Initial post

by Georgios Papachristou - Tuesday, 4 March 2025, 5:25 AM

Number of replies: 3

Knowledge Query and Manipulation Language (KQML) is a language that was developed to support the communication and exchange of information between intelligent software agents. By using KQML an agent is transmitting content messages on its own language to another agent, wrapped inside of KQML message (Finin et al., 1994). In particular, it is composed of three layers, namely the content layer where the original content of the message lies, the communication layer where lower level communication parameters are encoded, and the message layer where the performatives that make possible the interaction with other agents are being provided (Donancio et al., 2019).

Though as mentioned above, KQML enables the communication among agents, its lack of formal semantics as well as inability when it comes to support interoperability between agents are its main limitations. Having identified this issue, the Foundation for Intelligent Physical Agents (FIPA) specifies the key agents needed for the management of an agent system and the standard ontology to be utilized when systems interact with each other. Java Agent Development Framework (JADE) and Smart Python multi-Agent Development Environment (SPADE) are two agent frameworks compliant with FIPA. Though their differences mainly with regards to creation and manipulation of ontologies, both of them use a distributed BDI architecture, a Directory Facilitator, and implement the agent management system specified by the FIPA protocol (Donancio et al., 2019; Bellifemine et al., 2001).

To sum up, though KQML is the fundamental communication language among agents, its limitations have resulted in the development of other frameworks such as JADE and SPADE that are based on modern programming languages and in turn have ended up being more widely used.

References

Bellifemine, F., Poggi, A., & Rimassa, G. (2001). Developing Multi-Agent Systems with JADE. *7th International Workshop, Intelligent Agents VII. Agent Theories Architectures and Languages* (pp. 89-103). Boston: Springer.

Donancio, H., Casals, A., & Brandao, A. (2019). Exposing agents as web services: a case study using JADE and SPADE. *Computer Science*.

Finin, T., Fritzson, R., McKay, D., & McEntire, R. (1994). KQML as an agent communication language. *CIKM '94: Proceedings of the third international conference on Information and knowledge management* (pp. 456-463). Association for Computing Machinery.

Peer Response: Initial post

by Rodrigo Pereira Cruz - Saturday, 8 March 2025, 7:20 PM

Georgios' entry provides an excellent overview of the foundations of Knowledge Query and Manipulation Language (KQML), its strengths and weaknesses, and its relationship to modern programming languages' frameworks that enable agent-based programming, namely Java Agent Development Framework (JADE) and Smart Python multi-Agent Development Environment (SPADE).

A notable period in the history of agent communication languages takes place when successors to KQML are being developed. The Foundation for Intelligent Physical Agents Agent Communication Language (FIPA-ACL) is possibly the most notorious and well-known of KQML's successors (de Ridder, 2025). Built to address KQML's shortcomings, it nevertheless possesses weaknesses of its own, some of which, like not providing facilitation primitives, ultimately proved troublesome to developers (Labrou et al., 1999) and which undoubtedly facilitated the rise of modern programming languages and their agent-based frameworks.

Overall, agent communication languages' weaknesses were propagated across its various approaches, resulting in languages that proved difficult for many developers to use in a reliable manner. With the advent of modern programming languages, their simplicity, aided with new agent-based frameworks, ultimately allowed them to largely replace older paradigms and solidify their position as the go-to tools for agent development.

References

De Ridder, A. (2025) *An Introduction to FIPA Agent Communication Language: Standards for Interoperable Multi-Agent Systems*. Available at: https://smythos.com/ai-agents/ai-agent-development/fipa-agent-communication-language/ (Accessed: 8 March 2025).

Labrou, Y., Finin, T. and Peng, Y. (1999) 'Agent communication languages: the current landscape', *IEEE Intelligent Systems and their Applications*, 14(2), pp. 45-52. Available at: https://doi.org/10.1109/5254.757631.

Peer Response

by Noora Alboinin - Monday, 24 March 2025, 7:29 AM

Great summary of KQML and its role in agent communication. I liked how you explained the three-layer structure—it really helps clarify how agents exchange information (Finin et al., 1994).

You made a strong point about the limitations of KQML, especially around interoperability. I agree that this pushed the development of more flexible frameworks like JADE and SPADE, which follow FIPA standards and support better integration (Donâncio, Casals and Brandão, 2019).

Mentioning the BDI architecture was also useful. It shows how modern frameworks do more than just enable communication—they also support reasoning and goal-driven behaviour (Bellifemine, Poggi and Rimassa, 2001). It might be interesting to explore how the choice between JADE or SPADE depends on the developer's language preference or project needs.

Overall, a clear and informative post. Well done!

References

Bellifemine, F., Poggi, A. and Rimassa, G. (2001) *Developing Multi-Agent Systems with JADE*. Boston: Springer.

Donâncio, H., Casals, A. and Brandão, A.A.F. (2019) 'Exposing agents as web services: a case study using JADE and SPADE'. *Computer Science*. Available at: **https://repositorio.usp.br/bitstreams/6f1bbd66-85ec-4434-91d5-b6f2318261bd** (Accessed: 10 March 2025).

Finin, T. et al. (1994) 'KQML as an agent communication language', *CIKM '94*. New York: ACM, pp. 456–463.

Summary Post

by Georgios Papachristou - Tuesday, 25 March 2025, 4:50 AM

In my initial post, I briefly presented Knowledge Query and Manipulation Language (KQML), a language that was developed to support the communication and exchange of information between intelligent software agents. In addition, I briefly described how this language works in practice, highlighted its benefits, discussed its main drawbacks, lack of formal semantics and inability to support interoperability between agents, that lead to the development of other frameworks such as Java Agent Development Framework (JADE) and Smart Python multi-Agent Development Environment (SPADE) (Finin et al., 1994; Donancio et al., 2019; Bellifemine et al., 2001). Such analysis gave me the opportunity to understand how KQML enables communication between agents, as well as why JADE and SPADE are being applied more and more by researchers for agent communication.

As a response to my initial post, Rodrigo points out that the Foundation for Intelligent Physical Agents Agent Communication Language (FIPA-ACL) is one of KQML successors (de Ridder, 2025) that though was developed to address KQML's weaknesses, it comes with its own limitations, such as lack of facilitation primitives and troublesome to developers (Labrou et al., 1999). That being the case, modern programming languages and their agent-based framework, SPADE and JADE, found the opportunity to position themselves as major agent communication mechanisms.

Additionally, Noora provided her point of view regarding my initial post, highlighting as well that KQML limitations, such as inability to support interoperability between agents, and factors such as flexibility and BDI architecture of JADE and SPADE, resulted in the rise of such frameworks (Bellifemine et al., 2001).

To sum up, this discussion highlighted the benefits and the limitations of KQML as well as the reasons that led to the rise of JADE and SPADE in the communication between agents.

References

Bellifemine, F., Poggi, A. & Rimassa, G., 2001. *Developing Multi-Agent Systems with JADE.* Boston, Springer, pp. 89-103.

De Ridder, A. (2025) *An Introduction to FIPA Agent Communication Language: Standards for Interoperable Multi-Agent Systems*. Available at: https://smythos.com/ai-agents/ai-agent-development/fipa-agent-communication-language/ (Accessed: 8 March 2025)

Donancio, H., Casals, A. & Brandao, A., 2019. Exposing agents as web services: a case study using JADE and SPADE. *Computer Science.*

Finin, T., Fritzson, R., McKay, D. & McEntire, R., 1994. *KQML as an agent communication language.* s.l., Association for Computing Machinery, pp. 456-463.

Labrou, Y., Finin, T. and Peng, Y. (1999) 'Agent communication languages: the current landscape', *IEEE Intelligent Systems and their Applications*, 14(2), pp. 45-52.