Ontology and Rules provide Mass Customization of Vehicles
Background

- A Fortune 250 Company offers mass customization of a wide variety of Trucks and Buses
Background

- Mass Customization of Trucks and Busses
  - Customers describe the desired vehicle by selecting the base model and a wide range of attributes (e.g. vehicle length) and features (e.g. number of exits)

- Combinatorics of parts and assemblies
  - More than 480,000 combinations of parts, assemblies, and locations for a given vehicle
  - Each vehicle off the assembly line can be one-of-a-kind.
The Configuration Challenge

- Given an order that may never have been previously built, identify the best set of parts, assemblies and component locations for the vehicle (the Vehicle Configuration)
- Different parts and assemblies will be available at different plants at different times. So, need to select a configuration that can be built at a plant prior to the promised delivery date.
Solution Ontology

• Ontology defined both bottom-up and top-down
  – Bottom-up:
    • Allow design engineers to specify which combinations of parts and assemblies satisfy given models, attributes and features; Identify generalizations based on common usage.
    • Identifies what has been designed to work together
  – Top-down:
    • Provide Ontology for vehicle system and subsystem down to components and assemblies; ensures complete vehicle design and sphere-of-influence checks (some standards apply: ATA classification codes)
Solution Rules Engine

• Domain-specific UI
  – Engineers identify specific combinations in terms of both abstractions and instances
  – Rules are generated; They are not directly written by the engineers
  – Engineers work only in terms of their domain Ontology

• Employ a fast Rules Engine
  – Over 600K rules with avg. 24 condition elements
  – Truck configured in under 10 seconds on my laptop
  – Worlds fastest most scalable rules engine – recently patented (2008) – Not based on RETE; Much better memory profile
Benefit

- Ontology allows quick and reliable specification of new variations
- Rules are specified in terms of the Ontology (incl. features and attributes)
- Changes in Ontology and Changes in Rules can take effect immediately (or at designated times and plants)
  - Allows flexible change in suppliers and parts
  - New models and variations reuse previously proven engineering work
Summary

• Ontology-driven engineering is in mission-critical use today in large corporations
• Rules-based technologies exists today to flexibly and rapidly leverage Ontologies to meet business goals
• In many industries there are significant opportunities is mass customization and the “long tail”. The efficient management of knowledge assets is key to unlocking those opportunities.