Advanced Dialog Management

Emerging standards for managing advanced dialog on server and client

K. W. (Bill) Scholz
NewSpeech, LLC

Agenda

Advanced Dialog – working group charter and history

Advanced Dialog Architecture

Advanced Dialog Managers

- **Frame Based Engines**
- **Rule Based Engines**
- **Plan Based Reasoning**
- **Statistical Dialog Management**
- **Case Based Reasoning**

Advanced Dialog WG: Charter

- Advanced Dialog Working Group objectives:
  - Accelerating transfer of Advanced Dialog concepts from research to industry
  - Encouraging incorporation of Advanced Dialog methods into commercial applications
- Method:
  - Identify the best advanced dialog methods available
  - Form a model for incorporating these methods into practical development systems
  - Incorporate this strategy into speech community standardization efforts

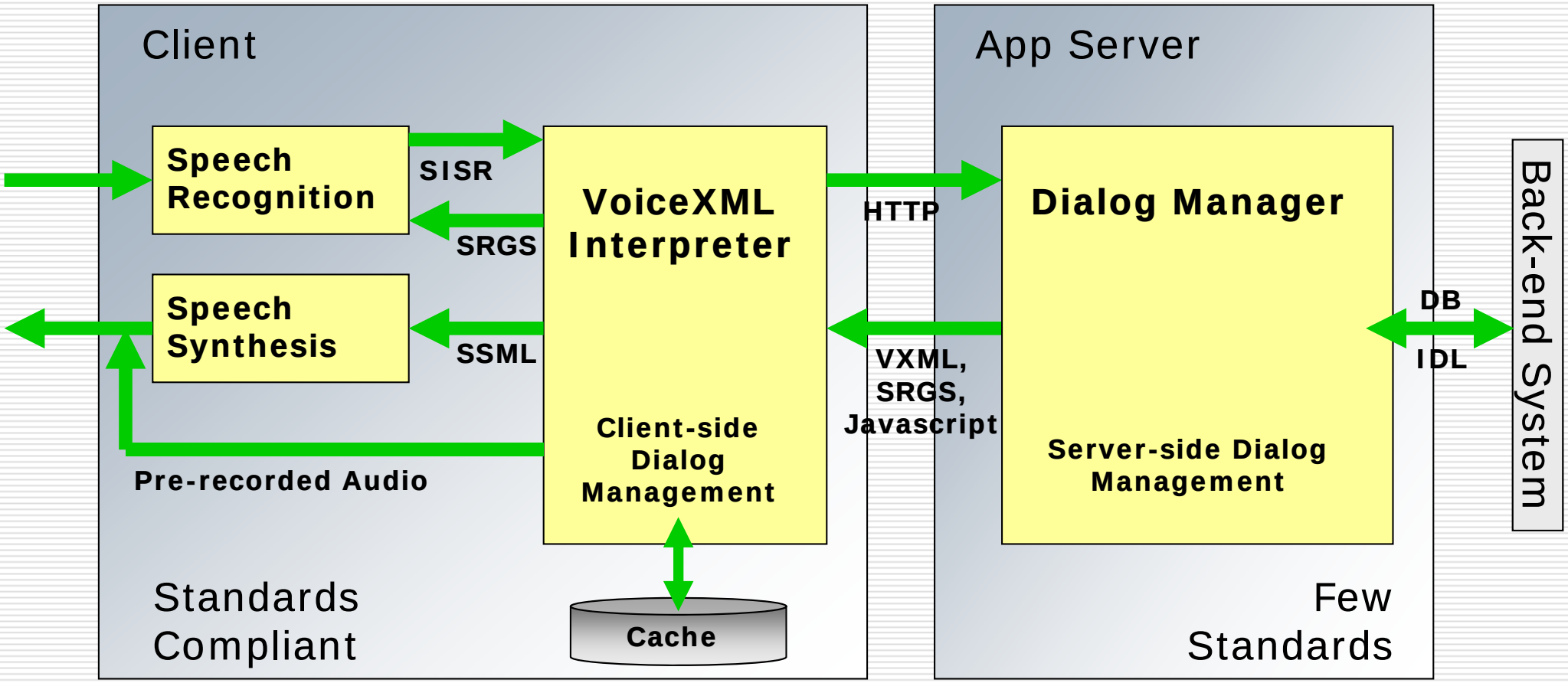
Advanced Dialog WG: Activities & Goals

- Weekly conference calls
- Workshop series (Feb 07, Aug 07, Mar 08)
- Goals
  - Provide input to the metalanguage working group.
  - Investigate the field of speech application design and the next step beyond state-based methods.
  - Specify architecture for a complete voice application, including server-side logic and backend interactions.
  - Facilitate writing re-usable voice applications using common VoiceXML patterns.
  - Produce a specification or model for how to deal with AD that is defined with sufficient detail to incorporate into the metalanguage specification.

Evolution of Advanced Dialog

- VoiceXML enhancements to address growing complexity
  - Adding ‘guards’ (‘if’ condition for many VXML tags) – approximates a rule-based system
  - Add global variables to state-based dialog
  - Allow state transitions to be stochastic
- What makes a dialog advanced?
  - A dialog is not advanced if you can count the number of states.

Speech Application Architecture



Dialog Management:
Client-side vs. Server-side

Dialog Management on Client

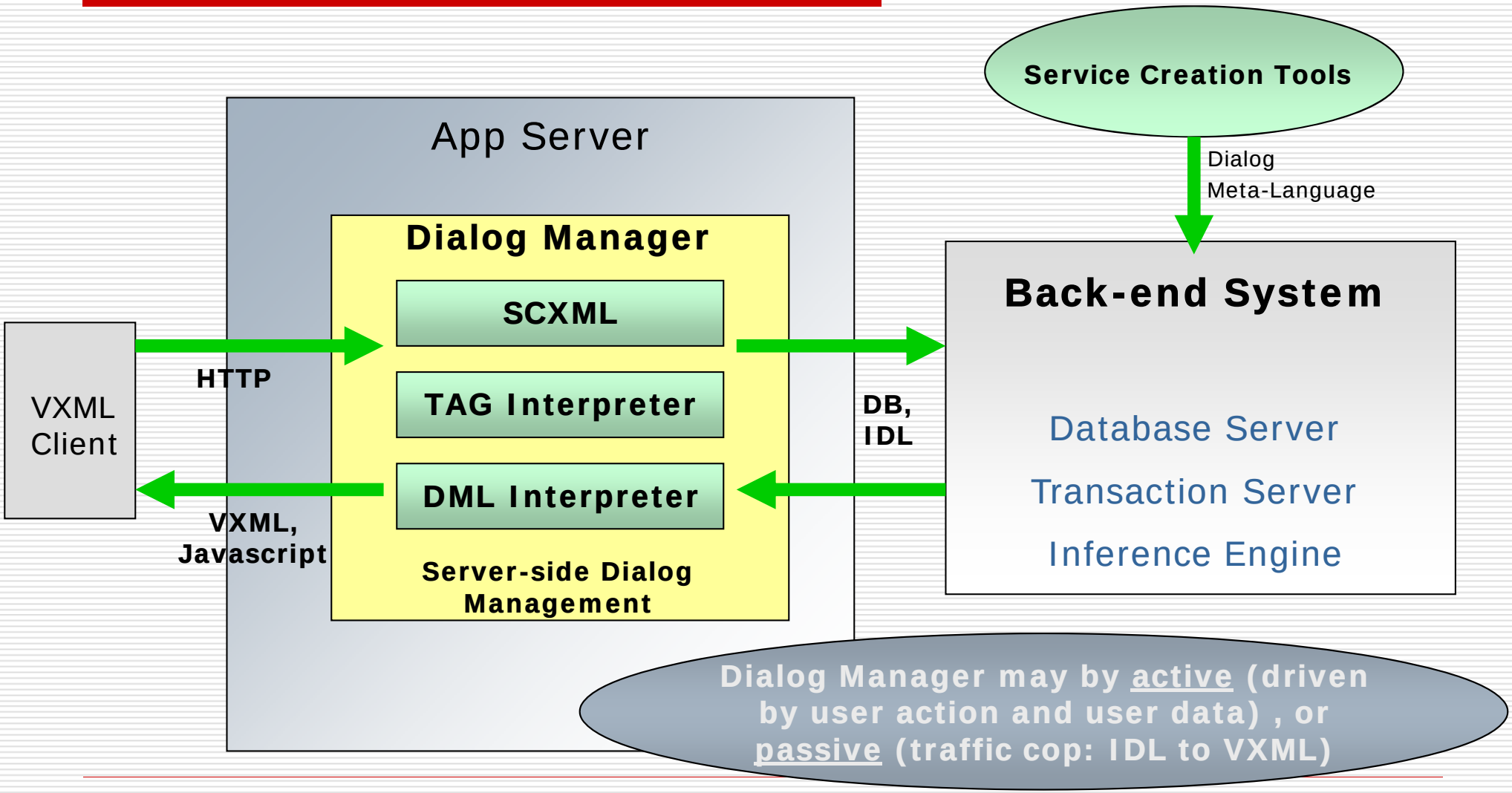
Dialog Management on Server

Dialog management done by VoiceXML interpreter, directed by mostly-static VXML data delivered by server, maintained on back-end DB.

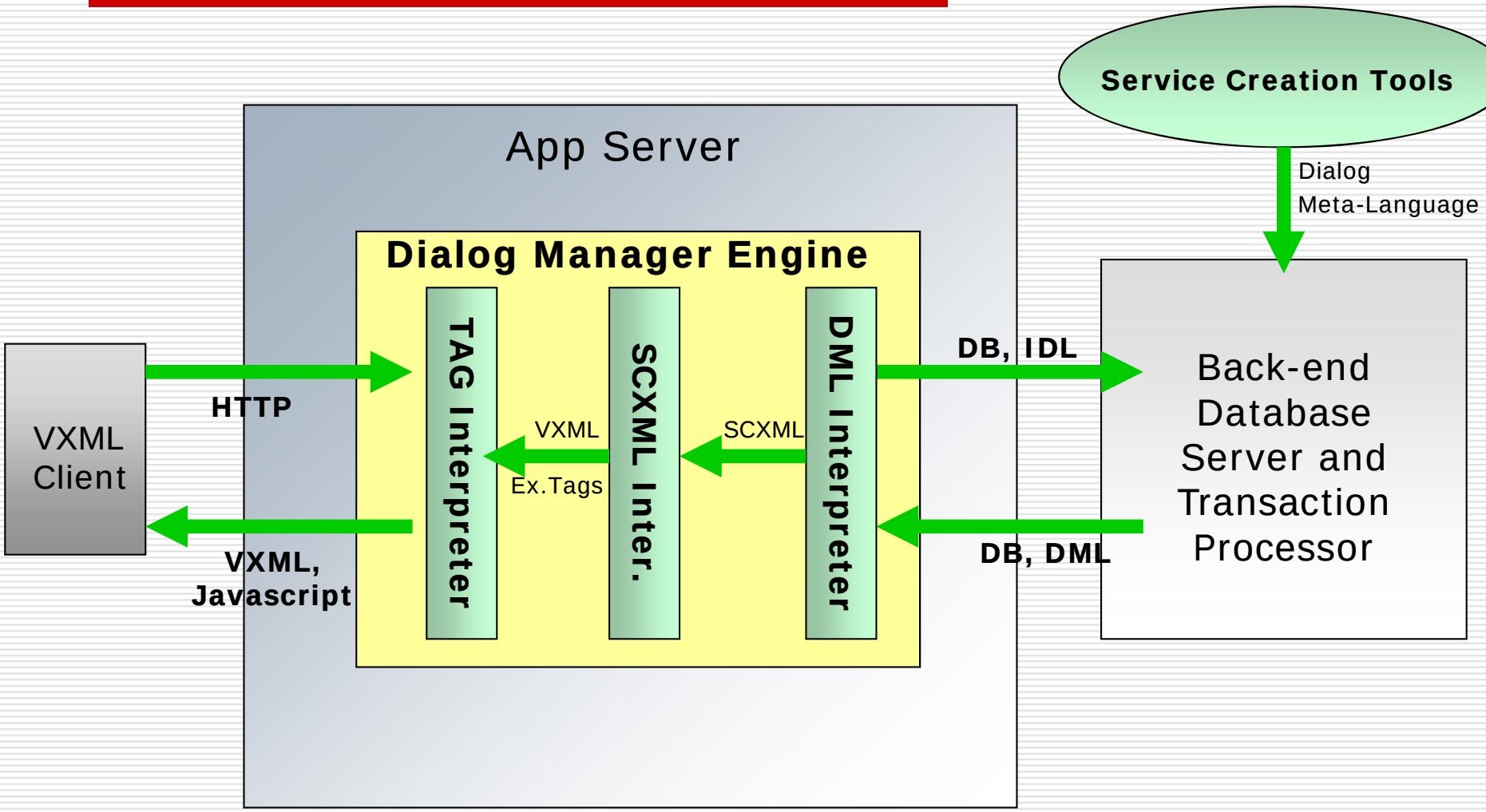
Dialog management done engine running on server, consulting back-end database for essential data, dynamically generating VXML.

Dialog management shared between engine on server and scripting on client. 'AJAX'

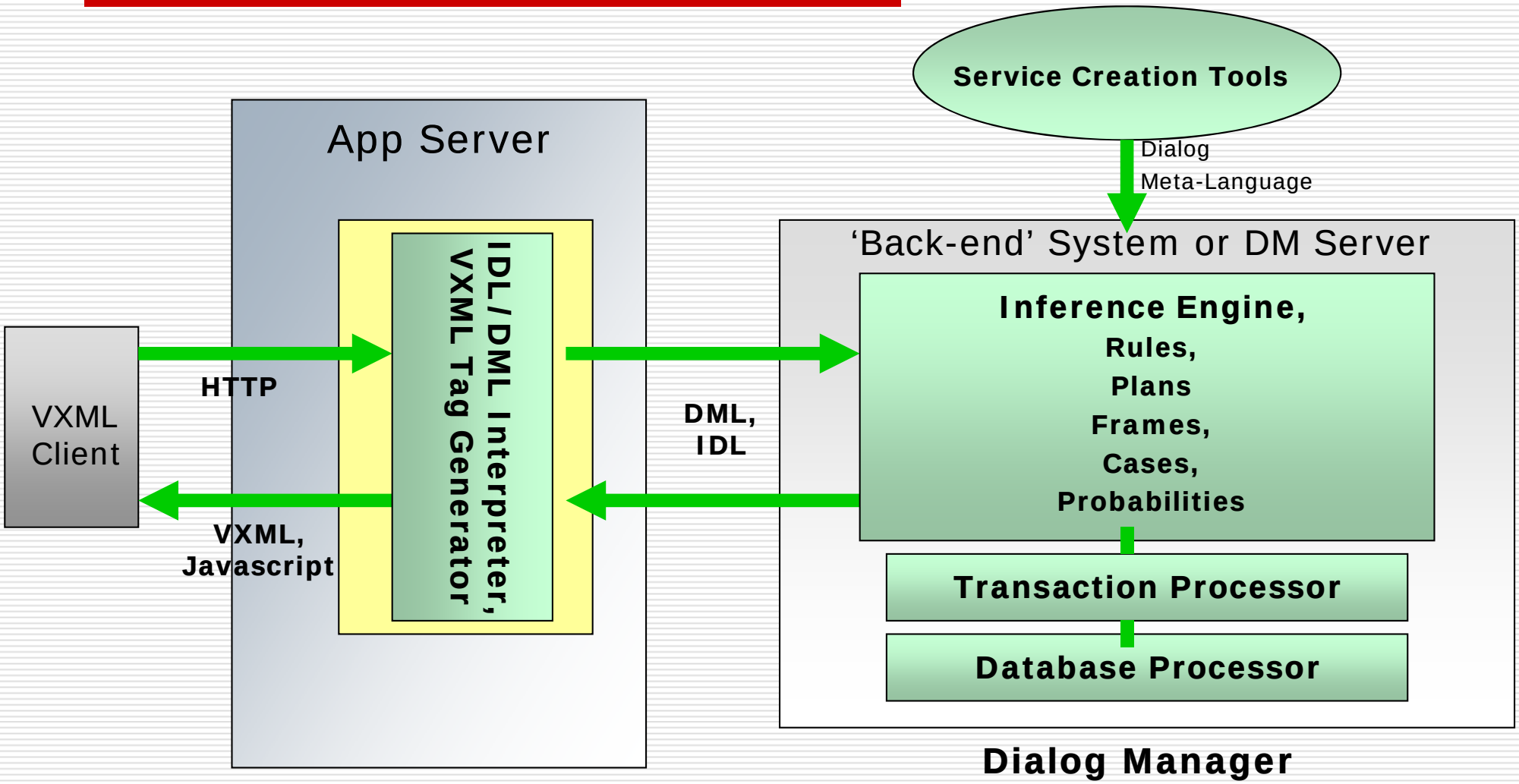
Advanced Dialog – Server-side



Active app. server dialog management



Passive app. server dialog management



Relation between DML and AD

- SCXML and VoiceXML specify explicit dialog states, so DML may not be appropriate for specifying advanced dialogs directly. **But ...**
- DML can pass submitted data to an external dialog manager, then pass prompts and grammars from the dialog manager back to a VoiceXML browser.
- Functionality required by AD that is **intrinsically** unsupported by VoiceXML (e.g. statistical language models) will need to be added to VoiceXML to be supported through DML.

Dialog Management

Inference engines - candidates

- Frame-based
- Rule-based
- Plan-based
- Stochastic
- Case-based reasoning

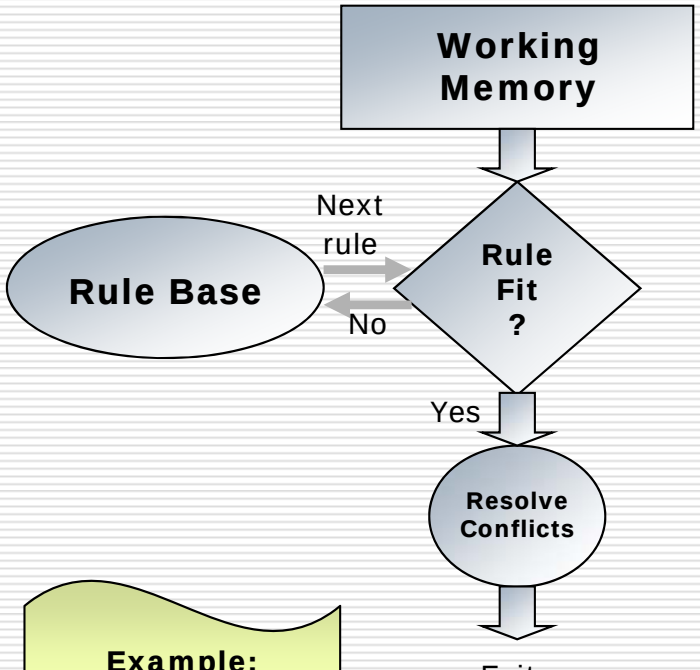
Frame-Based Systems

- A frame is a traditional way of organizing related information as a set of (possibly nested) *slots* and *values*
- Example: A sandwich
  - Bread: whole wheat, white, rye, kaiser roll, bagel …
    - If bagel: type could be ‘plain’, ‘poppy seed’, ‘egg’…
    - Toasted: yes/no
  - Filling: chicken salad, roast beef, pastrami…
  - Extras: tomato, lettuce, onion…
- In VoiceXML: *frames* and *slots* are familiar as *forms* and the *fields* within a form.
- Convenient to map dialog states to frames

Rule-Based Systems

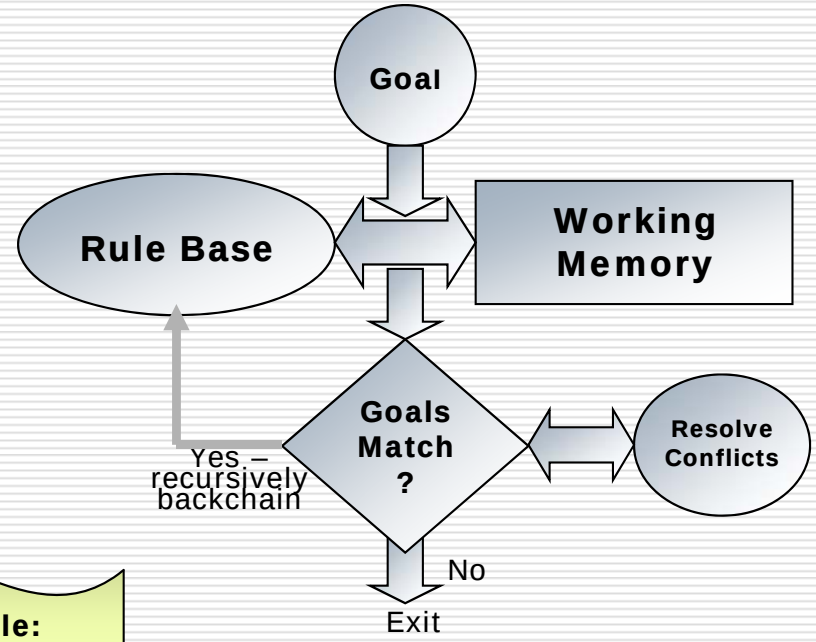
If <condition> then <action>

Forward Chaining



Example: Medical Diagnosis

Backward Chaining



Example: Medical Epidemic

Plan-Based Dialog Systems

Observation:

- humans don't produce communicative actions randomly
- actions are planned to achieve various goals
- dialog acts are *part of a plan*
- listener's job to uncover the plan and react accordingly

Example: "It is cold."

Plan-recognizer should determine:

a) information

b) request to close the door, or switch on heat

(depending on context)

Stochastic Dialog System

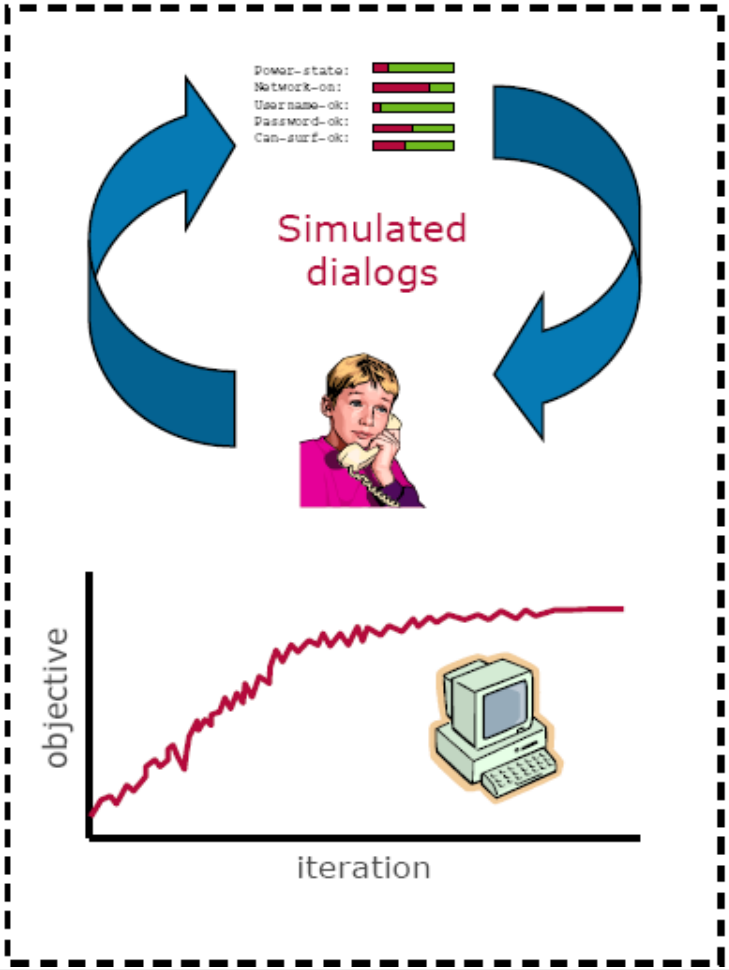
Objectives

Failure: -100

Success: +100

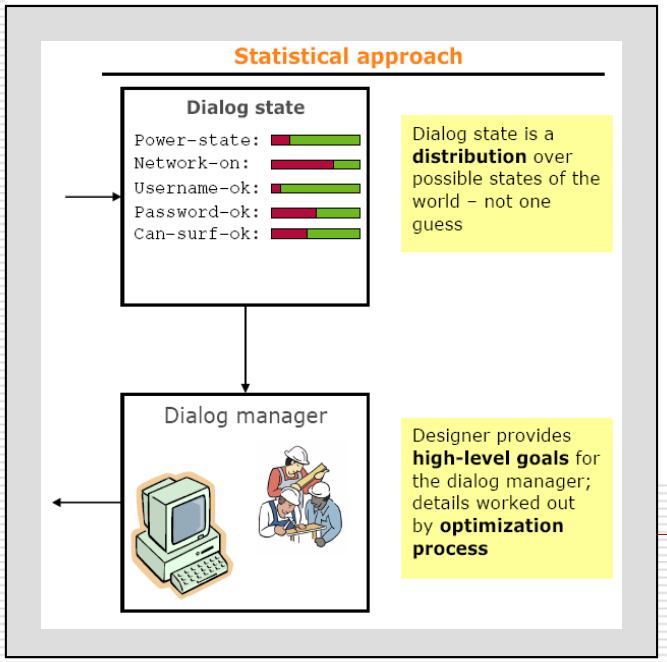
Each turn: -1

Optimization process



Notes:

- Designers provide the "palette" of actions and provide **high-level goals**
- The optimization **works out the details**
- Designer can also incorporate **constraints** or start optimization with **an existing design**



Case-Based Reasoning

A CBR knowledge base (KB) is a collection of cases, rules and scripts.

Definition…

- A CBR system uses Case Libraries. Each case:
  - Describes a problem and its symptoms
  - Provides a solution to the problem (often a script)

- Evidence obtained (from the caller, from tests, from data dips, etc.) matches symptoms and can activate each case at differing levels.
- Current activation levels for all cases create patterns that activate rules that drive the dialog by suggesting the next prompt, further tests or additional data dips.
- Through this interaction, eventually one case's activation level crosses a threshold and its solution is triggered.
- CBR systems are capable of adaptation over time by adding new cases, new rules and by adjusting the weights for evidence.

Knowledge Base Development

Knowledge engineers can develop and improve the knowledge base (the library of cases, rules and solution scripts) based on the experience of agents.

Build and improve the case library

- Knowledgeable and experienced agents

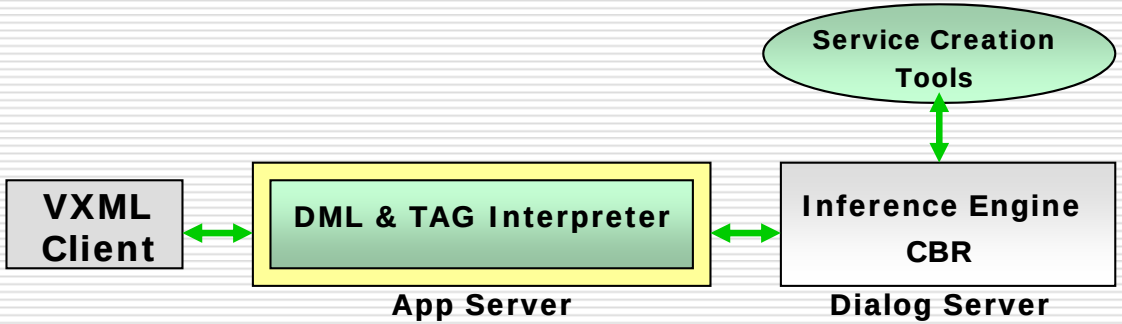
Use the case library to facilitate dialog

- Less experienced or offshore agents

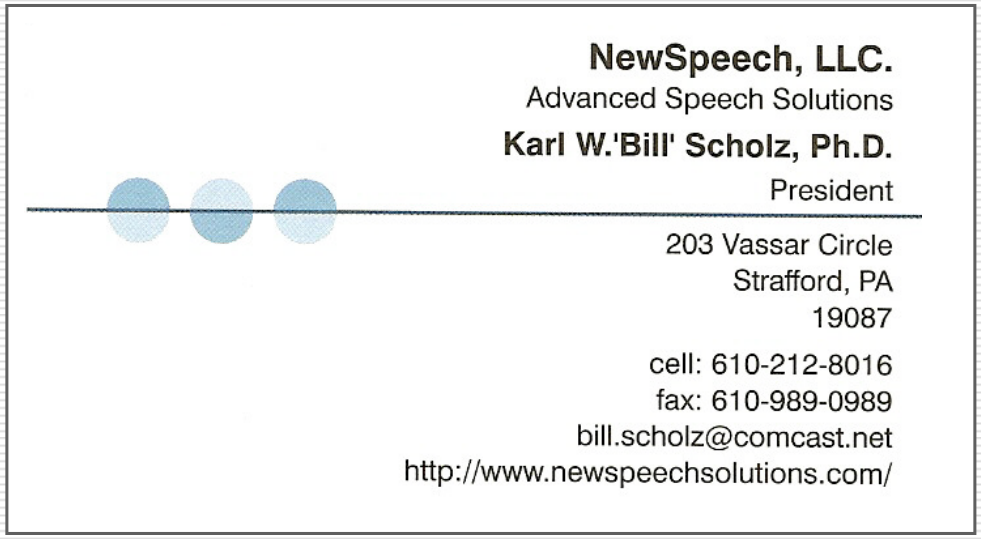
Use the case library to drive dialog during self-service automation

Summary and Conclusions

- AD Working Group – Charter and Mission
- AD Architecture
- AD Engine candidates
  - Frame Based
  - Rule Based
  - Plan Based
  - Stochastic
  - Case Based Reasoning



Thank You


NewSpeech, LLC.
Advanced Speech Solutions
Karl W.'Bill' Scholz, Ph.D.
President
203 Vassar Circle
Strafford, PA
19087
cell: 610-212-8016
fax: 610-989-0989
bill.scholz@comcast.net
http://www.newspeechsolutions.com/