



Defining Common Information Model (CIM) Compliance

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Presentation Outline

- **CIM Compliance Realities**
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- **CIM Usage Perspective**
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- **CIM Formal Definitions**
- **CIM Compliance Rules**
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- **Integration Readiness Assessment**
- **Conclusion and Recommendations**

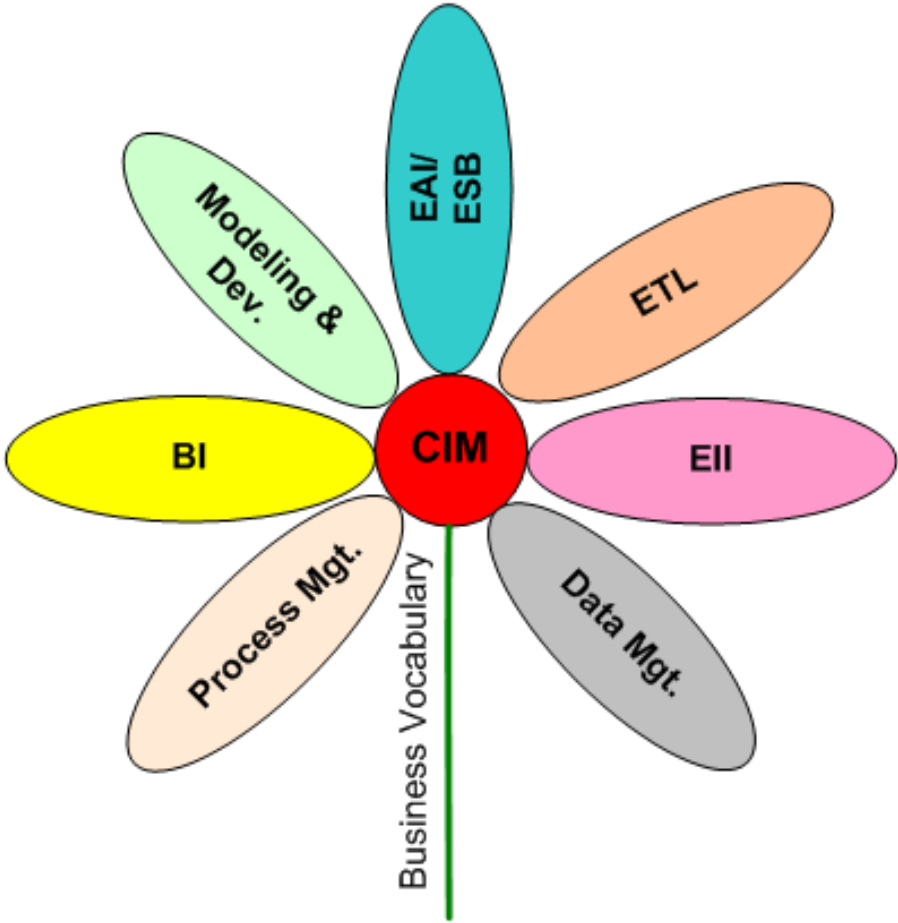


CIM Compliance Realities

- Lack of consistent and clear compliance rules
- CIM is not consistently leveraged on large scale integration projects
- Misperception of CIM Usage and compliance makes vendors hesitant to address compliance
- They all “smoke” CIM however most of them don’t “inhale” it.
- A fair amount of ambiguities at the different levels
- A need to promote CIM usage beyond network model exchange



CIM Usage Perspective

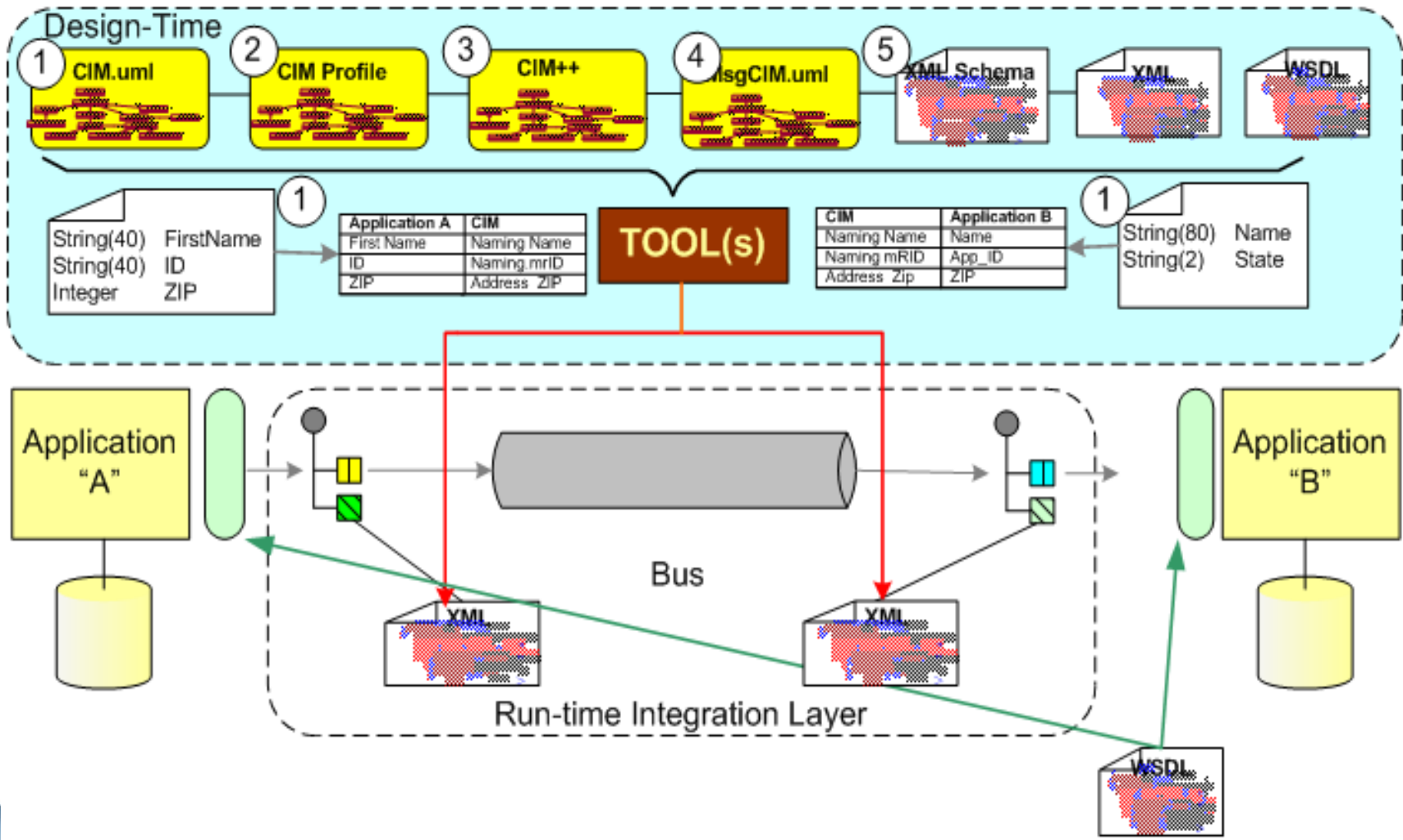


CIM Usage

- **Enterprise Application Integrating (EAI) / Enterprise Service Bus (ESB)** – provides basis for standard-based message payloads and data transformation
- **Enterprise Information Integration (EII)** – provides platform-independent logical model as well as mappings to underlying systems and federated queries.
- **Extract, Transform and Load (ETL)** – Generates data transformation workflows to convert data from a source to a target data store using CIM – DDL generation
- **Modeling and Development tools** – Create / extent / profile models (e.g. interface model) using CIM structures
- **Business Intelligence (BI) tools** – Using CIM and Business Vocabulary (BV) to generate common business views
- **Data Management solutions** - provides platform-independent logical model as well as data exchange mappings from CIM-based payloads to underlying systems.
- **Process Modeling** – More effective process engineering leveraging CIM use cases and standard functional decomposition
- **Composite Applications Framework** – provides standard-based interoperability framework for linking business components into functional assemblies
- **Network Model data exchanges** - provides ability for multiple components (within the same organization or B2B) to exchange network models



Example 1: CIM Usage – Web Service Design



CIM Formal Definitions (1)

- **Definition 1 - CIM Definition**

- *A CIM is a 4-tuple: $C = (E, A, P, R)$*

- **where**

- *E is set of Entities in CIM: $E = \{e_i | 1 \leq i \leq n, e_i \in E\}$*
 - *A is set of Attributes in CIM: $A = \{a_j | 1 \leq j \leq m, a_j \in A\}$*
 - *P is set of attribute data Properties in CIM $P = \{p_k | 1 \leq k \leq o, p_k \in P\}$*
 - *R is set of Relationships in CIM $R = \{r_l | 1 \leq l \leq q, r_l \in R\}$*
 - *n – number of entities in CIM*
 - *m – number of attributes in CIM*
 - *o – number of attribute data properties in CIM*
 - *q – number of relationships in CIM*



CIM Formal Definitions (2)

- **Definition 2 – CIM profile Definition**

- A CIM Profile is a 4-tuple: $C_{pr} = (E_{pr}, A_{pr}, P_{pr}, R_{pr})$

- Where

- E_{pr} is set of Entities in CIM Profile: $\{e_i | 1 \leq i \leq n_{pr}, e_i \in E\}$
 - A_{pr} is set of Attributes in CIM Profile: $A_{pr} = \{a_j | 1 \leq j \leq m_{pr}, a_j \in A\}$
 - P_{pr} is set of attribute Data Properties in CIM Profile: $P_{pr} = \{p_k | 1 \leq k \leq o_{pr}, p_k \in P\}$
 - R_{pr} is set of Relationships in CIM Profile: $R_{pr} = \{r_l | 1 \leq l \leq q_{pr}, r_l \in R\}$
 - n_{pr} – number of entities in CIM profile $\{n_{pr} < n\}$
 - m_{pr} – number of attributes in CIM profile $\{m_{pr} < m\}$
 - o_{pr} – number of data properties in CIM profile $\{o_{pr} < o\}$
 - q_{pr} – number of relationships in CIM profile $\{q_{pr} < q\}$



CIM Formal Definitions (3)

- **Definition 3 – Extended CIM Definition**

- An Extended CIM is a 4-tuple: $C_{ex} = (E_{ex}, A_{ex}, P_{ex}, R_{ex})$

- Where

- E_{ex} is set of Entities in extended CIM: $E_{ex} = \{e_i | 1 \leq i \leq n_{ex}, e_i \in E_{ex}, E \subset E_{ex}\}$
 - A_{ex} is set of Attributes in extended CIM: $A_{ex} = \{a_j | 1 \leq j \leq m_{ex}, a_j \in A_{ex}, A \subset A_{ex}\}$
 - P_{ex} is set of Properties in extended CIM: $P_{ex} = \{p_k | 1 \leq k \leq o_{ex}, p_k \in P_{ex}, P \subset P_{ex}\}$
 - R_{ex} is set of Relationships in extended CIM: $R_{ex} = \{r_l | 1 \leq l \leq q_{ex}, r_l \in R_{ex}, R \subset R_{ex}\}$
 - n_{ex} – number of entities in extended CIM $\{ n_{ex} > n \}$
 - m_{ex} – number of attributes in extended CIM $\{ m_{ex} > m \}$
 - o_{ex} – number of properties in extended CIM $\{ o_{ex} > o \}$
 - q_{ex} – number of relationships in extended CIM $\{ q_{ex} > q \}$



CIM Formal Definitions (4)

- **Definition 4 – CIM Mapping / Transformation Definition**
 - *A simple mapping or transformation is defined as 3 - tuple:*
 $T = (M, O, C)$ where
 - *T is set of mappings / transformations $\{t_i | 1 \leq i \leq n_t, t \in T\}$*
 - *C is set of CIM elements*
 - *M is set of Model elements*
 - *O – set of operations (simple transformation / function or direct mapping) that maps elements of set M to elements of set C*
 $O: M \rightarrow C$ where
 - $\{m_j = o_i(c_k)\}$
 - $\{m_j | 1 \leq j \leq a_m, m_j \in M\}$
 - $\{c_k | 1 \leq k \leq a_c, c_k \in C, \}$
 - $\{o_i | 1 \leq i \leq n_o, o_i \in O, a_m \leq a_c\}$
 - *a_m – number of attributes in M*
 - *a_c – number of attributes in CIM*
 - *o – number of operations that transform / map model data elements to CIM*



CIM Formal Definitions (5)

- **Definition 5** – CIM compliance indicator for a model is defined as percentage of model data elements mapped to CIM

– *CIM compliance indicator is defined as*

$$t_{\%} = a_t / a_m * 100 \text{ where}$$

- $t_{\%}$ - percentage of elements mapped to CIM
 - a_t – total number of data elements from model M mapped to CIM
 - a_m – number of applicable attributes in model M
- **Definition 6** – CIM compliance indicator for multiple models (e.g. sender/source and receiver/target) is defined as percentage of model data elements that map to each other ($M_1 \rightarrow M_2$) and to CIM.

– *A simple mapping or transformation is defined as 3 - tuple:*

$$T = (M, O, C) \text{ where}$$

- $t_m\%$ - percentage of elements mapped to CIM
- a_t – total number of data elements from model $M_1, M_2 \dots M_n$ that map to each other and to CIM
- a_n – number of applicable attributes in models $M_1, M_2 \dots M_n$



CIM Formal Definitions (6)

- **Definition 7** – CIM compliance indicator for multiple models (e.g. sender/source and receiver/target) is defined as percentage of model data elements that map to each other ($M_1 \rightarrow M_2$) and to CIM.
 - CIM compliance indicator s for multiple m models is defined as

$$s_m\% = a_t / a_n * 100$$

where

- $s_{m\%}$ - percentage of elements mapped to CIM
- a_s – total number of data elements from model $M_1, M_2 \dots M_n$ that map to each other and to CIM at entity, attribute, property and relationship level.
- a_n – number of applicable attributes in models $M_1, M_2 \dots M_n$



CIM Compliance Assessment Rules (1)

- Semantic Compliance

- Rule 1 - A necessary condition for CIM semantic compliance is the ability to map directly or using a simple translation, data elements of an information model to the respective attributes of the CIM.

Supposing Definition 4 and according to Definition 5, CIM Compliance Levels are

*If $10 < t_{\%} < 20$ then $CL = 1$
Else if $20 < t_{\%} < 30$ then $CL = 2$
Else if $30 < t_{\%} < 40$ then $CL = 3$
Else if $40 < t_{\%} < 50$ then $CL = 4$
Else if $50 < t_{\%} < 60$ then $CL = 5$
Else if $60 < t_{\%} < 70$ then $CL = 6$
Else if $70 < t_{\%} < 80$ then $CL = 7$
Else if $80 < t_{\%} < 90$ then $CL = 8$
Else if $90 < t_{\%} < 99$ then $CL = 9$
Else if $t_{\%} = 100\%$ then $CL = 10$*



CIM Compliance Assessment Rules (2)

- Interoperability (Message Payloads / Interfaces / Data Streams) CIM Compliance

- **Rule 2** - *A necessary condition for CIM compliant semantic interoperability between two systems is the existence of mapping schema or translation function that maps data elements of the domain models of both systems (sender/source and receiver/target) to the respective attributes of CIM.*

Supposing Definition 4 and according to Definition 6, CIM Compliance Levels are

If $10 < t_{\%} < 20$ then $CL = 1$

Else if $20 < t_{\%} < 30$ then $CL = 2$

Else if $30 < t_{\%} < 40$ then $CL = 3$

Else if $40 < t_{\%} < 50$ then $CL = 4$

Else if $50 < t_{\%} < 60$ then $CL = 5$

Else if $60 < t_{\%} < 70$ then $CL = 6$

Else if $70 < t_{\%} < 80$ then $CL = 7$

Else if $80 < t_{\%} < 90$ then $CL = 8$

Else if $90 < t_{\%} < 99$ then $CL = 9$

Else if $t_{\%} = 100\%$ then $CL = 10$



CIM Compliance Assessment Rules (3)

- Syntactic Compliance

- **Rule 3** - *A necessary condition for CIM compliant syntactic interoperability between two systems is the existence of semantically compliant sender and receiver as well as when both systems (sender and receiver) can process message structure/payload derived from CIM*

Supposing Definition 4 and according to Definition 7, CIM Compliance Levels are

If $10 < t_{\%} < 20$ then $CL = 1$

Else if $20 < t_{\%} < 30$ then $CL = 2$

Else if $30 < t_{\%} < 40$ then $CL = 3$

Else if $40 < t_{\%} < 50$ then $CL = 4$

Else if $50 < t_{\%} < 60$ then $CL = 5$

Else if $60 < t_{\%} < 70$ then $CL = 6$

Else if $70 < t_{\%} < 80$ then $CL = 7$

Else if $80 < t_{\%} < 90$ then $CL = 8$

Else if $90 < t_{\%} < 99$ then $CL = 9$

Else if $t_{\%} = 100\%$ then $CL = 10$



Integration Readiness Assessment

Complexity of Integration vs. Compliance Levels (Traditional Integration Tools)

Integration Complexity	Description	Semantic Compliance Levels				Syntactic Compliance Levels			
		2	4	7	10	2	4	7	10
High	No Semantic Model, No Endpoints	✓	✓			✓	✓		
Med/High	No Semantic Model, Some Endpoints	✓	✓			✓	✓		
Medium	Semantic Model, Some Endpoints			✓			✓		
Med/Low	Semantic Model, Endpoints			✓				✓	
Low	Semantic Model and standard based Endpoints			✓	✓			✓	✓
Zero Coding Effort*	Plug & Play				✓				✓
Zero effort	True Plug & Play								✓



Integration Readiness Assessment

Complexity of Integration vs. Compliance Levels (Next Generation Tools)

Integration Complexity	Description	Semantic Compliance Levels				Syntactic Compliance Levels*			
		2	4	7	10	2	4	7	10
High	No Semantic Model, No Endpoints	✓	✓			✓	✓		
Med/High	No Semantic Model, Some Endpoints	✓	✓			✓	✓		
Low	Semantic Model , Some Endpoints			✓	✓		✓		
Configuration Effort	Semantic Model , Endpoints				✓			✓	
Configuration Effort	Semantic Model and standard based Endpoints				✓			✓	✓
Configuration Effort	Plug & Play				✓				✓
Zero effort	True Plug & Play				✓				✓

*Semantic Model will be imported in Integration Tools and used as an Intermediary where all mapping and transformations will be defined for run-time. Therefore, semantic compliance will become more important in the future.





Conclusion and Recommendations

- CIM Semantic and Syntactic compliance rules are proposed
- This is an attempt to demystify CIM usage and simplify CIM compliance assessment
- Proposed rules can be used to assess components' integration readiness
 - Proposed rules can be leveraged by 3-parties for CIM compliance certifications
- Higher compliance levels decreases chances of projects' delays and leads to more effective and less expensive integration





Questions

- Contact Information

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