
MEF
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Automation of LSO APIs Using Intent-Based Networking

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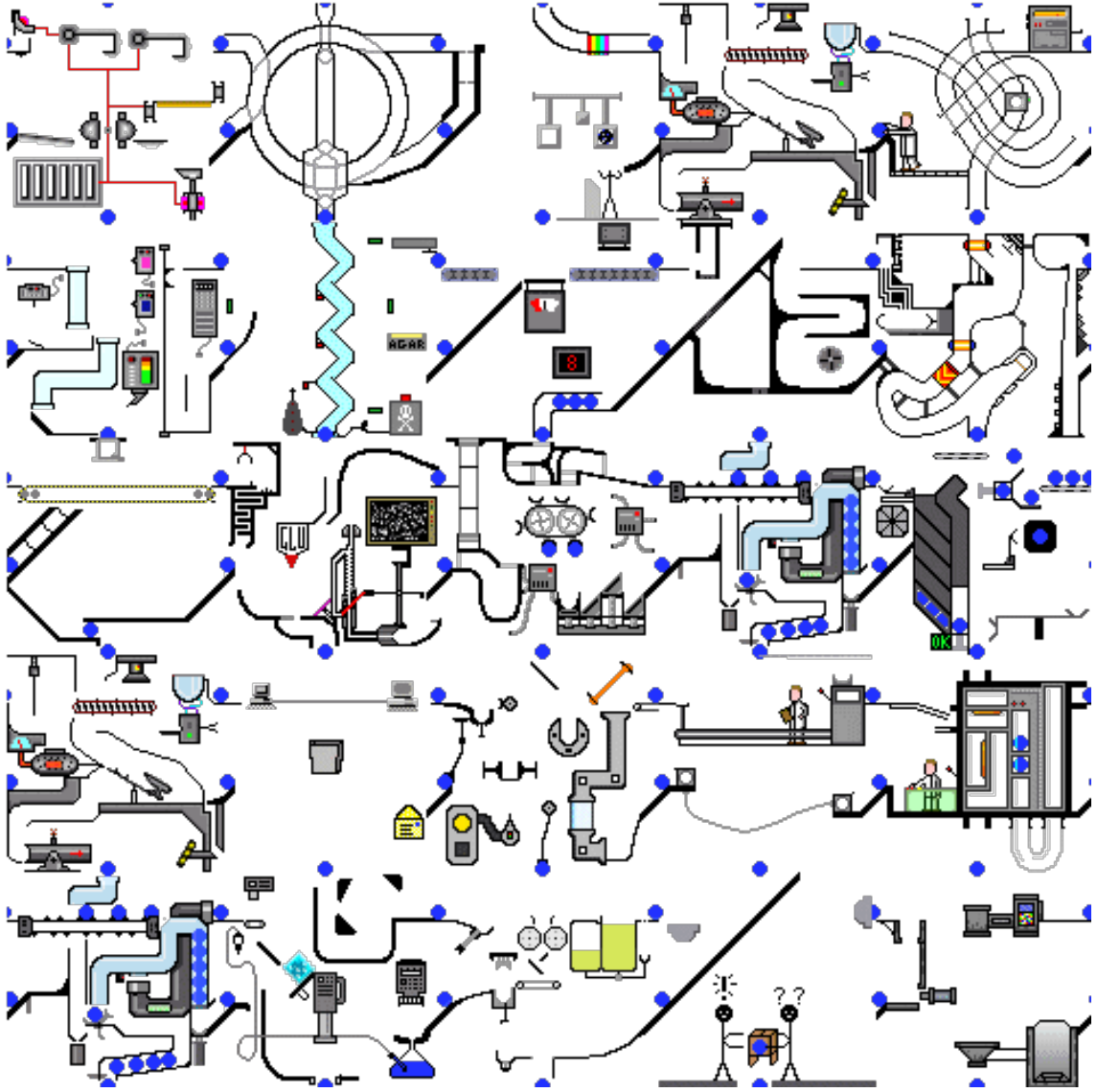
Executive Summary

- MEF's IBN work has defined a novel definition of intent that
  - Uses **natural language** to express intent (initially over Allegro and Cantata)
  - Embraces *different expressions of intent* from different constituencies
  - Uses *models* and other *MEF Assets* to *comprehend* these different intents
  - *Harmonizes* these different intents and *matches them to existing policies*
  - *Translates* these intents to lower levels of abstractions
  - *Produces lower level commands* suitable for admins to implement business logic computations as well as data and commands over Legato, Presto, and Adagio
- Intent users can define intent-related performance and security objectives that *continue to be enforced until removed*
- Domain Specific Languages, implemented as Controlled (Natural) Languages, provide extensibility while simplifying APIs

Complexity



- Changing Technologies
- Changing Functionality
- Complex Business Rules
- Inability to scale
- Braintrust loss
- Different User Needs

Constituencies: The Policy Continuum

Definitions of Intent and AI/ML

- Intent
  - Enables **definition of business and technical abstractions** that invoke network services and manage their behavior
  - Specified declaratively using a **restricted form of a natural language**.
  - *Translates what is required to how it is implemented, and then **validates the implementation continuously***

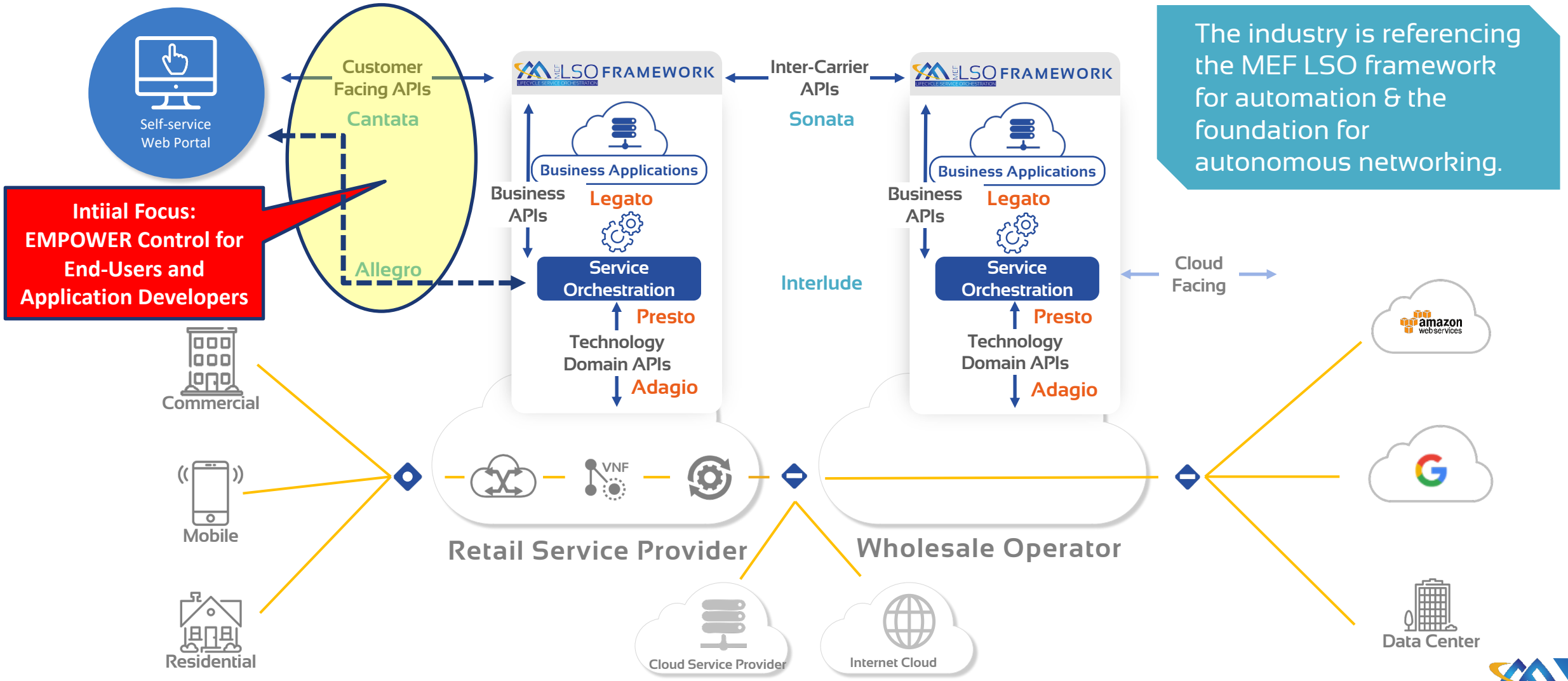
What is Novel:

- AI
  - **Machine-based intelligence** in the service provider's systems that **contextually self-learns** and provides rapid decisions in the form of policies for deployment of virtualized resources and reprogramming of networks.

- Machine Learning
  - **Machines** in service provider's systems that **learn from acquired data** on how to solve a problem more effectively so that AI can adapt policies accordingly.

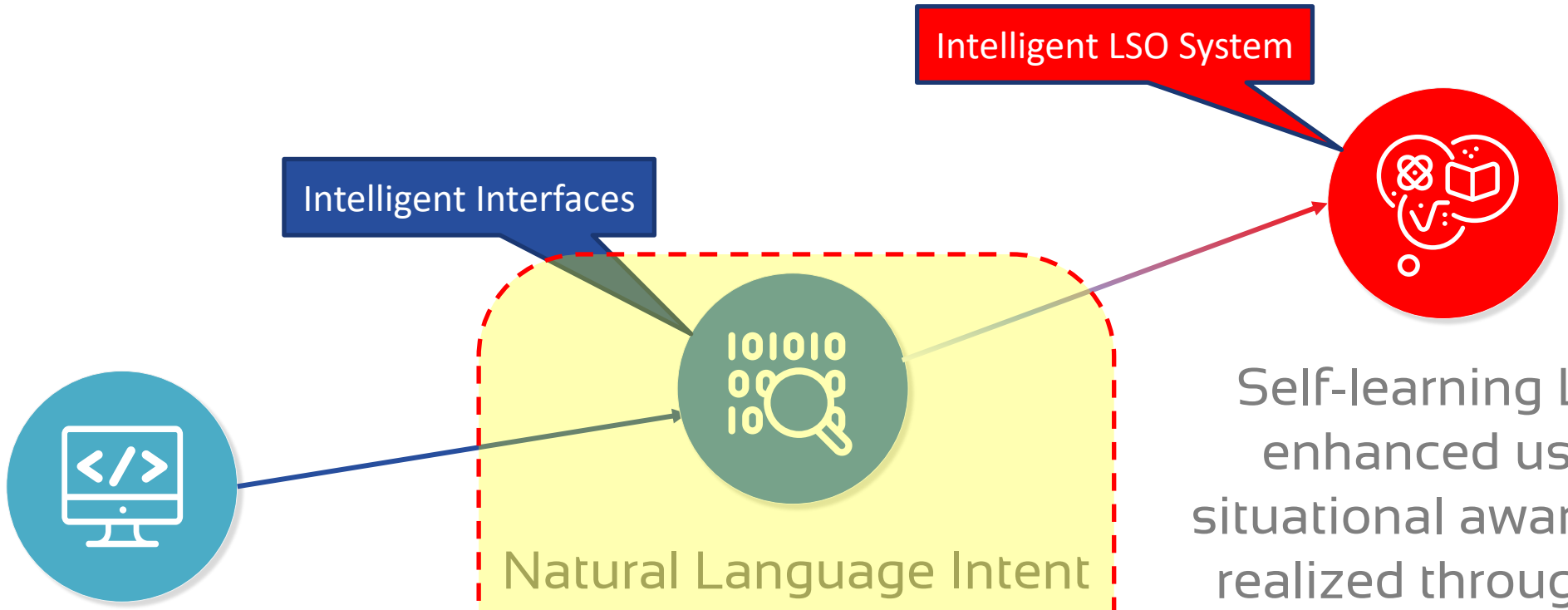
LSO and APIs enable machine automation across networks & over technology domains.

Machine automation reference points for machine interfaces (APIs)



The industry is referencing the MEF LSO framework for automation & the foundation for autonomous networking.

Evolution of How LSO Reference Points Will Be Used



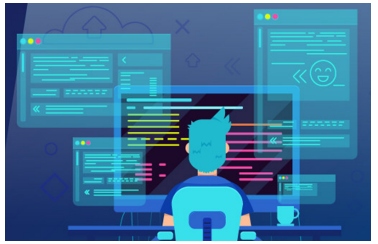
Static APIs with MEF-defined service payloads

Self-learning LSO, enhanced using situational awareness realized through AI-based cognition, to provide dynamically adaptable behavior

Functional Overview

Business User
expresses intent

...



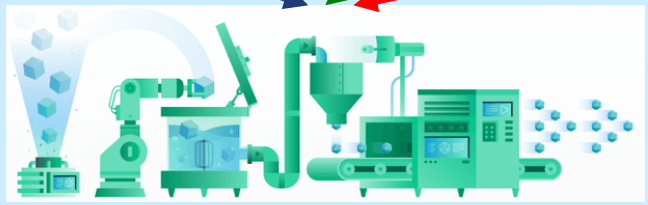
Developer
expresses intent

Network Admin
defines commands

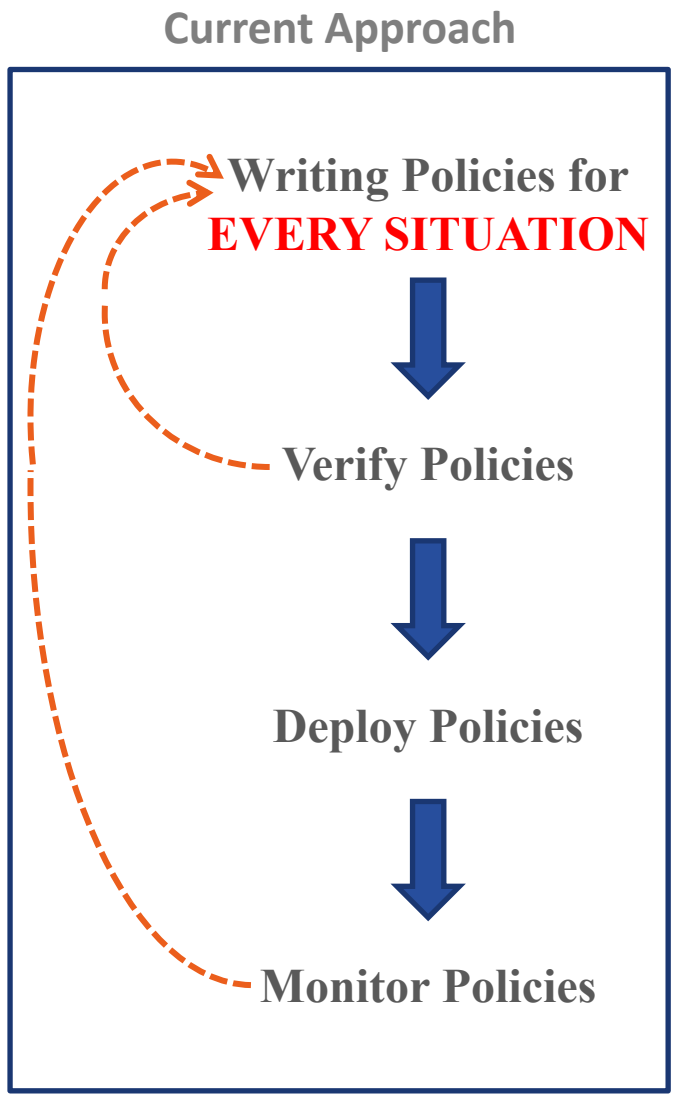
Grammar #1

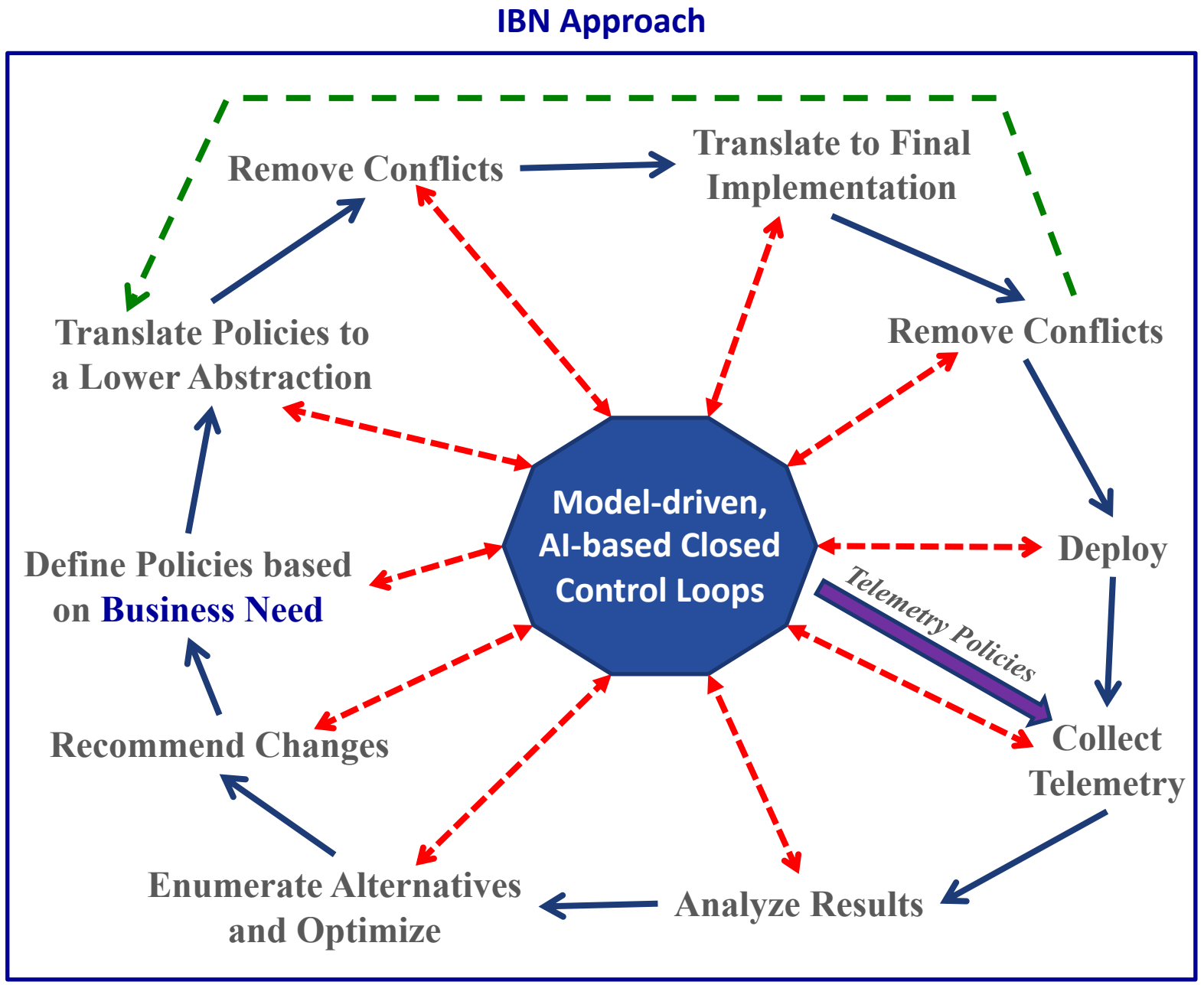
Grammar #2

Grammar #n



How IBN Works

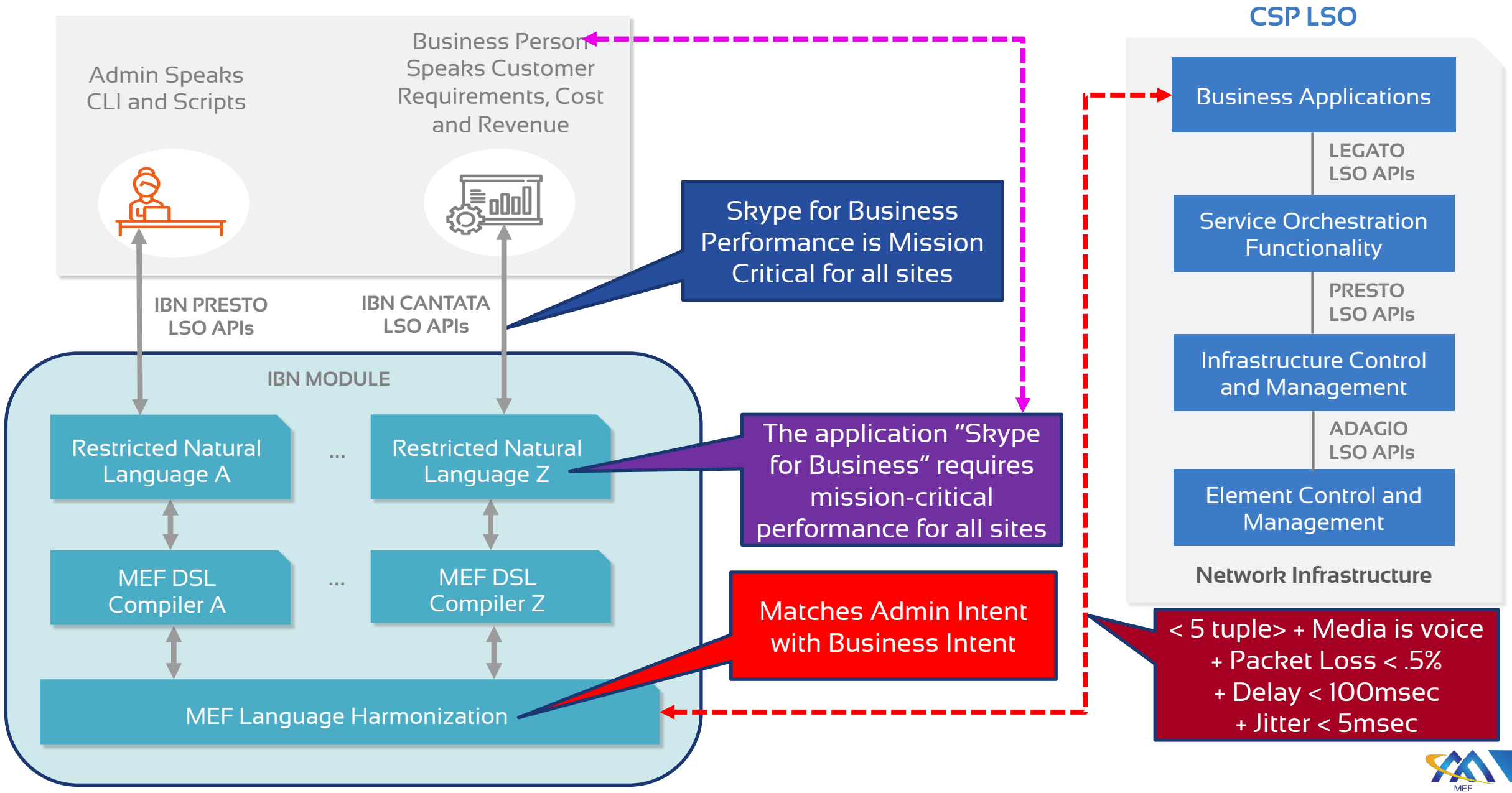




The Power of a Domain Specific Language (DSL)

- A DSL is a computer programming language that is specialized to serve the needs of a particular application domain
  - Uses concepts and terminology defined by that application domain for a given set of users
  - DSL examples: HTML, Verilog and VHDL, SQL, regular expression languages
  - A MEF DSL knows concepts applicable at a given IRP used by types of users
    - A CANTATA DSL understands end-user properties of an SD-WAN application
    - A LEGATO DSL understands detailed SD-WAN Service Attributes
    - Makes it SIMPLE and EASY to use for MEF users to use and customize policies
- DSLs can be used to *specify* and/or *program* solutions
  - Specification through the use of its *grammar*
  - Programming by translation to a programming language

Example Intent-Based Networking for SD-WAN App Perf



Example

- "Skype for Business Performance is Mission Critical"
  - Ambiguous!
  - Is this parsed as "Skype" "for Business Performance" "is Mission Critical"…or
  - "Skype for Business" "Performance is Mission Critical"
- Lexicon used to disambiguate the input
  - Recognizes "Skype for Business" is a type of application
  - Recognizes that "Mission Critical" is the highest level of Class of Service
- The point of Intent is to help the user!
  - User should not need to know exact language or technical terms
  - Most users have not programmed a network device!

Parsing Overview

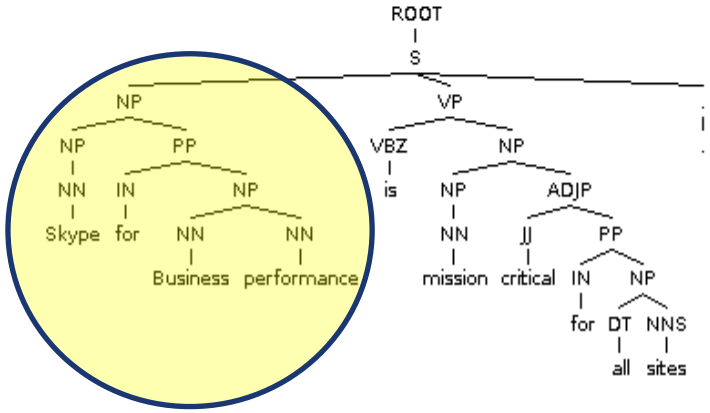
- Recognize Named Entities
  - Text strings that belong to different classes of interest
  - Examples: People, Locations, Organizations, Products, Dates, Time
- Disambiguate Text
  - Fundamental for understanding what the user meant!
  - Foundation for Information Extraction* to better understand context
    - Enables additional facts to be inferred
    - Customer has an SLA which maps to a CoS for each App user can use…
  - Bank: financial institution vs aerial maneuver vs. part of water vs. support
- Use a combination of open source tools to build custom software that understands **MEF** context
- Named Entities mapped to Model classes, attributes, relationships

* the automatic identification of selected types of entities, relations, or events in free text

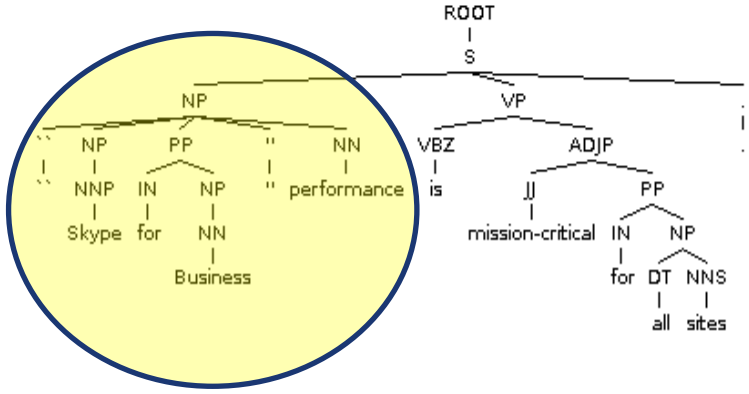
Exemplary Parses Infer Proper Semantics

Original → **Rewrite #1** → **Rewrite #2**

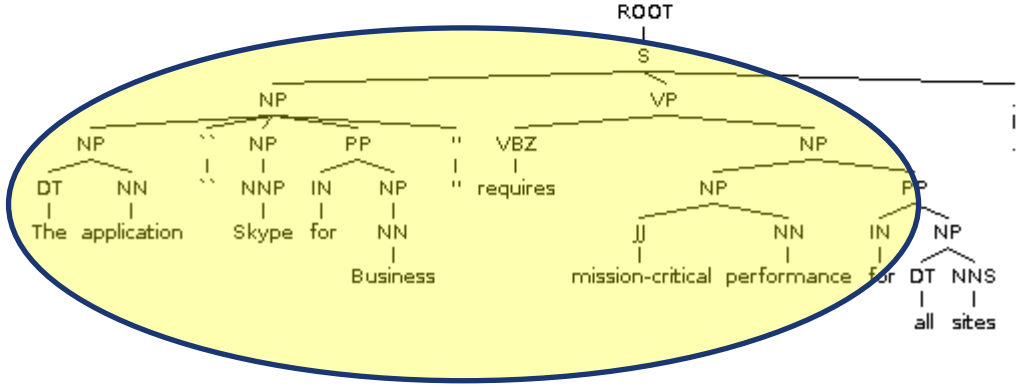
```
(ROOT
  (S
    (NP
      (NP (NN Skype))
      (PP (IN for)
        (NP (NN Business) (NN performance))))
    (VP (VBZ is)
      (NP
        (NP (NN mission))
        (ADJP (JJ critical)
          (PP (IN for)
            (NP (DT all) (NNS sites))))))
    (. .)))
```




```
(ROOT
  (S
    (NP (`` ``)
      (NP (NNP Skype))
      (PP (IN for)
        (NP (NN Business)))
      ('' '') (NN performance))
    (VP (VBZ is)
      (ADJP (JJ mission-critical)
        (PP (IN for)
          (NP (DT all) (NNS sites)))))
    (. .)))
```




```
(ROOT
  (S
    (NP
      (NP (DT The) (NN application))
      (`` ``)
      (NP (NNP Skype))
      (PP (IN for)
        (NP (NN Business)))
      ('' ''))
    (VP (VBZ requires)
      (NP
        (NP (JJ mission-critical) (NN performance))
        (PP (IN for)
          (NP (DT all) (NNS sites)))))
    (. .)))
```



Example of Intent: SECaaS for SD-WAN

Application Classification Criterion → Application Flow → Application Flow Group → Policy

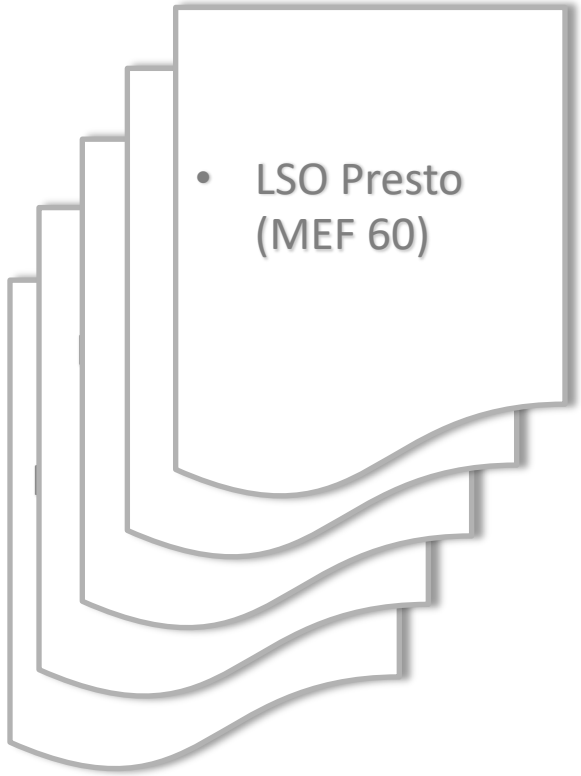
Policy	Description
PROTECT apps from bad traffic	Protect applications from unauthorized traffic using Security Functions: CASB, IDS/IPS and DDOS

Applicable MEF Work

MEF Service Definitions for CE, IP, SD-WAN, SECaaS

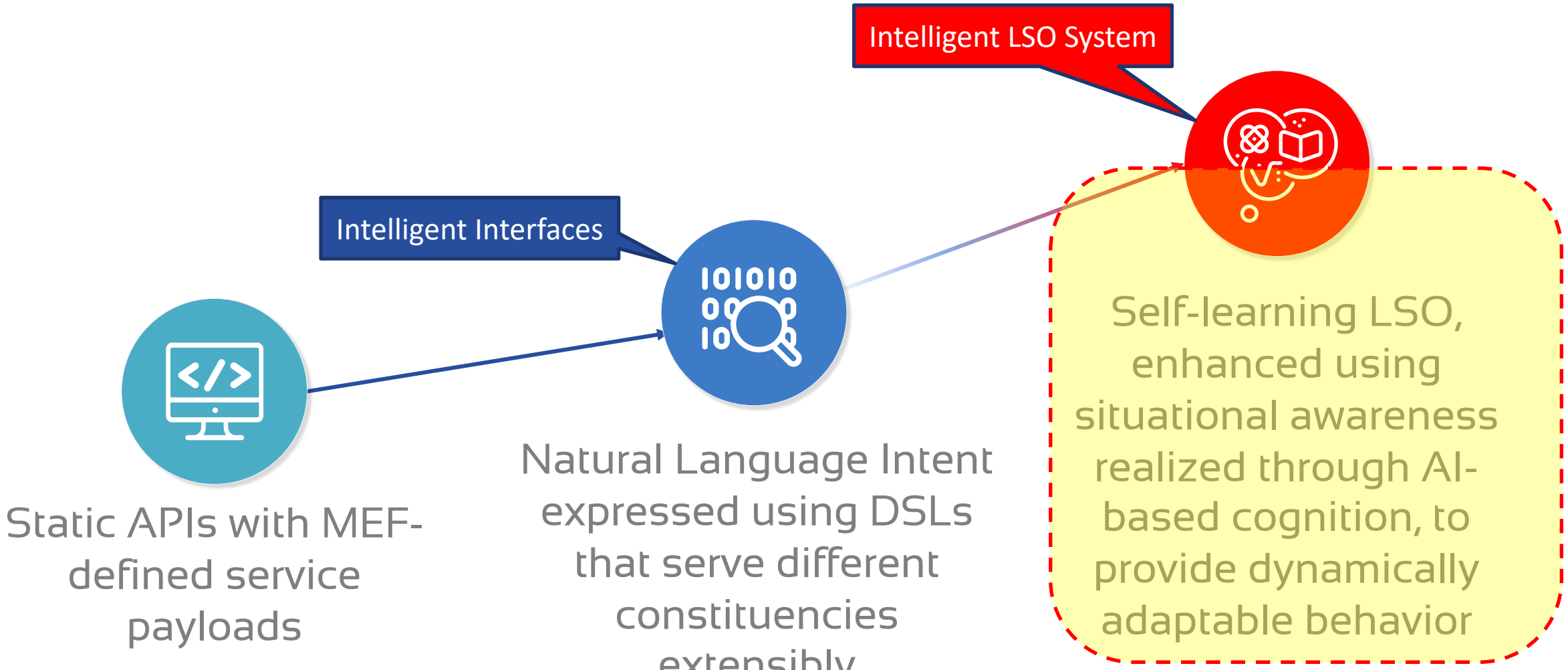
MEF Core Model, MEF Network Resource Model, MEF Network Resource Provisioning Model, MEF Common Services Model, MEF Common Resources Model

MEF Policy-Driven Orchestration, MEF Intent-Driven Orchestration



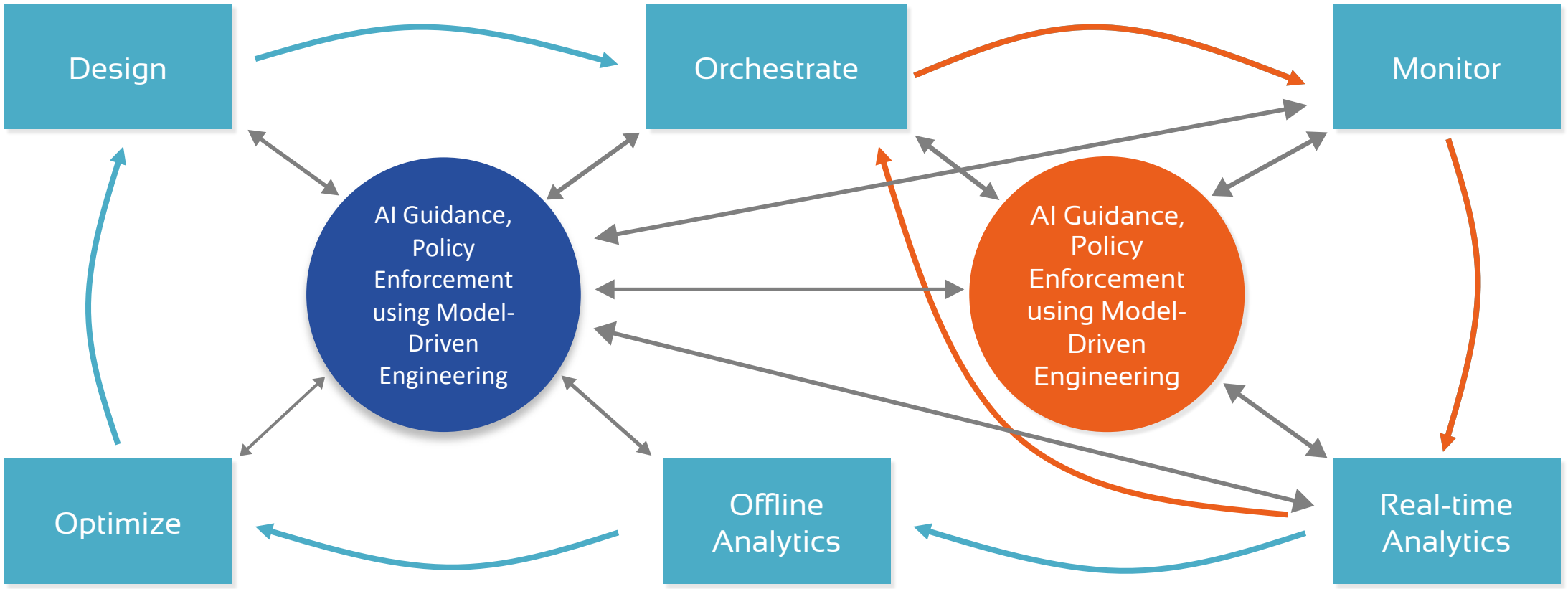
MEF Processes, MEF LSO RA, MEF Sonata, MEF Legato, MEF Presto

Evolution of How LSO Reference Points Will Be Used



Model-Driven, Policy-based, AI-Assisted Orchestration

1. **Outer Closed Control Loop for a Given Context and Long-Term Optimization**
2. **Inner Closed Control Loop Triggered by Context Change**

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