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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

On-going industry convergence and pressure to reduce cost is placing an ever-increasing emphasis on the need to rationalize and align various network management aspects across boundaries of standards/specifications producing organizations. The cost, resulting from integration and management challenges, of the lack of a coherent treatment of the whole network has becoming increasingly apparent to the point where operators of networks are demanding action.

This document provides key concepts and principles for the Federated Network Information Model covering all key aspects of a solution to the on-going industry convergence challenge. The proposal focuses on Information Model federation and is constructed to best deal with the various contradictory pressures of the current environment providing a pragmatic and realizable approach. The structure proposed will be called the Federated Network Information Model (FNIM).

The proposal set out in this document:

Explains:

- How, from a technical perspective, a number of standards and specifications generated by different organizations can function together to bring greater coherence to the management of converged networks and hence reduce operations costs.

- Specifically how TM Forum and 3GPP can work with each other and with other industry groups in a Standards Federation to develop a Federated Network Information Model drawing on insights from the broad community (including the TM Forum SID [7], TM Forum MTNM/MTOSI [8], 3GPP SA5 IRPs [14], DMTF CIM [15]).

- How the Federated Network Information Model can be used from a technical perspective (with the focus here being the Network Model).

Recognizes:

- The network is “always on”, therefore changes in management solutions should not impact networks in operation.

- There will always be on-going change.

- That this is only a start on a very long journey.

Allows and enables:

- Decoupling of concerns across the industry whilst growing industry coherence.

- Differing delivery pace across the industry whilst aiming for industry convergence.

- Variety from innovation whilst removing unnecessary variety in management infrastructure.

- Temporary divergences and overlaps during the convergence process.

Ensures:

- Change is made only as a result of understanding of specific market needs.

- Progress by providing coherent solutions to satisfy the needs of all participating industry partners in order not to be blocked by the slowest laggard.

Highlights:

- The challenges of dealing with differing methodologies/tooling used across the standards arena and points out that methodology/tooling differences if ignored will significantly slow progress towards the target.

- The need for development of a new governance regime and points to some of the attributes of such a regime.

- An approach of gradual restructuring and a controlled converging coherence starting small and growing step by value-justified step.

- The challenge of presenting the models so all can have an identical understanding.

- The challenge of interpreting models from different origins, with their different terminology and viewpoints, to arrive at a shared understanding through a federated model. This leads to recognition of the need for a deeper uniform semantic analysis of the area covered by the umbrella information model (UIM) and the navigation points among concrete models which may further lead to the need for the development of information architectures and patterns.

This document focuses on the Information Model aspect of the problem as it is clear that the lack of an agreed-upon, coherent information model across organizational boundaries to support the FMC aspects of the industry that defines the things to be managed and the way they should be expressed is one of the first aspects that need to be tackled.

Editor's note: Prior to embarking on a further summary of the proposal and its benefits, it is important to emphasize that the definition of the term "model" has to be carefully considered. A model is comprised of parts that themselves can be seen as models. As a consequence whether this activity results in a single model or a set of models depends upon perspective. The critical consideration is whether the parts of the solution can be interrelated and from the perspective of the problem highlighted above whether the parts can be interrelated across what were previously un-navigable barriers. The solution offers this navigability. Conversely it is critical that the solution offers appropriate decoupling of concerns and of governance. Whether this is considered one model or many is not relevant as long as the solution offers the properties, such as those noted above, that are critical for industry success.

This document proposes a Federated approach to model development and emphasizes the need for the development of an Umbrella Information Model (UIM) and its relationships with the other domain specific models. The document also deals with direct relationships between domain/technology specific concrete models.

It is proposed that:

- The work will be published and expressed in UML and will also be published in formats appropriate for each of the participating bodies to absorb (this may require nothing more than the UML format in some cases). The output form required by a particular body will be generated by resources contributed by that body.

- As necessary the model will be embellished using stereotype to express all aspects/properties of the model.

The proposal recognizes that the TM Forum Information Framework (SID) [7] and the TM Forum Integration Framework (MTNM/MTOSI) [8] work provide an enterprise-wide structure and model that can be used to seed the converged model. The proposal recognizes that the 3GPP SA5 group work [14] provides models relating to mobile networks (including RANs, CNs and IMS) that can be used to seed the converged model.

The proposal:

- Ensures on-going reduction in cost of integration and improvement of degree of integration for the purpose of End-to-End management;

- Enables models from many organizations to be used together for the purpose of End-to-End management (recognizing that there are a number of critical governance issues to be overcome to enable this);

- Provides structure for the alignment on a deeper understanding of the semantics and for the development and maintenance of an information architecture and associated patterns;

- Provides both an initial pragmatic solution form and a longer term target;

- Recognizes that the model will evolve in stages, but will never be "completed" and hence this is an on-going activity;

- Recognizes the importance of providing solutions that are backward compatible to existing standards. See [13, 17]

This content of this document has been jointly developed by 3GPP and TM Forum as part of the Joint Working Group on Resource Model Alignment [18].

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] ITU-T X.680 "OSI networking and system aspects – Abstract Syntax Notation One (ASN.1)".

[2] 3GPP TS 32.642 "UTRAN network resources IRP: NRM".

[3] ATM Forum, Technical Committee, Network Management, M4 Network View CMIP MIB Specification ("CMIP Specification for the M4 Interface", Sep 1995, http://www.broadband-forum.org/ftp/pub/approved-specs/af-nm-0027.000.pdf).

[4] 3GPP TS 32.622 "Generic network resources IRP: NRM".

[5] MEF Technical Specification MEF 7.1, "Phase 2 EMS-NMS Information Model", October 2009.

[6] 3GPP2 S.S0028-E "OAM&P for cdma2000 (Overview, 3GPP R7 Delta Specification, 3GPP2 Network Resource Model IRP)".

[7] TM Forum GB922, Information Framework (SID) Suite, Release 9.0 (http://www.tmforum.org/browse.aspx?catID=9285&artf=artf2048).

[8] TM Forum MTOSI 2.0 (http://www.tmforum.org/MTOSIRelease20/MTOSISolutionSuite/35252/article.html).

[9] TM Forum SD1-44_ConnectionlessTechnologyManagement.pdf available as part of [8] (Especially Appendix III "Mapping MEF – MTNMETH").

[10] TM Forum SD1-7_DSLOverview.pdf available as part of [8].

[11] TM Forum SD1-18_layers.pdf available as part of [8] (Especially 4.2.7 ATM and SDH capable STM-4).

[12] TM Forum "Connectionless, Connection Oriented Convergence and TP Modelling" (http://tmforum.org/FeatureDescription/ConnectionlessConnection/41718/article.html).

[13] TM Forum TR 146 "Lifecycle Compatibility Release 1.0" (http://www.tmforum.org/TechnicalReports/TR146LifecycleCompatibility/36664/article.html).

[14] See Appendix B for the list of 3GPP Technical Specification series on Network Resource Models.

[15] DMTF CIM ("Distributed Management Task Force Common Information Model").

[16] 3GPP TR 32.852 "Fixed Mobile Convergence (FMC) 3GPP/TM Forum Model Relationships & Use Cases".

[17] 3GPP TS 32.154 "Backward and Forward Compatibility (BFC); Concept and definitions".

[18] 3GPP / TM Forum JWG RMA: "FMC Federated Network Information Model (FNIM)" V3.0.

[19] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [19] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [19].

Encoding: It is the process by which information is converted into symbols to be communicated. In this document, the 'information' is captured by the so-called model.

Operations/Notifications: Specification conveyed over an interface between two interacting parties indicating the action to be performed on some identified entity or set of entities. In general the "operations model"/"business services model"/"action model" (or similar) cover the definitions of the actions performed to change the state/value/etc. of the thing and to receive information on changes that have occurred to the thing and to receive information on changes that have occurred to the thing.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [19] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [19].

DN	Distinguished Name
FIM	Federated Information Model
FNIM	Federated Network Information Model
FMC	Fixed Mobile Convergent
IM	Information Model
LT	Layer Termination
NM	Network Management
UIM	Umbrella Information Model

4 Characteristics and context of FNIM

4.1 Characteristics

The FNIM is “large scale” in the following sense:

- Different authorities (SDOs or standard organizations including expert group) are responsible for the development, maintenance and evolution of their own domain specific models.
- Operators may use the whole or part of the FNIM depending on their own business cases.
- Vendors can supply products using part of the FNIM depending on their own business cases.
- The FNIM needs to hold thousands of inter-related modelled entities. Different versions of modelled entities can co-exist in FNIM.

4.2 Contexts of FNIM

4.2.1 A broad standardization context

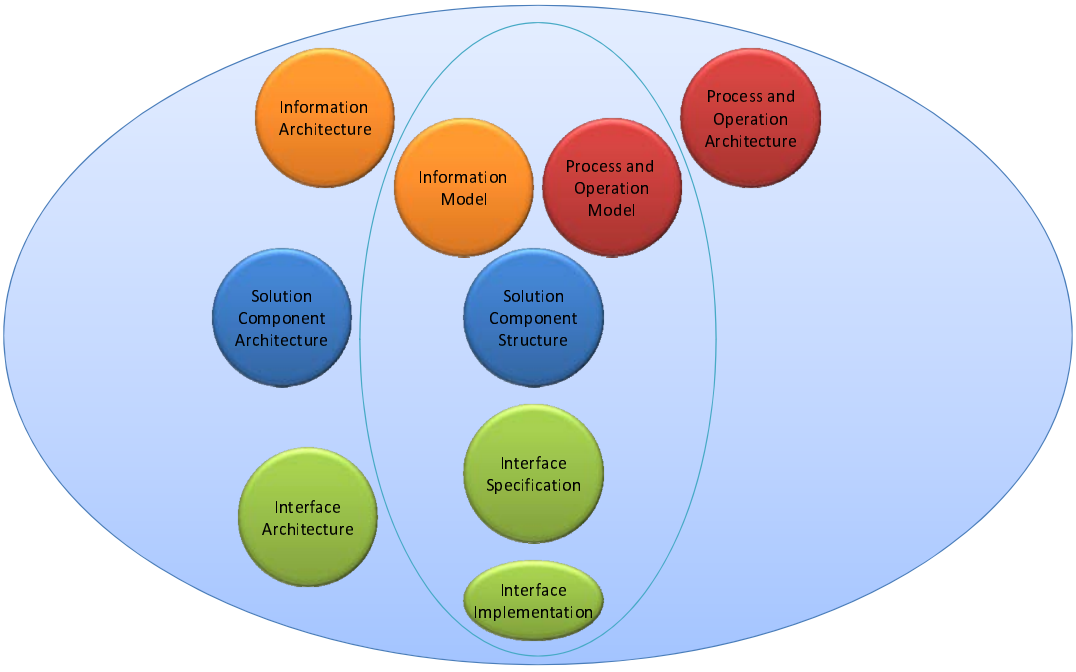

Figure 1: Broad standardization context

The figure depicts a broad standardization context. The concept embodied by the term Information Model (of Managed Elements etc.), abbreviated as IM, is separable from the concept of Process and Operation Model (covering definitions of activities). Clearly the Process and Operation Model influences and is influenced by the IM.

Encoding in general (of information defined in IM Process and operation model) to achieve an Interface Implementation is also separable and is not considered further here. Each aspect of the problem is guided and constrained by an appropriate Architecture (e.g. Metamodel) that defines the breadth and scope of the aspect.

The things in the IM are relevant to some activity identified in the Process and Operation Model. That relevance is necessary in order to fulfil some purpose of the system. The things in the IM are in many cases relevant to expose at some Interface in which case they will dictate some aspects of structure of information defined in IM and Process and Operation Model.

The IM can be broken down into two parts:

- Broad conceptual model that articulates the concepts of the problem space (alternative names are **purpose neutral, implementation neutral views**)

- Specific purpose models that each articulate the solution to a specific problem (alternative names are **purpose specific, implementation neutral views**)

In summary, the following definitions apply to terms of the above figure:

- Information Model (IM): The representation of things, their properties and their relationships. Example: TopologicalLink and TerminationPointEncapsulation are things that are interrelated and have properties represented via attributes.

- Process and Operation Model: The representation of the relevant activities required to facilitate the running of the business including the flows and interactions. Example: “IsolateCustomerProblem” and “Track&ManageCustomerProblem” are relevant activities that are interrelated by flows of control and information. “getAlarmList”, “getAttribute” and “createFlowDomainFragment” are examples of operations.

- Solution Component Structure: The representation of the units of functionality assembled to support the information defined in the IM and in the Process and Operations Model. Example: NMS and EMS are solution components that support various process activities and maintain information. The two are interconnected as part of the structure of the management solution.

- Interface specification: The definition of the interactions between the solution components supporting the exchange of information and control associated with running of the business. This interaction is in terms of the information defined in the IM and in the Process and Operations Model.

- Interface implementation: The implementation form of the interfaces appropriate for the runtime environment.

- Architecture: The patterns, rules, metamodels and structures derived from the fundamental properties of the problem space that guide and constrain the development of the model of each aspect of the problem space.

4.2.2 Integration with 3GPP/SA5 standard production processes

This context describes how 3GPP/SA5 would use the FNIM to produce its specifications that would be used for FMC network management purpose.

This context only refers to the model part. Note that the FNIM is not related to the design of any network management protocol.

The FNIM has multiple components. Two such components are the Umbrella Information Model (UIM) and a number of concrete models (see definition of FNIM in section 0). The right-most box of the following diagram depicts the classes of the UIM. The middle box depicts one of the concrete models, i.e. the 3GPP IRP NRM concrete model. The concrete classes are designed as extension of UIM and must use the appropriate relations defined (see clause 6.1).

Using the concrete classes (of the concrete model) as input, 3GPP/SA5 uses appropriate tools to generate and publish the various specifications.

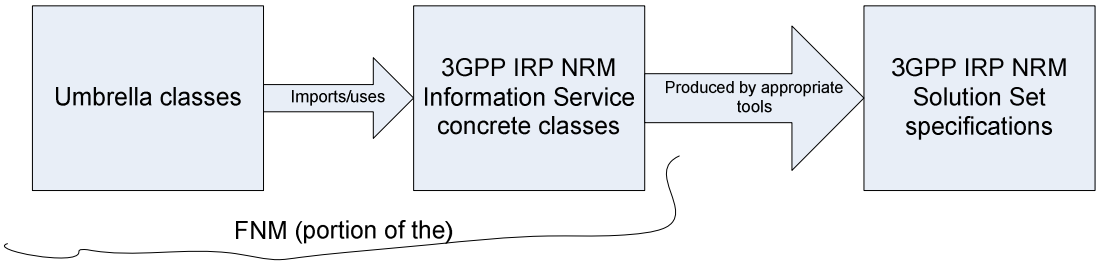

Figure 2: Context of 3GPP/SA5 usage of FNIM

4.2.3 Integration with TM Forum's universe of discourse

This context describes how TM Forum would use the FNIM for FMC network management purpose.

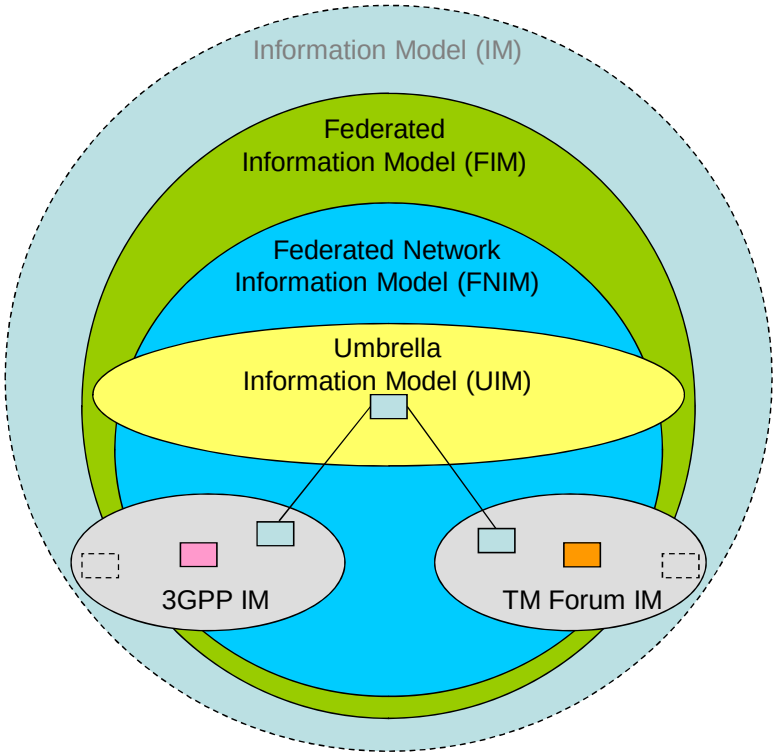

Figure 3: Context of TM Forum usage of various Models

The Federated Information Model (FIM) is a subset of the IM. It relies on a coherent Information Architecture (including meta-model to ensure integrity and coherence). The FIM focuses on IM relevant to the generation of interface specifications but does not cover the specific encoding. The positioning of interfaces is essentially dictated by the Solution Component Structure that defines boundaries.

The following definitions apply to the figure:

- Information Model: See definition in section 4.2.1 "A broad standardization context".
- Federated Information Model (FIM): The parts of the IM that are being developed collaboratively or have been developed collaboratively and agreed by two or more standards bodies. Some of these parts will be found in the specific SDO or standard organization including expert group models.
- Federated Network Information Model (FNIM): The part of the FNIM that deals with Network domain considerations. There will be other domain models in future (F*IM).

– Umbrella Information Model (UIM): The parts of the FNIM that represent the agreed model structures that various SDOs or standard organizations including expert groups will use (via "specific linkages" including inheritance, mappings and other derivations [Note 1]) for their definitions of their respective Domain/Technology-specific concrete classes. The use of UIM maximizes the probability of the Domain/Technology-specific concrete classes being semantically consistent, a necessary characteristic for FMC NM purposes.

– 3GPP IM, TM Forum IM: The IM of all things relevant to the specific SDO or standard organization including expert group including elements that are federated and elements that are not. The federated elements are related to and/or derived from the UIM in the area of the FNIM.

Note 1: The phrase "specific linkages" means "inheritance, mappings and other derivations" and is used in other parts of this document.

5 Features of FNIM

5.1 Introduction

This section describes FNIM features that are essential for the maintenance of the integrity of a large and scalable FMC network model.

5.2 Model components

The FMC network model is partitioned into model components. Clear rules are defined for inter-relationship of model components. The rules should be simple and stable (not changing frequently).

Use of model components and adherence of the simple model component inter-relationship has the following advantages.

- It removes the need to keep the evolution of various model components in synchrony (see more on 5.6). For example, it is a valid implementation where one model component has evolved (requiring new solution) while other model component remained unchanged (does not require new solution).
- Domain experts (e.g. radio experts) can focus their design on their model components and (can, if they want to) be ignorant of contents of other model components (e.g., mobile backhaul networks experts).

5.3 UIM Model component partition

The UIM model component is further partitioned. The partitioning of the UIM model component supports the following:

- A body (e.g. SDO or standard organization including expert group) adoption/use of UIM specification releases/versions need not be lockstep with the availability of the UIM specification releases/versions.
- A body adopting/using a UIM specification may or may not use a particular UIM partition, as long as the partition in question is not classified as essential or mandatory for adoption/usage.
- A vendor's implementation needs not have lockstep with UIM specification releases/versions.
- A vendor may or may not implement a specified UIM partition, as long as the partition in question is not classified as essential or mandatory by the body that governs solutions in that part of the problem space.
- A solution, an assembly of capabilities specified by UIM partitions of the UIM model components and other model components, must be such that mixed versions of UIM partitions and their asynchronous upgrades are achievable (Lifecycle Compatibility [13]).

5.4 Ability to navigate among instances of different model components

This ability allows an instance (source instance) of a class defined in one model component (source model component) to relate (navigate) to another instance (target instance) whose class is defined in another model component (called target model component).

Two mechanisms are recommended.

- The source model component uses a class called ExternalIOC. An instance of this ExternalIOC is a representation of the target instance (which in turn, is the representation of a function under management). In the source model component, the source instance is related (can navigate) to this ExternalIOC instance. ExternalIOC instance captures some information of the target instance such as the DN of the target instance. How this information is kept in synchrony with that of the target instance is case dependent.

– The source instance is related (enables navigation) to the target instance, i.e. the source instance would capture the unique name by which the target instance is known, such as the DN of the target instance. How this information is kept in synchrony with that of the target instance is case dependent.

The source and target instances may be managed by different Domain Managers.

This source and target model components may be defined by different SDOs or standard organizations including expert groups.

Note that the use of these two mechanisms is well known.

5.5 Ability to import model elements designed elsewhere

Use of this feature is for model component-A to include model elements (e.g. classes) defined in another model component, say model component-B.

This feature can also be used, say by a 3GPP specified model component-A, to include model elements (e.g. classes for transport managed resources, TM Forum defined classes) defined in another model component, say component-B, specified by other organizations (e.g. TM Forum, BBF, etc.)

This feature is essentially a copy and paste procedure with a clear indication of the 'source' or design authority of the imported model elements.

Note that the concept of Import is well known in software and modelling design work.

5.6 Independence of tool and platform

Use of FNIM does not require nor mandate the use of a specific tool. Tool and model are evolving at their own paces and decoupling them allows standard authors to choose the best tool for the job (e.g., validation model design, generation of solution).

Decoupling model design from specific platform (e.g. development platform, testing platform) is a necessary condition since it is unrealistic to assume a particular platform for all products in compliance to FMC NM standards.

5.7 Independence of solution technology and access protocol design

This does not imply nor mandate the use of a specific machine-readable language, e.g. XSD, CORBA IDL, GDMO, etc, to express the designed model elements.

This does not imply nor mandate the use of a specific access protocol (e.g. to manipulate or query the parameter values of a class instance). It ensures no dependency can exist between model design and access protocol design.

5.8 Experience

The FNIM concept has been used successfully, albeit in a much smaller scale than FMC network model, in the following cases.

– 3GPP2 develop/maintain/evolve the model component(s) related to CDMA2000 technologies, while 3GPP does similar work related to GSM/UTRAN/EUTRAN technologies plus the GENERIC NRM IRP model component. Vendors can implement standard network management solutions for these technologies and operators' IRPManagers (a 3GPP IRP Framework conceptual object) can use these solutions in a unified way.

– BBF/Home develop/maintain/evolve the H(e)NB network resource models. Relevant IRP Framework model components makes references to those H(e)NB network resource models allowing, for example, an IRPManager to download configuration files to, upload PM counters from and receive alarm notifications from H(e)NBs. Vendors can implement standard network management solutions for these technologies and operators' IRPManagers can use these solutions in a unified way.

5.9 Model components release handling

Each SDO or standard organization including expert group has its own well understood and maintained specifications release mechanism. Each release will have some definition of features that need to be covered and some timeframe for that coverage. There is clearly a time gap between the completion of a new feature and its availability of the management solution for that new feature. Some vendor/operator organizations may choose to intercept developing work (early adopters) whilst others may chose to wait until the solution is complete and has been field proven for several releases (laggards). It is critical that the mechanisms and structures put in place to enable the development and use of a converged model do not disrupt any standards body's ability to deliver to its committed schedule.

Having said that, it is also clear that to move to a more coherent standardization environment that supports the converged network, rather than siloed and inefficiently managed network fragments, will require investment and will require changes in approach by all concerned.

Recognizing that a change of approach will only be applied where there is a suitable business driver, it is expected that the industry business case will be needed to justify any specific deployment impacts to ease the perception of cost (see [16] for examples of industry business cases).

6 Elements of the FNIM

6.1 FNIM components

This section describes the two key elements of FNIM (UIM and Domain/Technology-specific Concrete Models) in terms of model component relations (6.1/6.2) and production of model definitions specifications (6.3).

The Umbrella Information Model (UIM) provides abstract definitions applicable across Domain/Technology-specific Concrete Models to enable end-to-end consistency of such definitions (it is described as 'abstract' in the sense that its components are used via "special linkages" by Domain/Technology-specific Concrete Models, and that it is not designed for the purpose of partial or full instantiation of its components and is not sufficient to provide meaningful network management service).

Domain/Technology-specific Concrete Models are described as 'concrete models' in the sense that their instantiation is necessary to provide meaningful management services. These Domain/Technology-specific Concrete Models uses "special linkages" with the common definitions of the Umbrella Information Model (UIM) for the purpose of end-to-end consistency of management information semantics. In addition, these Domain/Technology-specific Concrete Models have specified relationships between each other to enable end-to-end monitoring and management of a converged network.

6.2 Relations between model components (including UIM)

This section is a graphical representation of the FNIM in terms of relation between model components.

There are two areas considered:

- The definitions of the classes inside the UIM model component.
- The definitions of relation (R0 in Figure 4) used between various classes in UIM model component and other model components.

The aim is to have identical R0 for use between the UIM model component and other model components while the UIM model component need to have no knowledge of its usage by classes of other model components. This will ensure consistency (e.g. resource management style, paradigm) for managing mobile managed resources, as well as other managed resources such as transport managed resources.

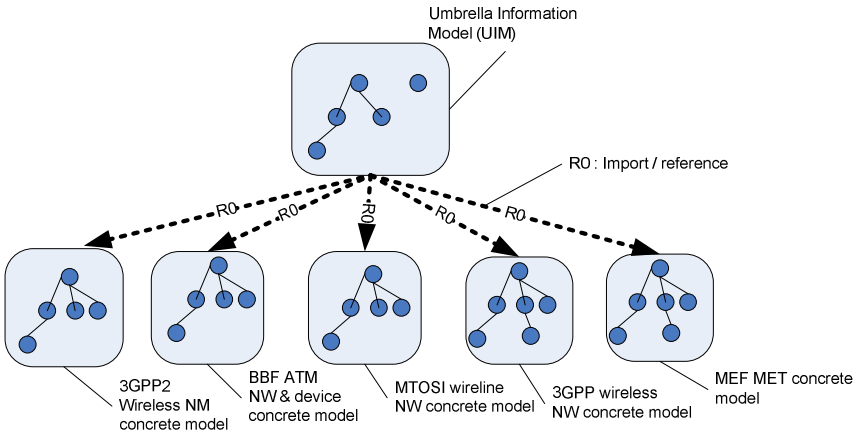

Figure 4: Relation between UIM model component and other model components

Taking the example of "3GPP wireless network classes" and the UIM, 3GPP model components (e.g. TS 32.622 [4]) would import relevant UIM classes and make derivatives for their use. R0 in this case is an inheritance relation. There are other forms of relations that could be defined.

6.3 Relations among pairs of model components

This section is a graphical representation of the FNIM in terms of bilateral relation between each pair of model component, neither of which is a UIM model component.

The relation between pairs of model components may not be same. Each relation may or may not be symmetrical. UIM may not be involved in such pair-wise relations.

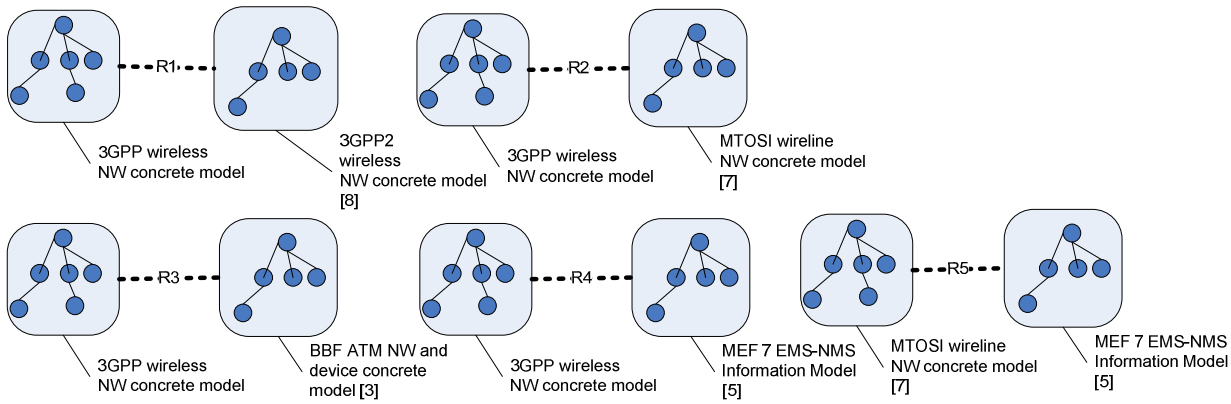

Figure 5: Relation between pairs of model components (not involving UIM model component)

Taking the example of a relation between 3GPP model components and BBF ATM model components (i.e. R3): the 3GPP model components would create necessary 3GPP defined ExternalIOC representing one of the classes of "BBF ATM network and device classes". This type of relation is used extensively in the 3GPP IRP framework for the purpose of navigation from one managed domain to another.

In the case of the relationship between MTOSI and MEF there is an association where MEF does not provide a concrete model but instead a detailed abstract model. The MTOSI concrete model is mapped to the MEF 7 model (see [9]).

6.4 Production of solutions re FNIM

This section is a graphical representation of the FNIM in relation to tools that generate machine-readable model forms in various languages such as XSD, CORBA IDL, GDMO, etc.

In the context of this document, The "Solution specifications" refers to only the model part and not the Operations/Notifications part (e.g. encoding of the managed resource modelled constructs over the wire). Examples of such are the various 3GPP NRM IRP SSs. They do not refer to the Interface specifications such as the 3GPP Interface IRP SSs. This document does not deal with the question if the Tool generates the Interface specifications. No single physical Repository is required to hold FNIM.

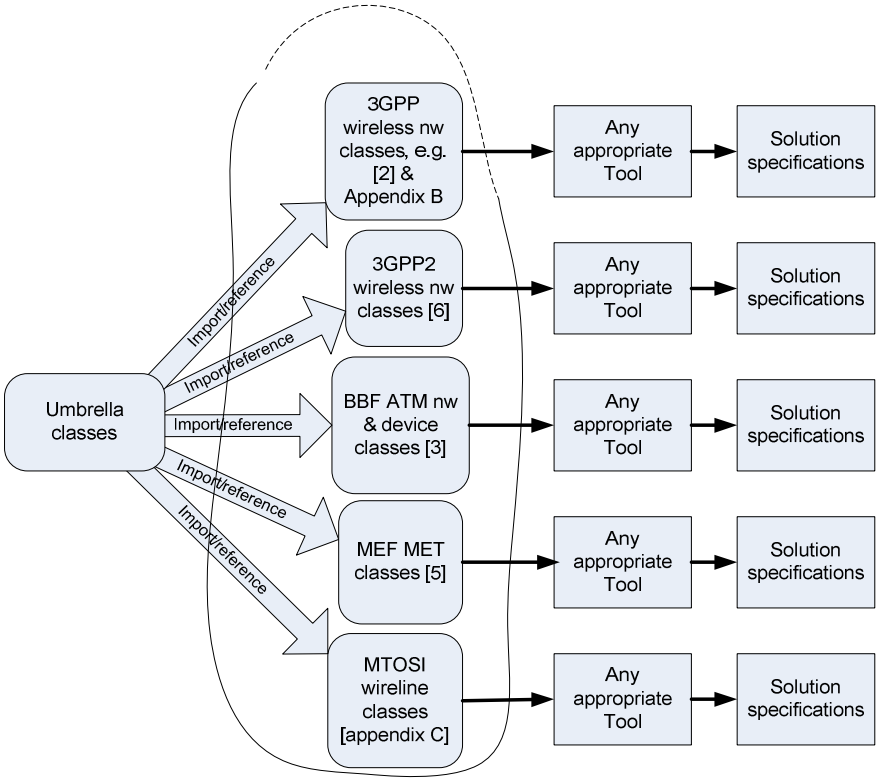

Figure 6: (Model) Solution production related to FNIM

7 Name Convention for class instances (managed objects)

Editor's Note: This section describes a method to make DN unique. There is greater complexity of name space management to explore as a result of current practices of manual administration of name spaces. For example an Operator has his way (or system of identification) to identify a thing that has a DN, as well.

7.1 Background

FMC NM involves a federation of models, which are designed and maintained by different SDOs or standard organizations including expert groups. The model(s) contain classes of managed resources. Instances of these classes are identified by an identifier (called name in this document).

To maintain integrity of the class instances of the federated model, the names of all instances, whose classes are defined under the federated model, must be unambiguous, i.e. an (unambiguous) name can only refer to one instance and an instance may have more than one (unambiguous) name.

For simplicity, FMC NM employs unique names, i.e. one name can only refer to one instance and one instance have at most one name.

7.1.1 Name

A name is a unique identification of an FMC FNIM specified managed resource instance.

7.1.2 Name space

A name space (NS) is a collection of names. This name convention uses a hierarchical containment structure, including its simplest form - the one-level, flat NS (the rightmost NS of Figure 7). This name convention does not support an arbitrarily connected NS, or graph structure, in which a named managed resource can be both child and parent of another named managed resource.

The Figure below shows some examples of supported NSs.

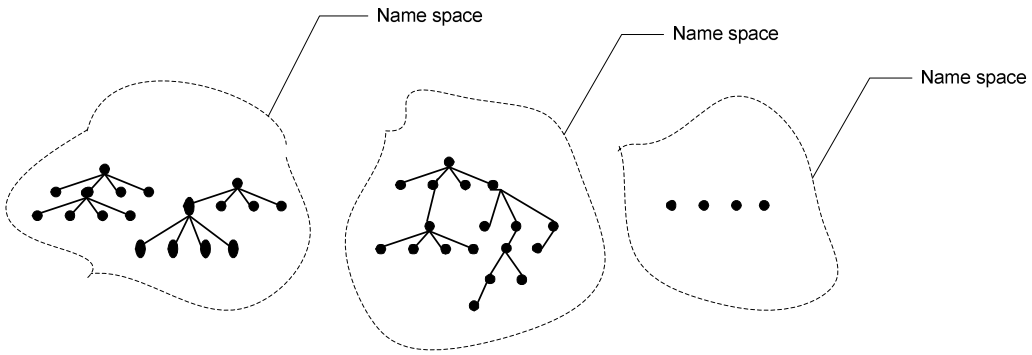

Figure 7: Examples of supported name spaces

7.1.3 Unique names

Names in a NS can be organised as one or more inverted tree hierarchies (see the left-most two NSs of Figure 7). A managed resource instance that contains another one is referred to as the superior (parent), whereas the contained managed resource instance is referred to as the subordinate (child).

FMC NM involves a federation of models, which are designed and maintained by different SDOs or standard organizations including expert groups technology-domain-specific-models. The model(s) contain classes of managed resources. Each instance has a name.

From the perspective of FMC NM, the FMC NS is partitioned into various (sub) NSs. Each (sub) NS is a collection of names of instances, whose classes are defined by the corresponding technology-domain-specific-model.

For illustration, suppose the following Figure 8 shows the (sub) NSs for names of instances whose classes are defined by, say 3GPP/SA5 [4] (the one on the left) and MEF [5] (the one on the right of the figure).

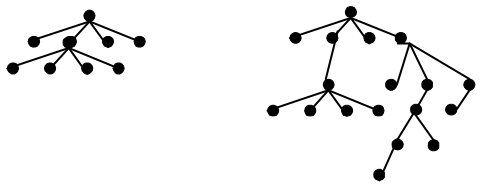

Figure 8: Two (sub) name spaces

This document does not specify the following, since they are specified already by specifications of various technology-domain-specific-models:

- The method by which the names within a (sub) NS can be made unique;

This document specifies the method by which names among all (sub) NSs of the FNIM can be made unique.

The following procedural steps apply for operators involved:

- Register itself with a domain name (e.g. “acme.com”) with a domain name registrar that is accredited by the Internet Corporation for Assigned Names and Numbers (ICANN), the organization charged with overseeing the name and number systems of the Internet.
- For each (sub) NS it manages, construct a naming-path using the two domain components (dc=acme, dc=com) from its registered domain name.
  - The name-path may contain just the two domain components from its registered domain name. It may also contain more domain components such as organization units, e.g. (dc=FixedNetwork, dc=acme, dc=com; dc=mobileNetwork, dc=acme, dc=com) or localities, e.g. (dc=montreal, dc=acme, dc=com; dc=Sorrento, dc=acme, dc=com).
- Use name-path as the root of its (sub) NSs.

The following Figure 9 illustrates the use of two name-paths, where one has three and the other has two domain components, as the name-paths for the two (sub) NSs.

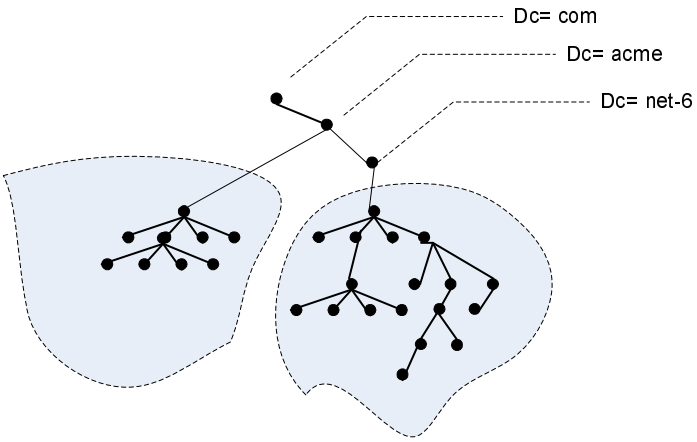

Figure 9: Use of two name-paths

Annex A (informative): Modelling methodology/approach not recommended

This appendix is a graphical presenting of an alternate approach to FNIM. The TM Forum/3GPP Joint Harmonization Project group agreed not to recommend this alternate approach.

One key aspect of this methodology/approach is that it requires one repository for all model components. A consequence of this methodology/approach would be: TM Forum would be charged with the task to produce solution specifications for FMC NM standards.

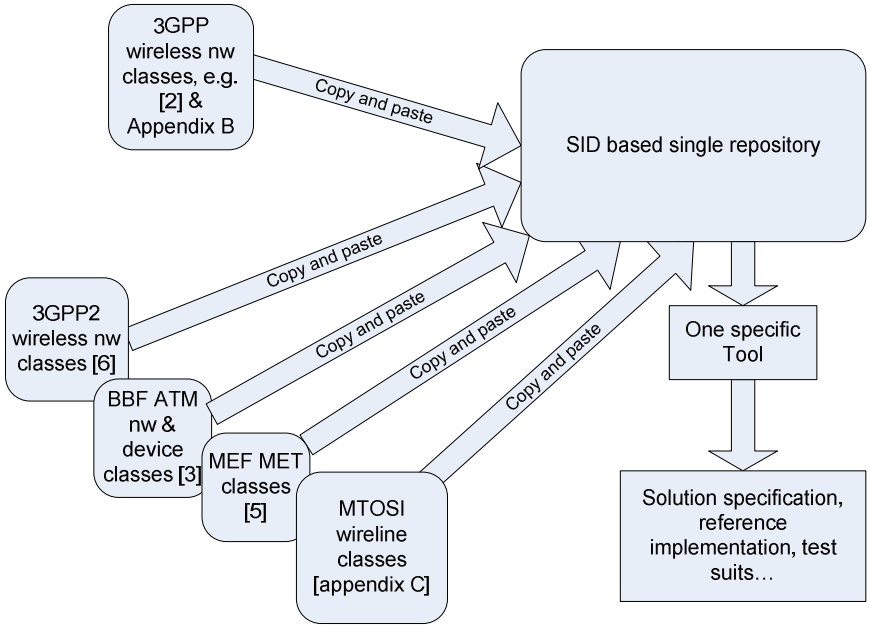

Figure 10: Alternative approach to FNIM - not recommended

Annex B (informative): 3GPP TS network resource models

This appendix lists the 3GPP TS related to mobile managed resource models. This list is expanding (e.g. number of classes to be modelled is increasing).

The FNIM, described in this paper, does not require a repository to physically hold copies of such specifications (and those of other SDOs or standard organizations including expert group such as BBF's ATM NM models) for design and generation of FMC NM solutions.

- TS 32.622 Telecommunication management; Configuration Management (CM); Generic network resources Integration Reference Point (IRP): Network Resource Model (NRM)
- TS 32.762 Telecommunication management; Evolved Universal Terrestrial Radio Access Network (E-UTRAN) Network Resource Model (NRM) Integration Reference Point (IRP): Information Service (IS)
- TS 32.642 Telecommunication management; Configuration Management (CM); UTRAN network resources Integration Reference Point (IRP); Network Resource Model (NRM)
- TS 32.752 Telecommunication management; Evolved Packet Core (EPC) Network Resource Model (NRM) Integration Reference Point (IRP): Information Service (IS)
- TS 32.652 Telecommunication management; Configuration Management (CM); GERAN network resources Integration Reference Point (IRP); Network Resource Model (NRM)
- TS 32.782 Home enhanced Node B (HeNB) Subsystem; Network Resource Model (NRM); Integration Reference Point (IRP): Information Service (IS)
- TS 32.776 Home Node B (HNB) Subsystem; Network Resource Model (NRM); Integration Reference Point (IRP): Information Service (IS)
- TS 32.742 Telecommunication management; Configuration Management (CM); Signalling Transport Network (STN) interface Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)
- TS 32.732 Telecommunication management; IP Multimedia Subsystem (IMS) Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)
- TS 32.722 Telecommunication management; Configuration Management (CM); Repeater network resources Integration Reference Point (IRP); information Service (IS)
- TS 32.712 Telecommunication management; Configuration Management (CM); Transport Network (TN) Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)
- TS 32.692 Telecommunication management; Inventory Management (IM) network resources Integration Reference Point (IRP); Network Resource Model (NRM)
- TS 32.682 Telecommunication management; Inventory Management (IM) Integration Reference Point (IRP); Information Service (IS)
- TS 32.672 Telecommunication management; Configuration Management (CM); State Management Integration Reference Point (IRP); Information Service (IS)

Annex C (informative): TM Forum defined network resource models

Refer to TM Forum defined network resource models (extracted from [7]).

Annex D (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2013-01					Fixes layout problems	11.0.0	11.0.1
2013-03					Fixes the title of the spec by removing a semi colon	11.0.1	11.0.2
2014-06	SA#64	SP-140359	001	-	remove the feature support statements	11.0.2	11.1.0
2014-07					Correction of link in Annex C	11.1.0	11.1.1
2014-10	-	-	-	-	Update to Rel-12 version (MCC)	11.1.1	12.0.0
2016-01	-	-	-	-	Update to Rel-13 version (MCC)	12.0.0	13.0.0
2017-03	-	-	-	-	Update to Rel-14 version (MCC)	13.0.0	14.0.0
2018-06	-	-	-	-	Update to Rel-15 version (MCC)	14.0.0	15.0.0
2020-07	-	-	-	-	Update to Rel-16 version (MCC)	15.0.0	16.0.0

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2020-09	SA#89e	SP-200726	0006	-	A	Remove the reference to M-SDO tdoc	16.1.0
2022-03	-	-	-	-	-	Update to Rel-17 version (MCC)	**17.0.0**

History

Document history		
V17.0.0	April 2022	Publication