Dynamic Gate Product and Artifact Generation from System Models

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Overview

Document Generator ("Docgen"): Generate model content as a paper artifact ("document").

- Stakeholder: someone with a UML/SysML model
  - UML: Unified Modeling Language
  - SysML: Systems Modeling Language
- Use-case: stakeholder has to produce a document containing information in the model
  - Requirements documents, test procedures, n-squared matrices, architecture description documents, etc.

Docgen Context

- Current systems engineering paradigm: "Power Point Engineering"
  - Plethora of disjointed documents
  - Human overhead finding latest data
  - Documents obsolete immediately
  - Spaghetti diagrams
- Future SE paradigm: Model-Based Systems Engineering
  - Centralized "gold source" of information
  - Documents are views of the system
  - Diagrams conform to visual rules
- How do we transition?

Docgen Solution

- Reality of the transition to MBSE: legitimate need for artifacts
  - Human-friendly communication format
  - Engineers must provide and communicate evidence for claims about the system
  - Documents (of specific format) are often non-negotiable requirements

- Docgen provides an interface
  - A document is just a view into the model
  - Query models to produce documents
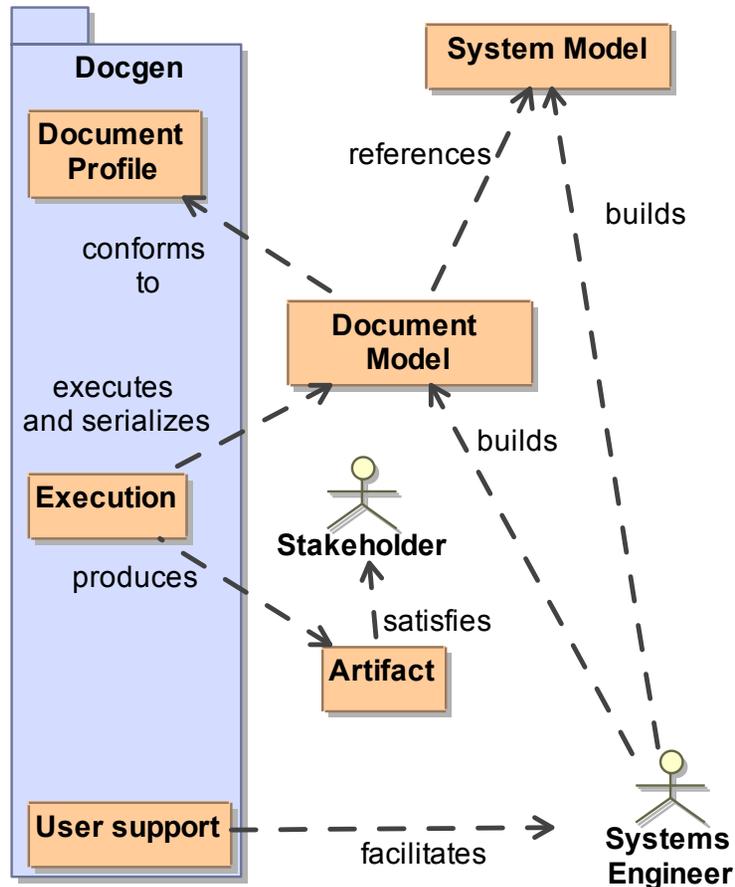 - Store the view (document) specification with the model

What is a document?

- Information organized logically
  - Sequence
  - Depth

- Rules
  - Sections contain sections, text, figures, tables, etc.
  - Paragraphs do not contain sections, etc.

- Abstract this…
  - A document is a serialized view of a system model
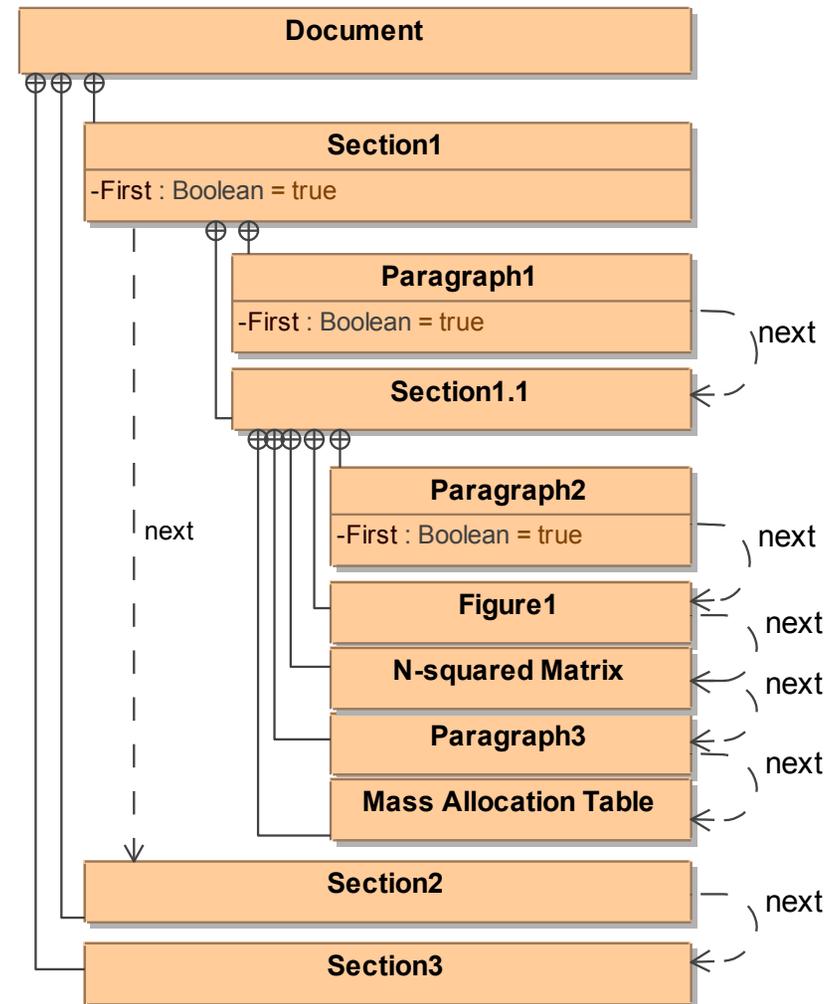
What is Docgen?

- Developed for JPL AMMOS Ops Revitalization – model centric project
- Part 1: Semantics (UML profile)
  - Model logical structure of output (the view)
  - Link queries to system model
- Part 2: Execution
  - Traverse the logical structure
  - Execute queries and analysis
  - Serialize to DocBook XML
- Part 3: Provide user support
  - Model validation
  - Infrastructure support

Document Profile

Structural Elements:

«stereotype»	«stereotype»	«stereotype»	«stereotype»
Document	**Section**	**Paragraph**	*Query*
[Package]	[Package]	[Comment]	[Element]
-title : String +subtitle : String -index : Boolean = true -version : String [1] -debugMode : Boolean		-hasDocbook : Boolean	-queryTargets : NamedElement [0..*] -queryTitles : String [0..*]

Other Properties:
-Authors

Inherited Properties:
-First : Boolean
-Next : [Section or Appendix]
-Previous : [Sect, Para, Qry]
-Title : String
-xref-ID : String
-Ignore : Boolean

Inherited Properties:
-First : Boolean
-Next : [Para, Qry, or Section]
-Previous : [Paragraph or Qry]
-xref-ID : String
-Ignore : Boolean

Other Properties:
-Body : String

Inherited Properties:
-First : Boolean
-Next : [Para, Qry, or Section]
-Previous : [Paragraph or Qry]
-xref-ID : String
-Ignore : Boolean

Document "rules" enforced through profile relationships

Query is abstract; subclassed for specific analysis
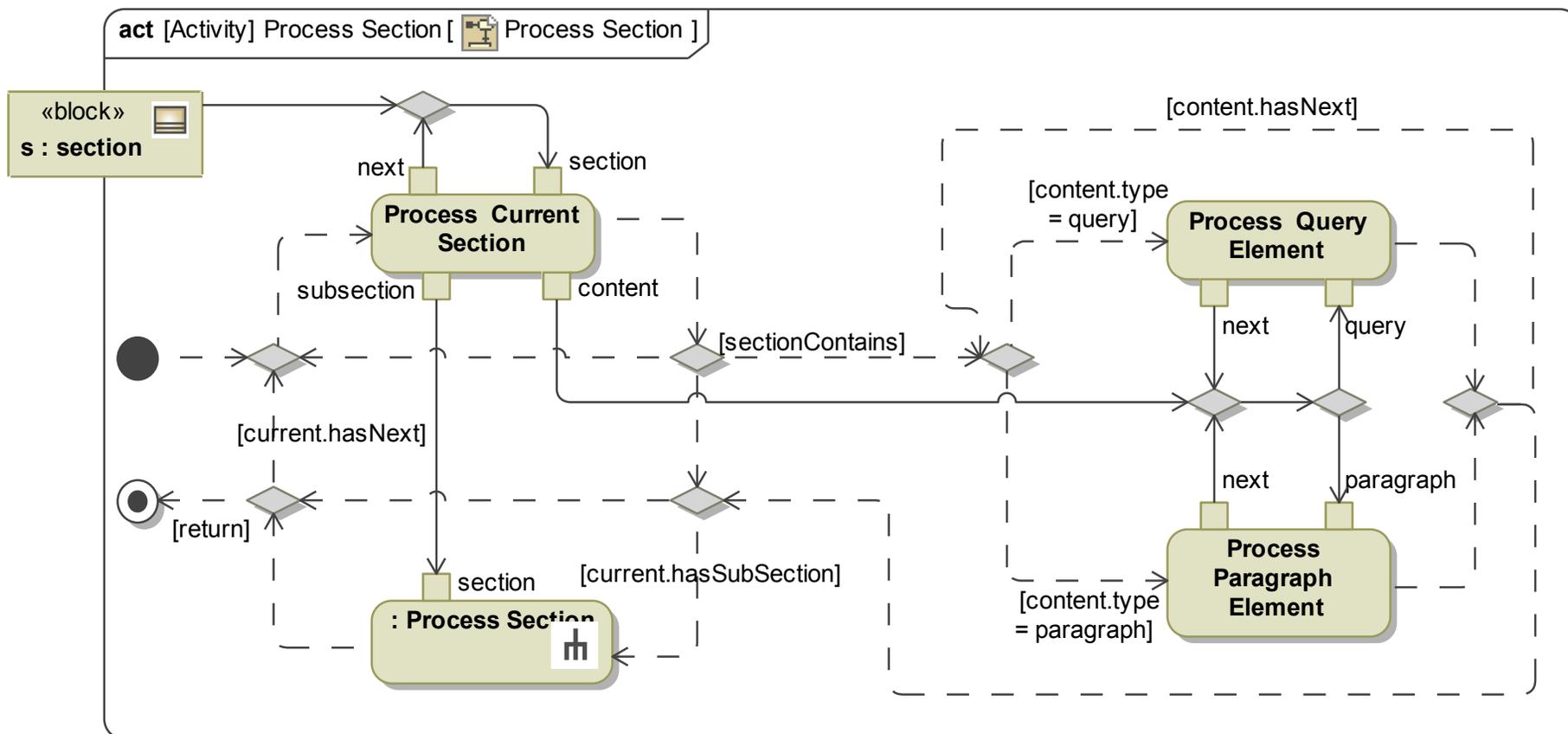
Execution Implementation

- Behavior is logically tool-independent
  - Implemented in any framework with access to model and profile
  - We used MagicDraw UML's Velocity Template Language and OpenAPI interface
- Serialize document model
  - Linked list
  - Hierarchical
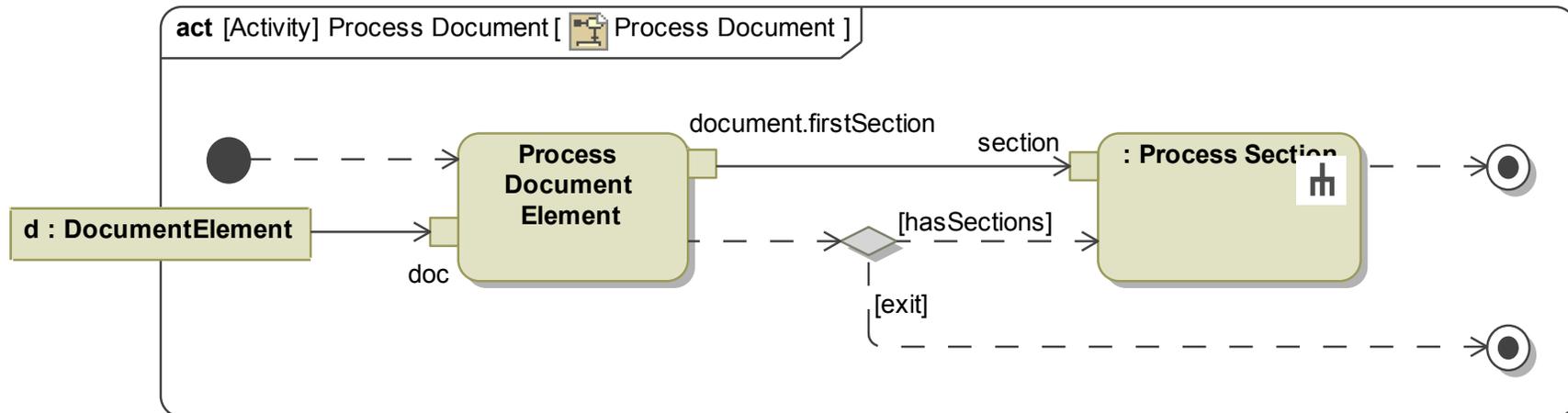
Execution Implementation (2)

Recursive section processing:

Using Docgen

- Docgen validation
    - Correct usage of first, next, previous properties
    - Maintenance of cross-referencing
    - Cosmetic section numbering
    - Pre-generation Diagnostics

- Docgen user convenience
    - Pop-up text editing

- Downstream Processing – producing a document:

Document Profile		Generate Docbook XML	XSLT Stylesheets		Transform Docbook XML		Document (PDF, HTML, etc)
Document Model			Docbook XML				

Advantages and Applications

- Goal: interface between MBSE and document-centric paradigm
  - Leverage MBSE and document advantages
- Centralize models with document views; generic format
- Generate documents concurrent with system design
- Re-use of code; engineers focus on their expertise (not on coding or fighting with word processing software)
- Applications
  - JPL AMMOS Ops Revitalization: 2 Architecture Description Documents; successful model-based reviews;
  - JPL Integrated Model Centric Engineering Initiative; Ops Con
  - Mars Science Laboratory
  - Docgen user guide: Docgen test model produces the user manual

Conclusions and Future Work

- Conclusions:
    - Leverages power and extensibility of UML/SysML
    - Allows MBSE environment to produce documents satisfactory to current engineering paradigm
    - One-time labor investment produces perpetually current documentation
    - Docgen can help demonstrate feasibility and power of MBSE
- Future Work:
    - External generation (remotely from web)
    - Interface with executable models
    - Data exchange with external simulation tools

Backup (1)