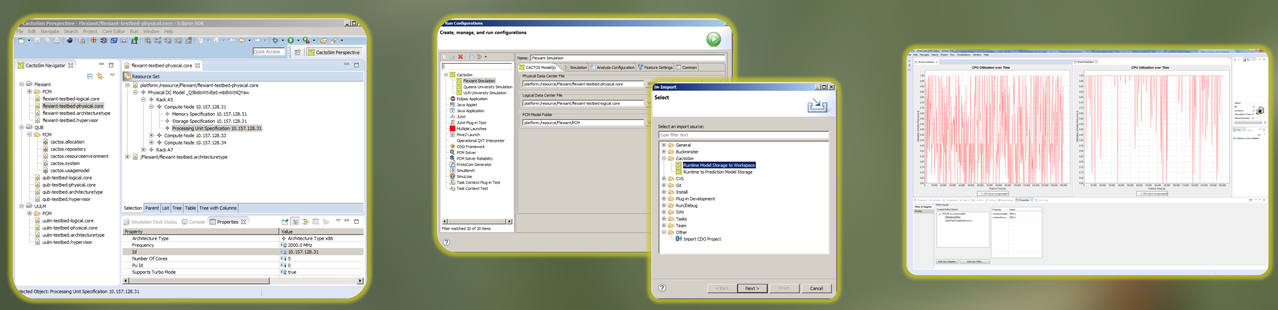



**CactoScale** acquires and analyses application behaviour and infrastructure performance data. It consolidates multiple sources of performance and error monitoring data and updates Infrastructure Models accordingly.

**CactoOpt** applies mathematical models to optimise application-resource mappings and create Optimisation Plans. It includes a library of configurable multi-objective optimisation algorithms to maximise data centre efficiency.




**CactoSim** is a discrete event simulation (DES) framework that enables the evaluation of the effect of provisioned CactoOpt runtime optimization strategies in a simulated environment at design time. This offers significant benefit over the utilization of testbeds which are typically costly to provide on a large scale and can have a high level of complexity. CactoSim allows for reproducible and controlled experimentation with different workload mix and resource scenarios enabling both performance and risk analysis to be performed as well as the tuning of potential bottlenecks in a data centre.



The current prototype integrates with the Runtime Toolkit and enables detailed data centre modelling. The simulation provides results for decision support through seamless model transformation to PCM. Further iterations will improve the mapping and prediction factors.

**CactoSim's Architecture** is driven by the integration of the CACTOS Prediction Toolkit and the CACTOS Runtime Toolkit. **CactoSim Engine** and **IDE** build on Palladio and the SimuLizar Plugin for analyzing self-adaptive systems. They use a more complex Infrastructure Model and employ QVTo model transformations internally to map between the PCM and this model. The **Prediction Model Storage** uses EMF Store for versioning different data centre design and configuration alternatives. The **Cyclic Optimiser Simulation** uses this mapping to delegate optimisation plan creation to the CactoOpt Infrastructure Optimiser. This plan is enacted by **VMI CactoSim** within a simulation run.

*This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no. 610711*

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**2014 Symposium on Software Performance, November 26-28, Stuttgart, Germany**