

Peer response 2 - Haris

Haris effectively highlights the advantages of Agent Communication Languages (ACLs), such as KQML, in enabling flexible, asynchronous communication in distributed systems (Bordini *et al.*, 2007). He emphasizes their ability to separate communication protocols from content, supporting interoperability across heterogeneous agents and facilitating dynamic tasks like negotiation (Finin *et al.*, 1994; Soon *et al.*, 2019). Haris also acknowledges the challenges associated with ACLs, including computational overhead and reliance on predefined semantics, contrasting this with the determinism and efficiency of method invocation in languages like Python and Java. His follow-up nicely elaborates on modern programming frameworks (e.g., JADE, PADE) that integrate ACL capabilities while addressing inherent limitations, suggesting a hybrid approach to balance flexibility and performance (Bergenti *et al.*, 2017).

While Haris effectively articulates the strengths of ACLs in supporting rich interactions in open systems, there are many advantages to method invocation that ought to be highlighted. For example, the simplicity and rapid feedback of method calls are crucial in scenarios where performance is paramount (Bennett, Farmer and McRobb, 2016). Moreover, the potential for improved debugging and maintenance in tightly coupled environments, as acknowledged, is significant, particularly when the development team's familiarity with these languages can lead to accelerated project timelines.

Modern multi-agent systems increasingly require seamless collaboration among disparate agents. The emerging concept of hybrid systems, which combines the robustness of ACLs with the rapid execution of method invocation, suggests a direction for future developments (Zambonelli *et al.*, 2001). Such systems can leverage the strengths of both frameworks to accommodate a wider range of applications, particularly in domains like the Internet of Things (IoT) (Bouzouba, Moulin and Kabbaj, 2020; Savaglio *et al.*, 2020).

In conclusion, while ACLs excel in dynamic, distributed environments, method invocation remains invaluable for efficiency-driven applications. As suggested by Haris, a hybrid approach could provide a robust framework for developing complex, multi-agent systems, offering a balanced alternative that meets diverse operational needs.

References

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