Universal Meaning Representation Format (UMRF) for Natural Language Task Engines

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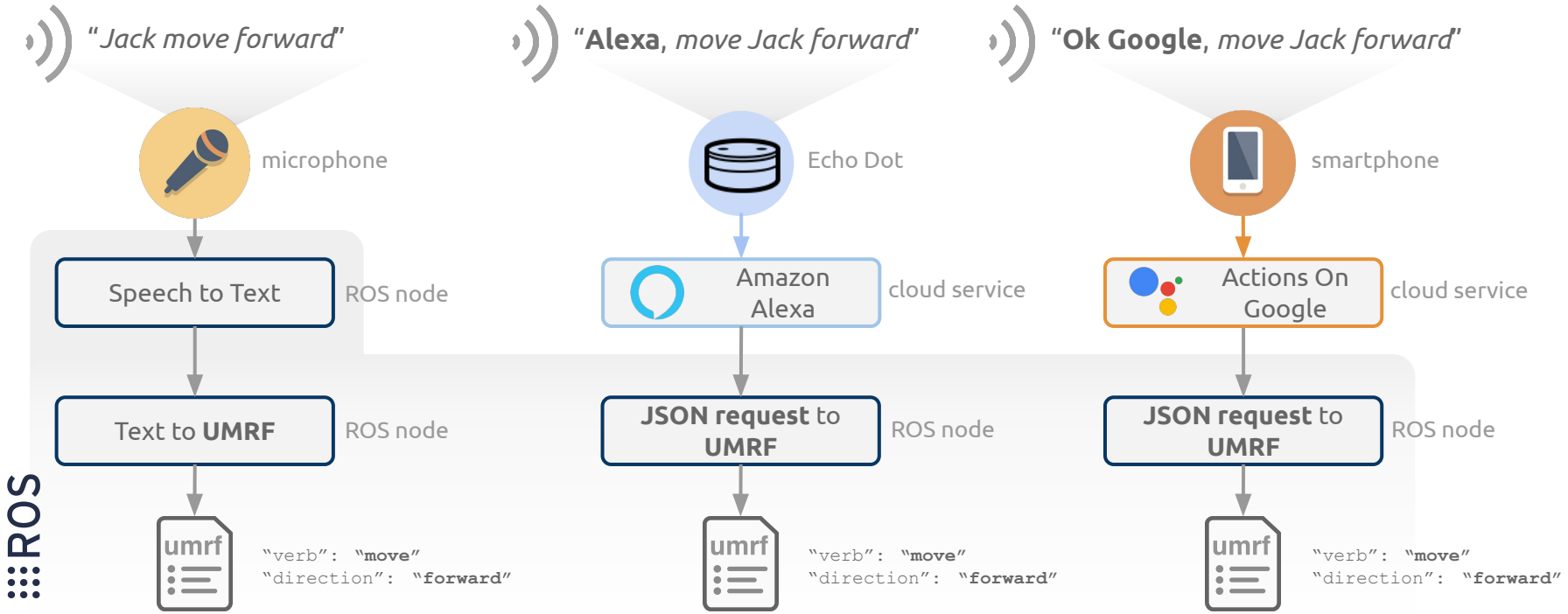
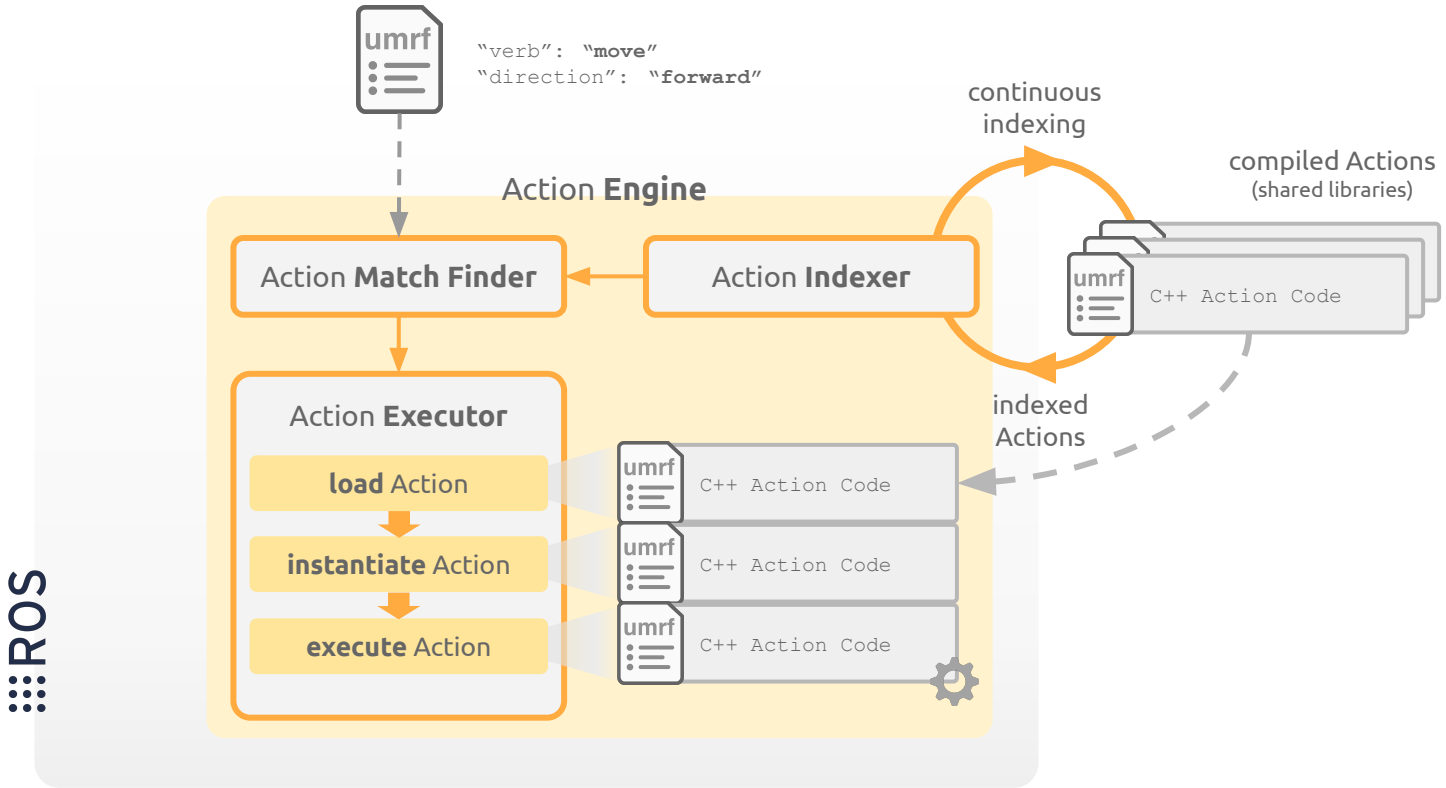
Motivation and Demonstration

- The **Universal Meaning Representation Format** (**UMRF**) - generalizes third-party meaning representations to a common formalism, making them accessible to **Robot Task Management Systems**
- **Implications**:
  - Separates **parsing** and **task execution** layers in Natural Language (NL) pipelines
    - Easier to swap parsers
    - Accelerates development and testing of NL systems
  - Flexible enough to **represent many input modalities**
  - Promotes corobot applications by providing **better interfaces for developing human-robot interaction systems**
- **Demo materials available at**
  - https://github.com/temoto-telerobotics-demos/roscon_2019_ws

High-Level Overview: Front End

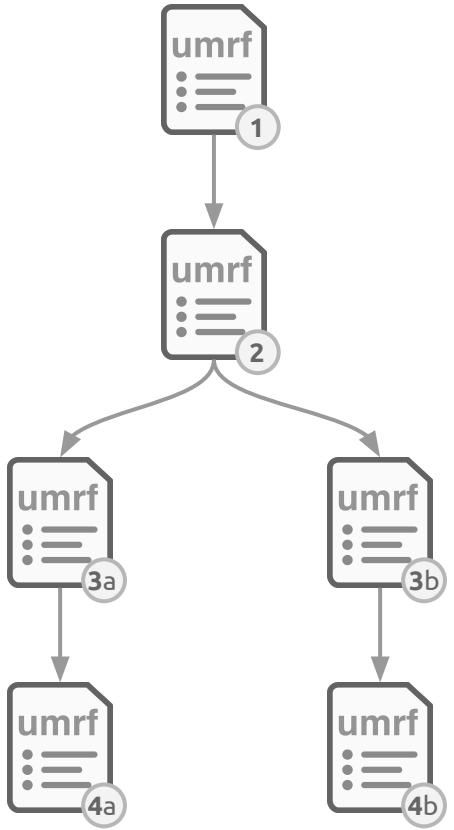


High-Level Overview: Back End



UMRF Graph

- **UMRF**s can **build upon each other** to invoke more complex behaviour
  - Parallelism
  - Cycles
- **Parameters** can be passed along **Actions**
  - Default data types (strings, numbers, boolean)
  - Custom data types (objects, containers, pointers)



UMRF JSON Syntax

- Design founded in predicate-argument semantics with influence from slot-intent Meaning Representations (MR)
- UMRF Data Fields
  - **Name** - name of the action
  - **Input Parameters** - input information for the action
  - **Output Parameters** - the resulting information after the action is performed

```
{
  "name":"NavigateTo",
  "package_name":"ta_navigate",
  "input_parameters":{
    "verb":{
      "pvf_type":"str"
      "pvf_val":"navigate"
    },
    "location":{
      "pvf_type":"str"
      "pvf_val":"kitchen"
    }
  },
  "output_parameters":{
    "goal":{
      "pvf_type":"geometry_msgs::Pose"
    }
  }
}
```

Generated UMRF JSON for "*Robot, go to the kitchen*". The output data can be used by other actions when combined in graph

Developed ROS tools

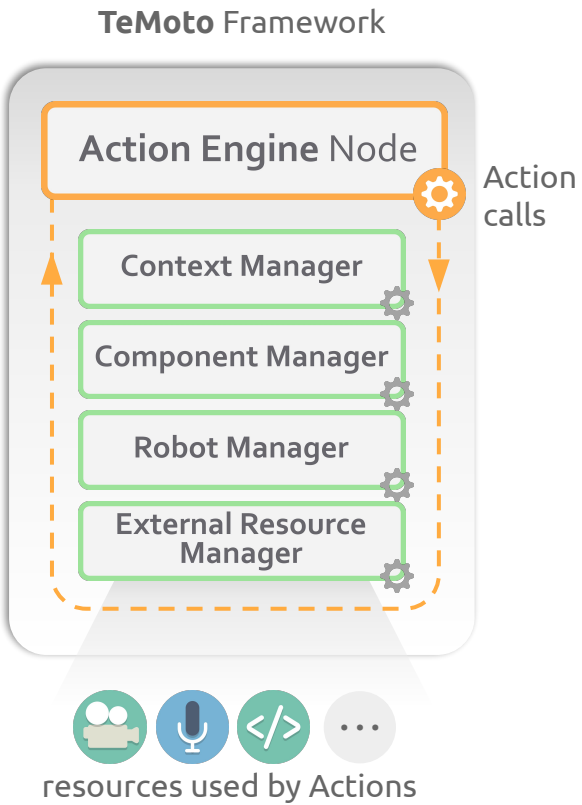
- **TeMoto Action Engine**
  - Implements UMRF Graph execution back-end in C++
  - Freely available at https://github.com/temoto-telerobotics/temoto_action_engine
  - Apache 2.0

- **TeMoto Action Assistant**
  - GUI tool for creating base for TeMoto Actions
  - Freely available at https://github.com/temoto-telerobotics/temoto_utils
  - Apache 2.0

The bigger picture - TeMoto framework

- **TeMoto framework** is a set of **ROS** based tools that help to **rapidly develop** semi-autonomous teleoperated systems
- **Actions** utilize the **Managers** via resource queries,
  - e.g., Component Manager →*start the camera …*
- **Actions** keep the application code **modular and scalable** and **Managers** provide *resource abstraction, dynamic allocation* and *simple API*

More information on temoto-telerobotics.github.io



Conclusion & Future Work

- **UMRF is an intuitive convention** that allows to
  - merge different NLP systems
  - segregate front-end interfaces from back-end task management
- **TeMoto Action Engine** is C++ implementation of UMRF definitions
- **Future Work**:
  - Extensive testing **on more MRs** and **more diverse task spaces**
  - **Simple developer tools** for designing and testing **UMRF Graphs**
  - Creating a tool that maps slot-intent MRs to the UMRF (automatic conversion)
  - Create an open-source Temoto parser based on task grammars