Operating in a Hierarchy of Time Scales for an Always-On Relational Agent

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A Little History…

- Many Collagen/Disco plan-based dialogue system with turn-taking
- Engagement with robots [Sidner et al., AIJ 2005]
  - real-time continuous symmetric signaling
  - but used ad-hoc programming
- Wanted a more principled approach

Herb Clark: "Talk and Its Timing"

[AAAI 2010 Fall Symposium on Dialog with Robots]

	Speaking by Turns	vs.	Working Together
Timing:	one speaker at a time		both people signal simultaneously
Medium:	speech alone		speech, gestures, placement, etc.
Focus on:	dialogue itself		joint activity

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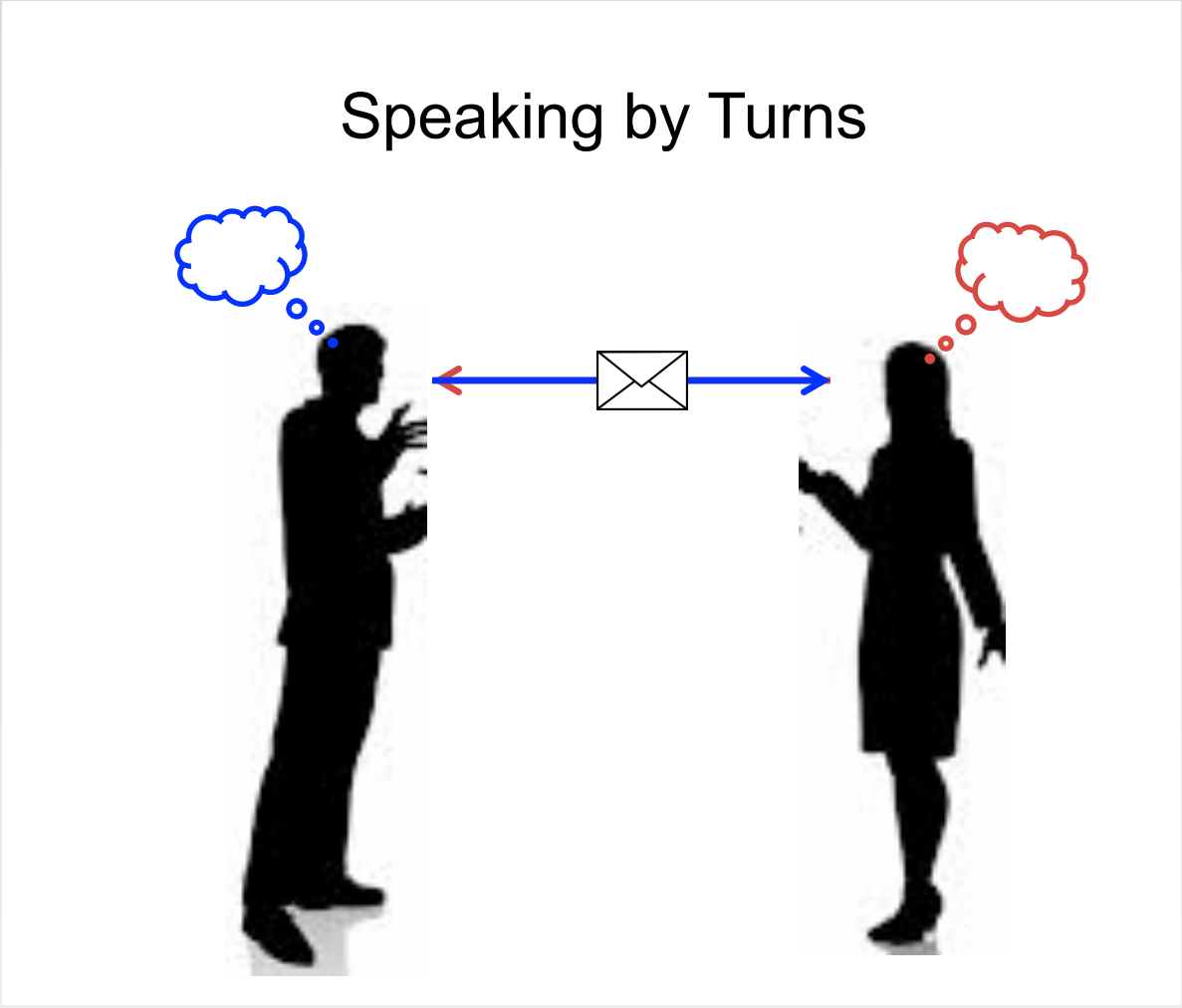

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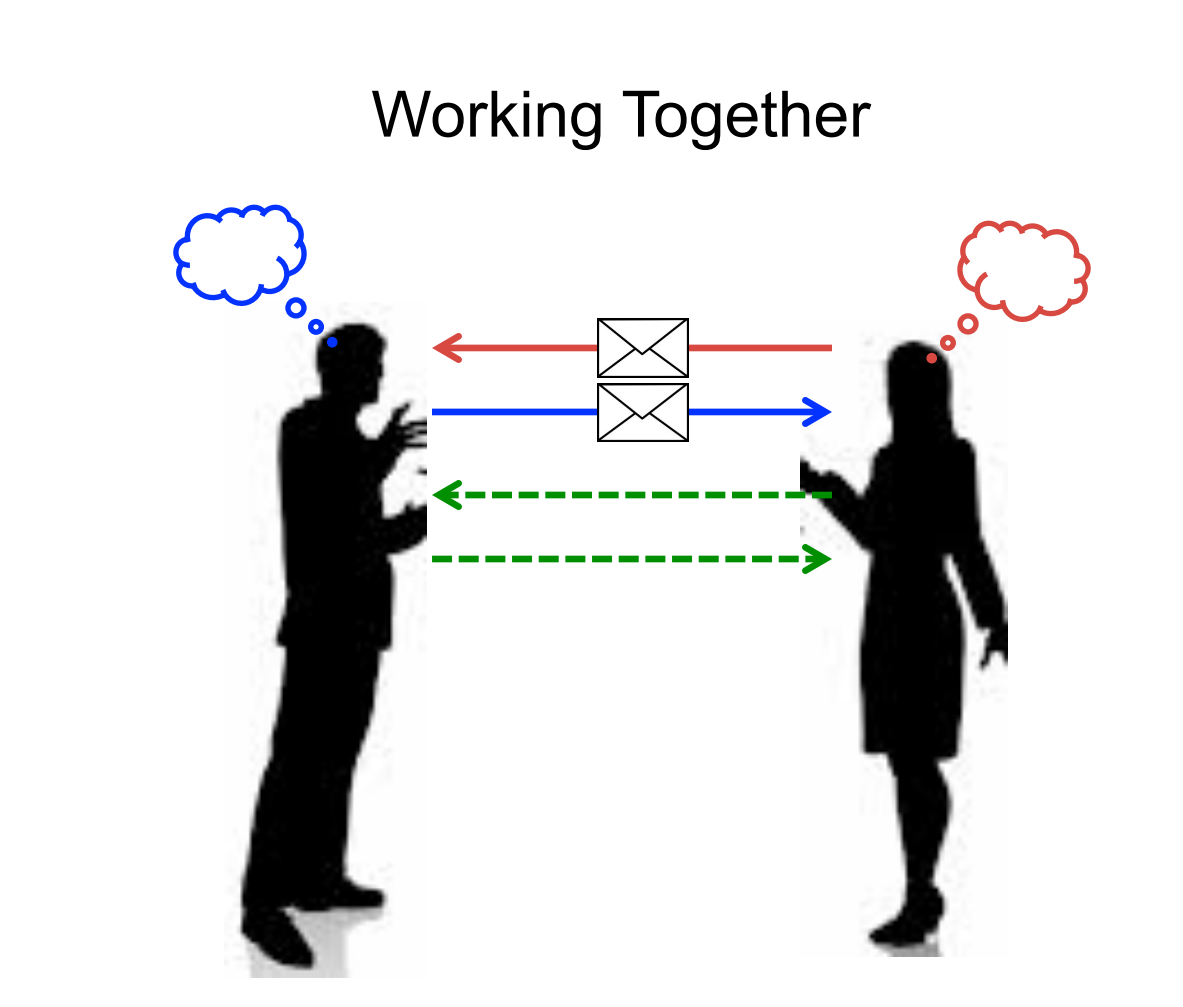
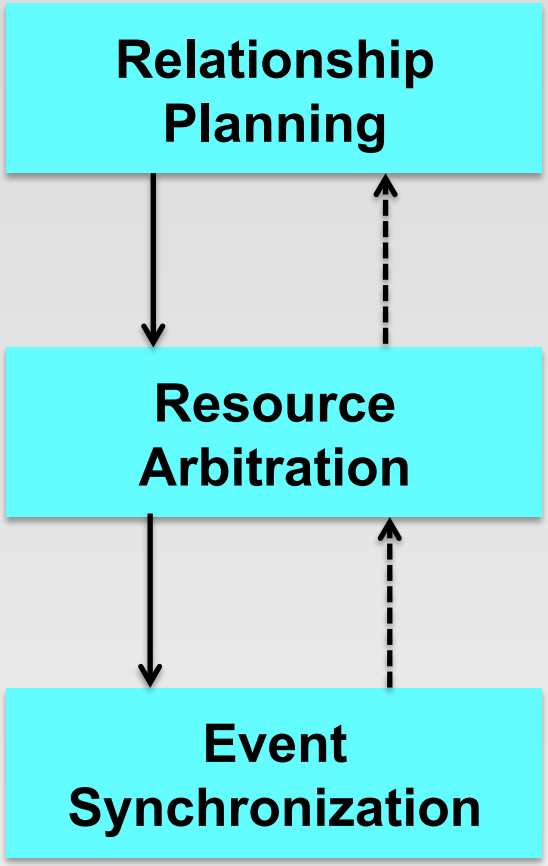


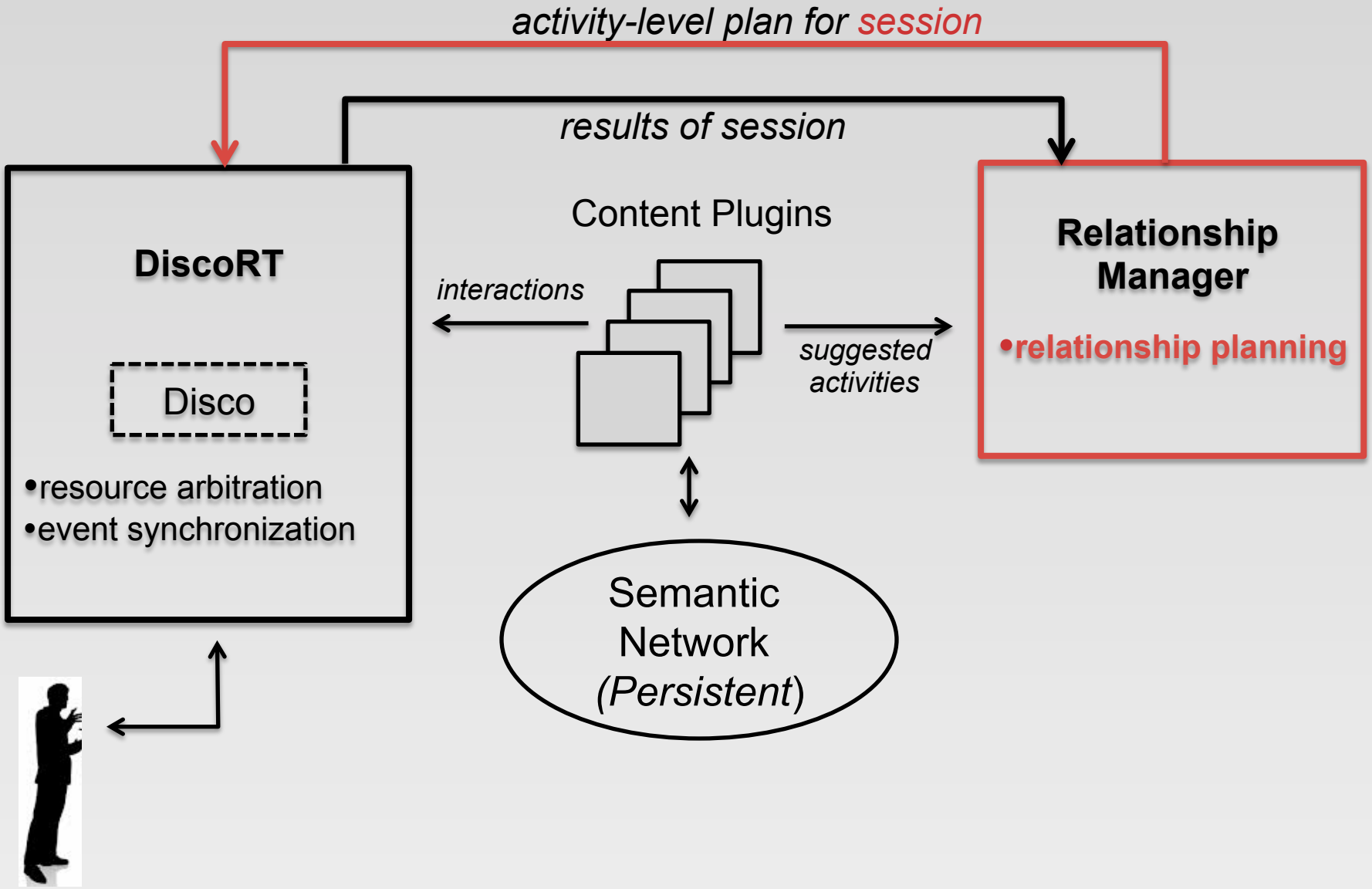
Always-On Relational Agents for Social Support of Isolated Older Adults

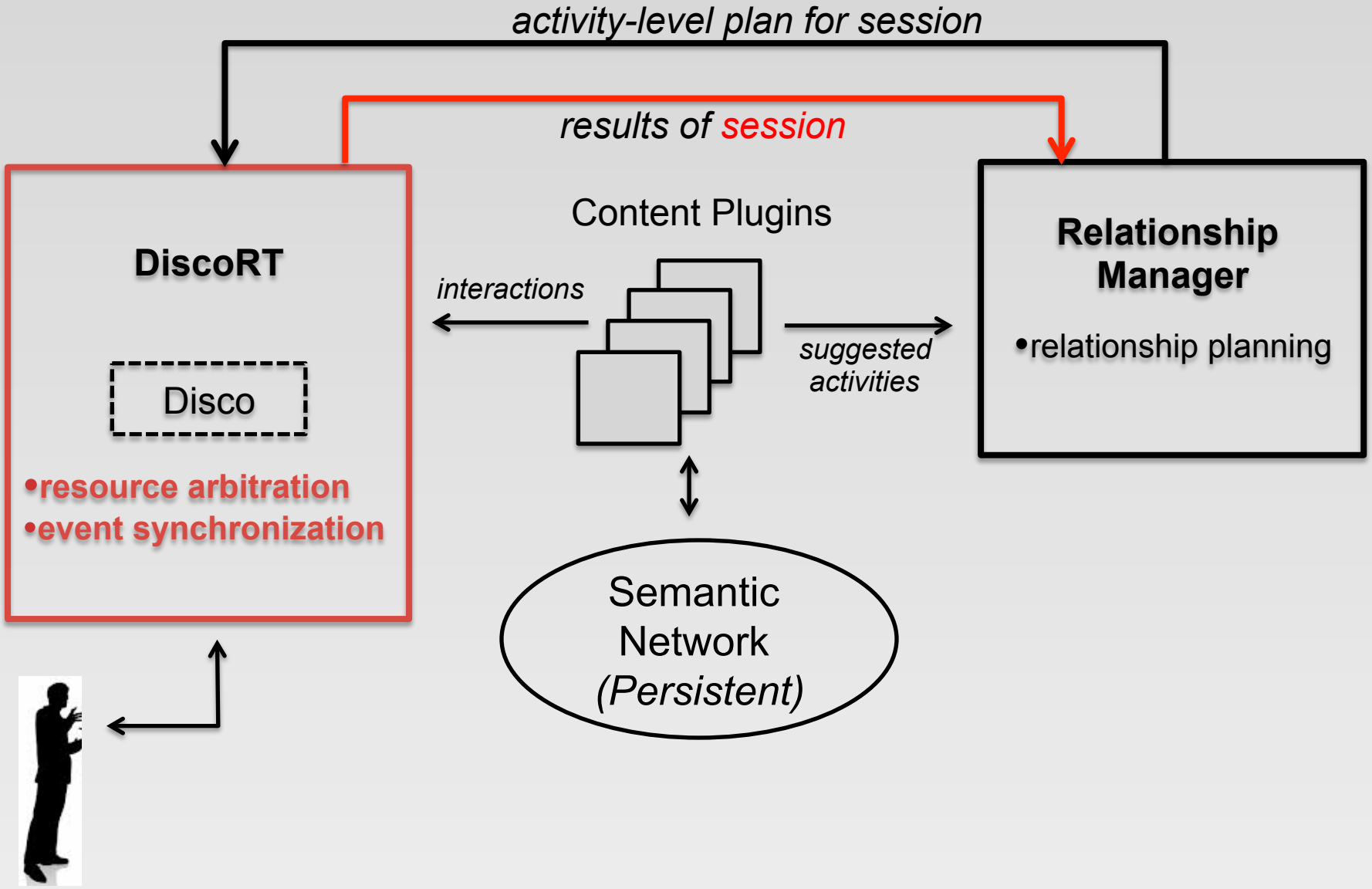
- Joint NSF-supported project
  - *WPI:* C. Sidner (PI), C. Rich
  - *Northeastern:* T. Bickmore
- Currently starting year 3 of 4
  - *completed:* empirical observations
  - *ongoing:* pilot studies (WoZ and other)
  - *upcoming:* large-scale longitudinal in-home study
- Concept video

A Hierarchy of Time Scales

Time Scale	*Processing*	*Example*
hr / day / week	**Relationship Planning**	*Our relationship is close enough today for me to bring up the issue of diet.*
sec / min / hr	**Resource Arbitration**	*There is not enough time before the 3pm trip to start the topic of diet.*
msec / sec	**Event Synchronization**	*Turn my head toward the card game when I say "this card".*




activity-level plan for session
results of session
DiscoRT
Disco
•resource arbitration
•event synchronization
Content Plugins
interactions
suggested activities
Relationship Manager
•relationship planning
Semantic Network (Persistent)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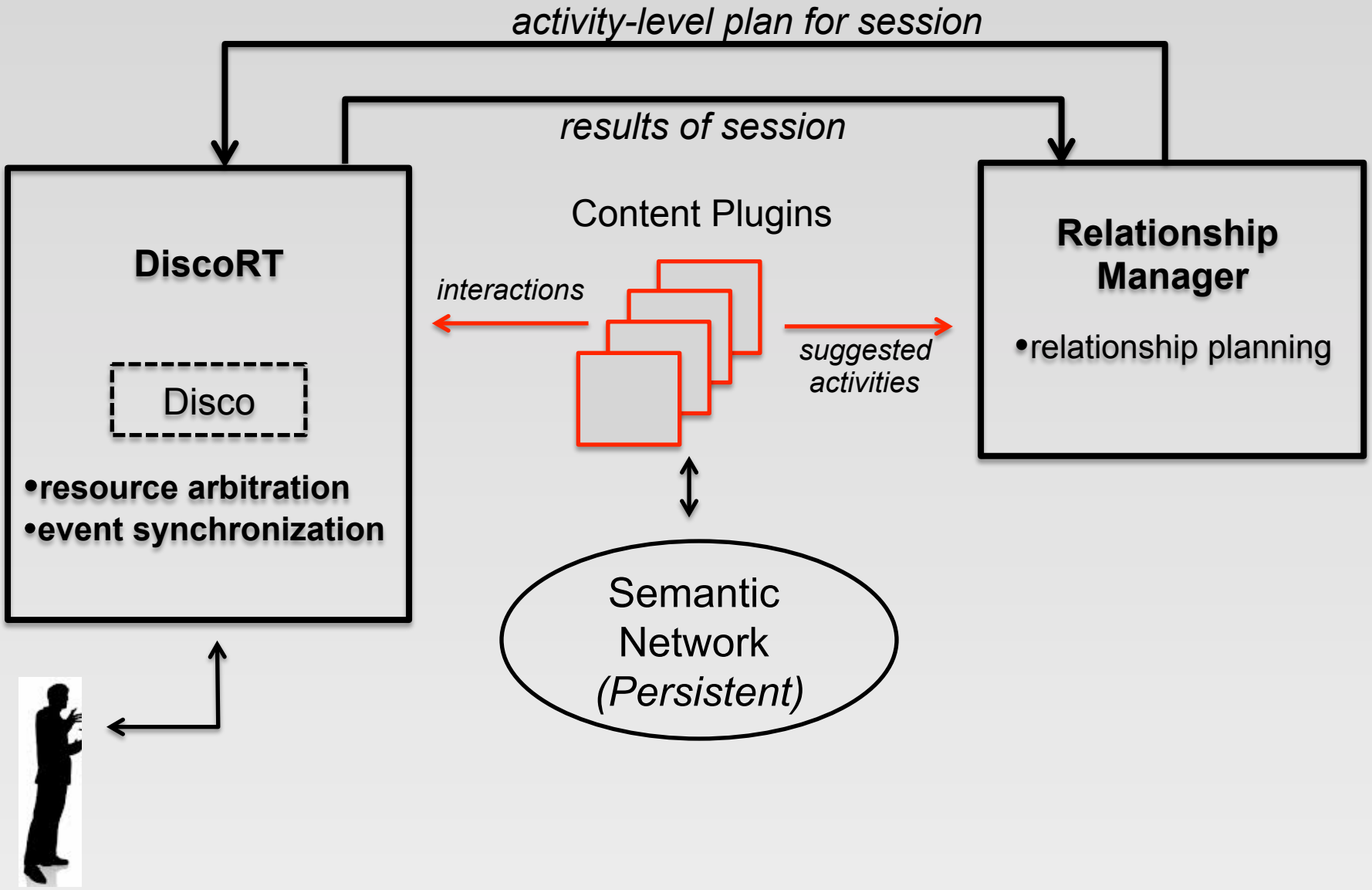
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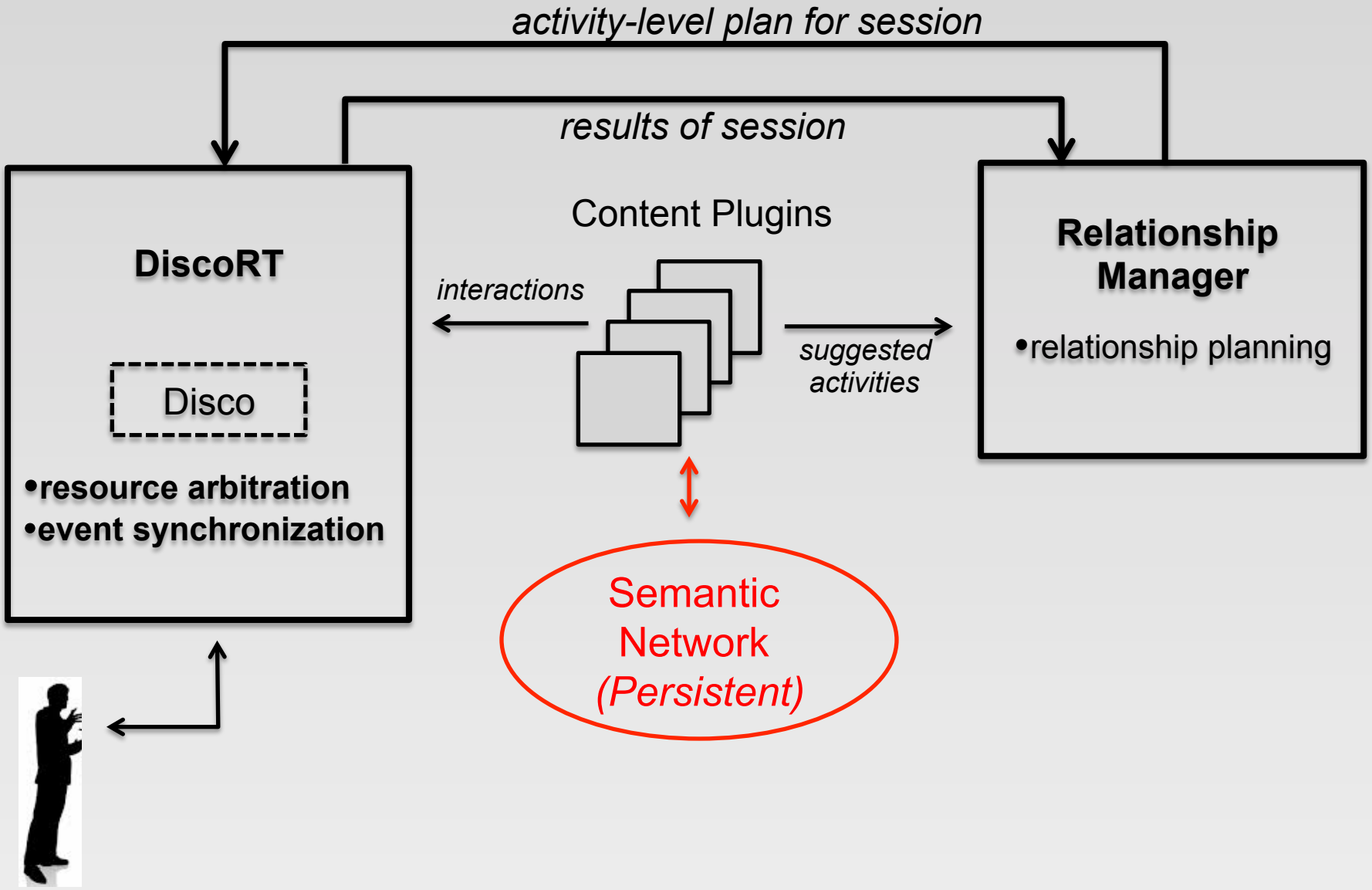
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DiscoRT

- Handles “innermost” two loops
  - *resource arbitration* (sec/min/hr – “soft RT”)
  - *event synchronization* (msec/sec – “hard RT”)
- Design influences
  - plan-based dialogue (Disco)
  - reactive robot systems (Brooks, Arkin)
  - synchronization languages (BML)
  - our previous work on engagement

DiscoRT

Activity Schemas

from relationship mgr

Perceptors

face det

motion det

menu input

emotion reco

rummy

weather

engagement

planning

plan tree

resource requests

(soft RT)
resource arbitration

Disco

Realizers

event synchronization (hard RT)

focus stack

Resources

Voice

Hand

Gaze

An Example Session

relationship planning
resource arbitration (soft RT)
event synchronization (hard RT)

- A diet discussion is planned for this session.
- Agent sees the person walking by and attempts to initiate interaction with a greeting.
- During chit-chat about the weather, the person barges in by clicking on menu before the agent finishes speaking.
- During card game, the agent looks toward the card display when it says ``this card.''
- After playing cards for ten minutes, the agent broaches the topic of diet.
- The agent notices and reminds the person that it is time for a previously scheduled Skype call with the person's brother.
- The agent pauses the card game and brings up the Skype video screen.
- When the Skype call is done, the person abruptly leaves without saying goodbye.
- After a few minutes, the agent concludes that the person intended to end the session.
- The agent updates its persistent model of the activities that occurred during the session and, based on its rules, concludes that the long-term relationship has advanced from “acquaintance” to “companion.”

Conclusion

- Architecture is fully implemented
- Multiple content plugins being developed
- Virtual agent condition and robot condition
- “Proof of the pudding will be in the eating” ☺
- Biggest unaddressed issue: incremental processing (at all levels)
  - see Scheutz (ADE: dialog and action with robots)