



IF-Soar: An Autonomous Fire Direction Center for Indirect Fire Training

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Agenda



- Overview
 - Description of Indirect Fire
 - The Call for Fire
 - IF-Soar's Job Description
- Connected Components and Architecture
 - JSAF
 - SoarSpeak
 - System Architecture
- Adjust Fire: An Extended Example



Agenda

- IF-Soar Design
 - New Goal System (NGS) agent design paradigm
 - Dialog Management
- Nuggets/Coal



What is Indirect Fire?

- Any fire on a target where the firing entity does not take direct visual aim on the target
- Typically artillery fire
 - Howitzers
 - Mortars
 - Naval cannons
- Executing indirect fire missions involves three functional elements
 - Forward Observer (FO) to identify and describe the target
 - Fire Direction Center (FDC) to process the mission and provide appropriate parameters to the firing entities
 - The gun(s) to do the shooting

Slide 4



The Call for Fire (CFF)

- Structured sequence of messages from the FO to the FDC
- Mechanism for delivering all necessary fire mission parameters and requests to the FDC
- Organic CFFs consist of three lines
 1. Observer identification and warning order
 2. Target location
 3. Target description, method of engagement, method of fire and control

An Autonomous Fire Direction Center

- IF-Soar is a model of an autonomous FDC
- Processes incoming fire requests from human FO
- Executes fire requests within JSAF simulation environment
- Communicates with FO through
 - Acknowledgments to the CFF
 - Message to Observer (MTO)
 - Fire/detonation confirmations

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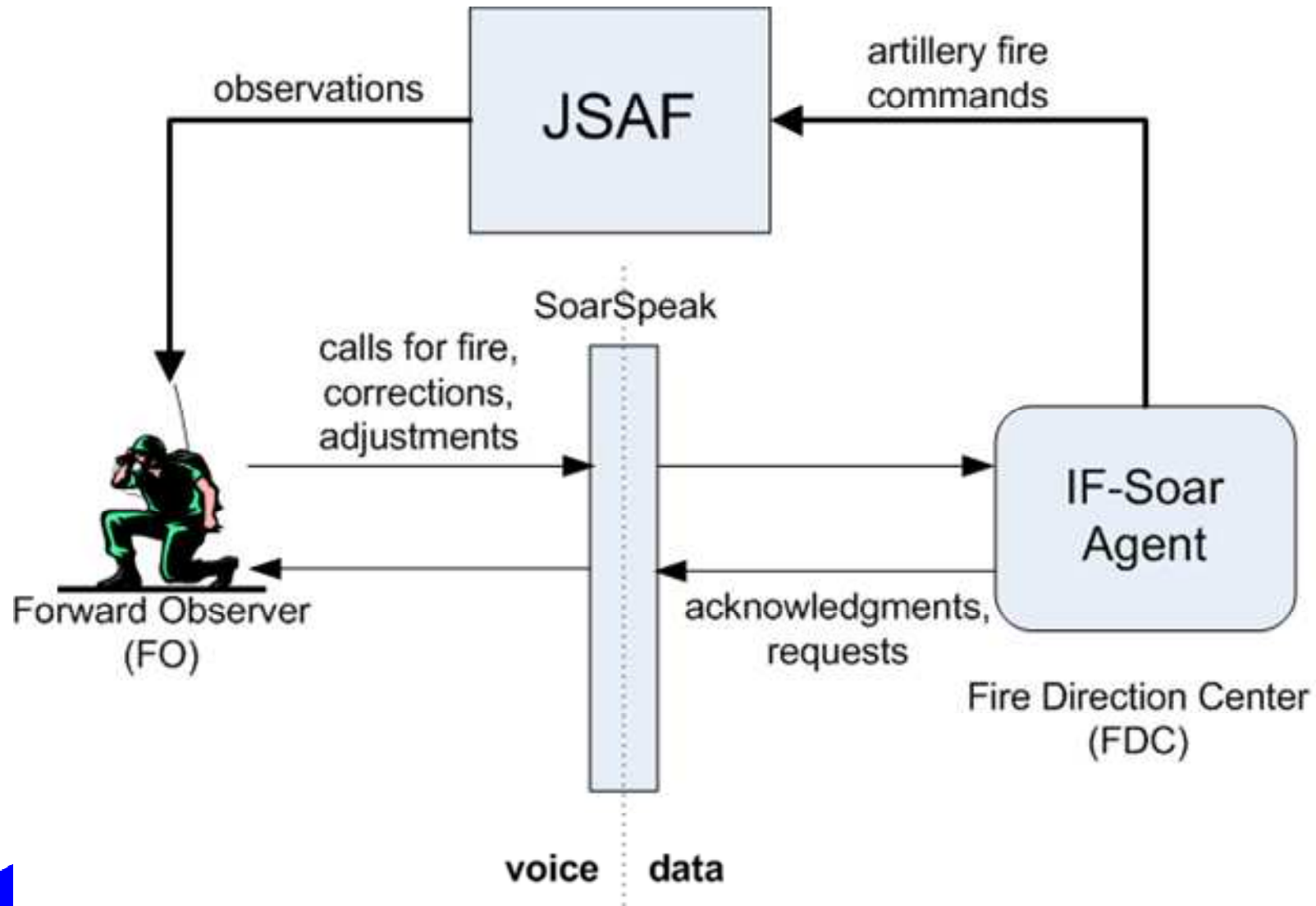
JSAF

- Simulation environment
- 2D planned-view display (PVD) for observing entities and fires effects
- Provides capability for other computer-generated forces (CGFs) to populate the environment

SoarSpeak

- Collection of applications for providing text-to-speech (TTS) and speech-to-text services for communication with Soar agents
- XML-based configuration
- Support for several network protocols including TCP/IP, HLA and DIS
- Support for multiple speech-to-text engines including Nuance and IBM's ViaVoice
- AT&T's NaturalVoices text-to-speech engine
- Semantic language parser ANGST converts recognized text to readable form for IF-Soar agent

System Architecture



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Adjust Fire/Fire for Effect

- Adjust Fire missions allow FO to fire single rounds of munitions at targets
- Typically used when FO needs to iteratively determine coordinates for an effective artillery strike
- After observing effects of an adjust fire mission, FO can call an 'adjustment' to generate an identical shot at a slightly altered location
- When FO has determined the appropriate coordinates, a Fire for Effect mission can then be called to deliver multiple rounds on target

An Adjust Fire Mission

- FO (human, jaguar01):
"A3R51, this is jaguar01, adjust fire, over"
- FDC (IF-Soar, A3R51):
"jaguar01, this is A3R51, adjust fire, out"

- "grid 6 3 5 9 2 7, over"
- "grid 6 3 5 9 2 7, out"

- "correction, grid 6 4 5 9 2 7, over"
- "grid 6 4 5 9 2 7, out"

An Adjust Fire Mission (cont.)

- *"seven tanks in the open, over"*
- **"seven tanks in the open, authenticate BRAVO JULIET FOXTROT, over"**
- *"I authenticate ECHO, out"*
- **"good authentication, out"**
- **"hotel, D P I C M, 1 round, target AA0001, over"**
- *"hotel, D P I C M, 1 round, target AA0001, out"*

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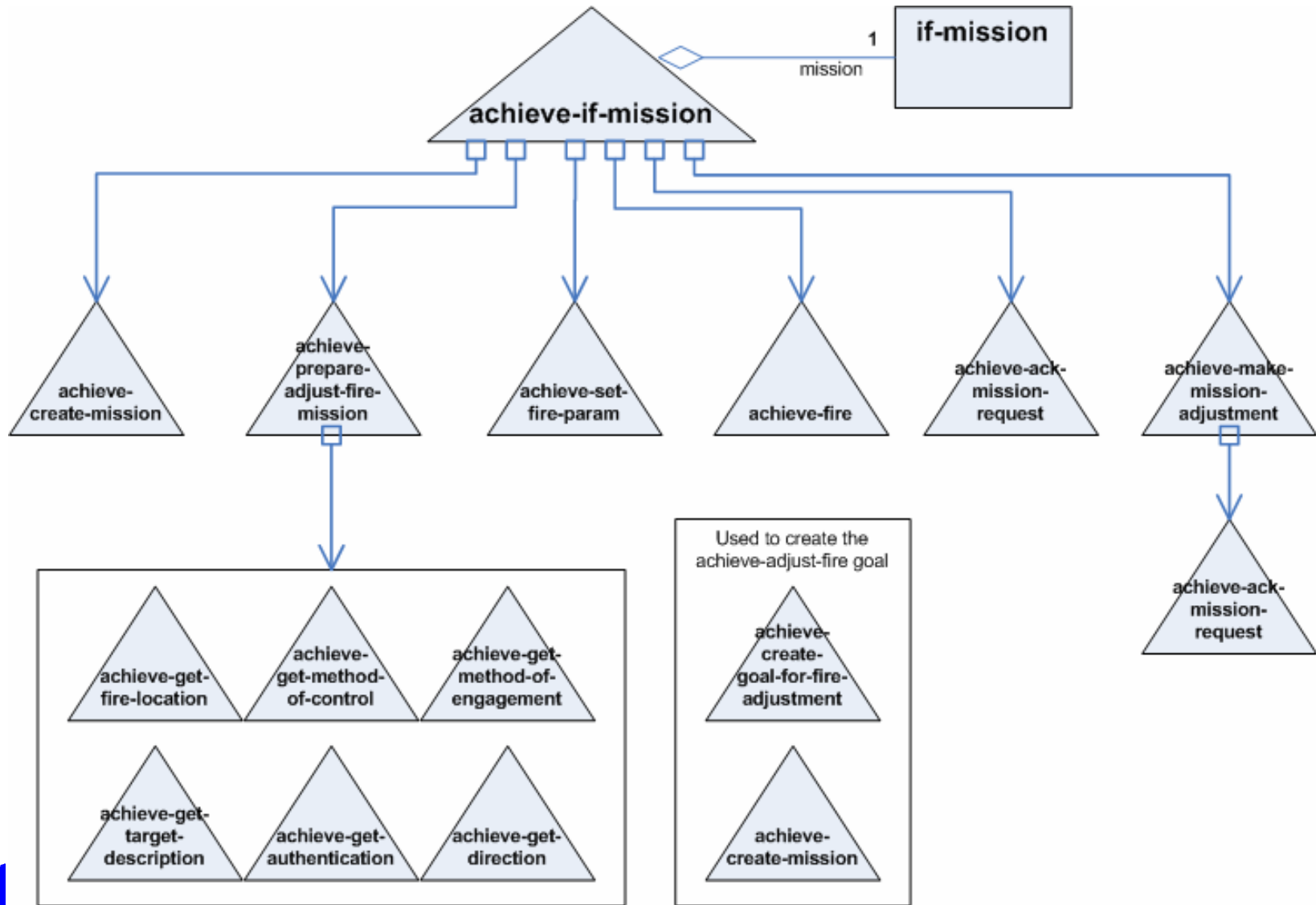
New Goal System (NGS)

- An implementation of the 'Forest of Goals' behavior design paradigm
 - Declarative goals
 - No operator hierarchy or persistence
- Exists as a library for Soar 8
- Includes assortment of Tcl macros that reproduce common LHS and RHS production segments
 - Operator proposal
 - Operator application
 - Goal creation

Overview of IF-Soar Design

- General
 - NGS v1
 - 1954 productions
 - o-supported goals (mostly)
- Goals used to
 - Logically filter incoming information from FO
 - Handle incoming and outgoing communication
 - Generate outgoing fire parameters
- XML Mission configurations
 - Callsign of IF-Soar agent (e.g. A3R51)
 - Locations of FO and available batteries
 - Available munition types and quantities
 - Reference IDs for known points

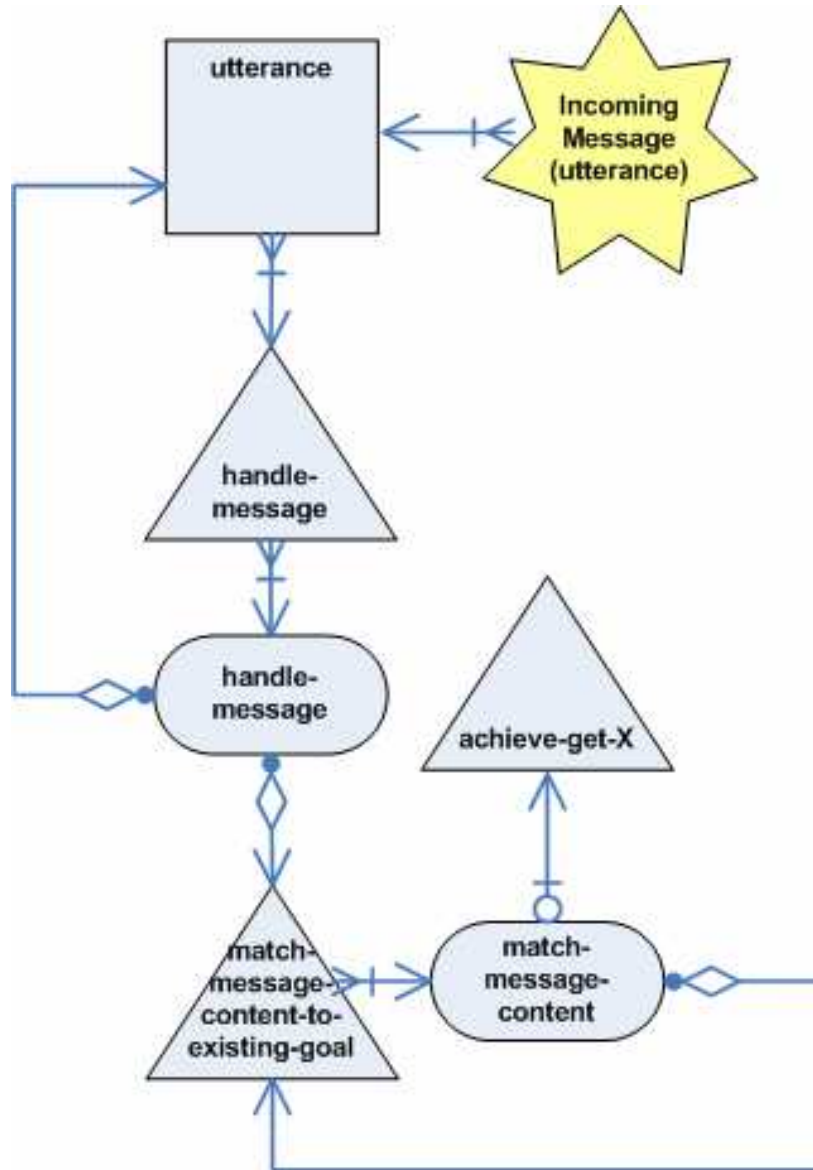
A Forest of IF-Soar Goals



Dialog Management in IF-Soar

- Standard messages and corrections
 - Format of lines defined in SoarSpeak grammar
 - **correction** modifier tells agent to overwrite existing data
 - Agent uses series of goals to fetch the incoming message and append it to appropriate retrieval goal
 - *handle-message* fetches message from input-link, hands it off to...
 - *match-message-content-to-existing-goal* parses information from message, appends arguments to...
 - *achieve-get-X* goals
 - *achieve-get-fire-location*
 - *achieve-get-target-description*
 - ...

Dialog Management in IF-Soar (cont.)

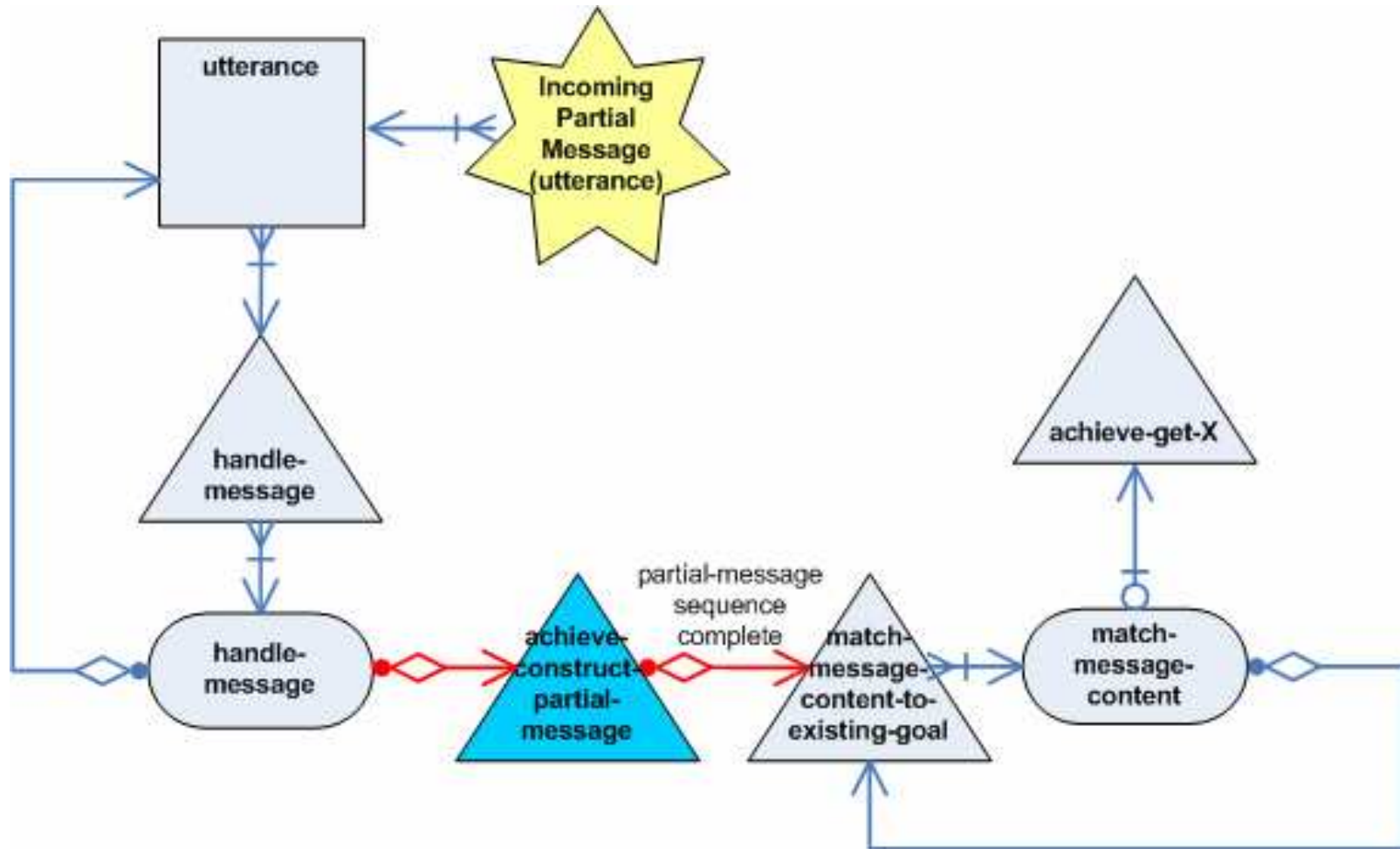


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Dialog Management in IF-Soar (cont.)

- Partial messages
 - Helped to mitigate the problem of poor speech-recognition performance
 - Message fragments defined in SoarSpeak grammar, identified as a **partial-message**
 - Agent deciphers message type, creates new goal to collect incoming message fragments
 - Example from target description message:
 - *"three tanks in the open,"*
 - *"willy pete point detonating,"*
 - *"at my command, over"*
 - 'over' denotes end-of-message, agent collects the fragments and hands over to *match-message-content-to-existing-goal* as it would otherwise

Dialog Management in IF-Soar (cont.)



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Nuggets

- Robust system, capable of handling a variety of
 - warning-order types
 - munition types
 - target descriptions
- Works with JSAF, communicates with speech-recognition federate using HLA
- Supports corrections and partial messages, alleviating limitations of speech recognition

Coal

- Agent can get confused by utterances recognized by the grammar but not in context of the mission
- Agent does not consider munition ballistics or ranges when computing a fire solution
- Partial message capability
 - requires artificial expansion of SoarSpeak grammar (~15%)
 - message fragments only recognized in logical blocks

Demo of System

- If anybody is interested, come see me for a demo

