

Future of Adaptive Middleware

Open Discussion Session @ The 8th Workshop on Adaptive and Reflective Middleware

Format

- ▶ **Short Contributions**
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 - ▶ Fabio Costa
 - ▶ Luis Vega
 - ▶ Francois Taiani
 - ▶ Paul Grace
 - ▶ Nalini Venkatasubramanian



ARM'2009: Panel on the Future of (Adaptive) Middleware

Gordon S. Blair



A Few Words from Danny Cohen

- ▶ In the beginning ARPA created ARPANET.
- ▶ And the ARPANET was without form and void.
- ▶ And darkness was upon the deep.
- ▶ And the spirit of ARPA moved upon the face of the network and ARPA said, 'Let there be a protocol,' and there was a protocol. And ARPA saw that it was good.
- ▶ And ARPA said, 'Let there be more protocols,' and it was so. And ARPA saw that it was good.
- ▶ And ARPA said, 'Let there be more networks,' and it was so.



Gordon's distributed systems version

- ▶ In the beginning there was small scale experimentation.
- ▶ And the experiments were without abstraction or openness.
- ▶ And darkness was upon the deep.
- ▶ And the spirit of the OMG moved upon the face of the distributed system and said, 'Let there be a middleware standard,' and there was a standard. And OMG saw that it was good.
- ▶ And Microsoft said, 'Let there be more standards,' and it was so. And Microsoft saw that it was good.
- ▶ And the community said, 'Let there be more networks and of course also mobility, ubiquity and cloud computing for good measure,' and it was so.....

But is it good?



A statement of challenges

- ▶ What are the theories and systems principles that underpin distributed *systems of systems*, in particular:
 - ▶ How do we achieve basic systems properties including **interoperability** in such systems?
 - ▶ How do we ensure that **end-to-end quality of service** properties can be achieved in such systems?
 - ▶ How do we **manage** such complex systems-of-systems?

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The solution space: a personal view

- ▶ The need for a strong *architectural representation* of system structures, preferably applied consistently throughout the system architecture
- ▶ The need for associated *meta-representation* and meta-information to aid reasoning about such system structures
- ▶ The need to step from syntactic structures to semantic structures (cf. *semantic middleware*)
- ▶ The need to *reify the goals and intent* of the system and to (dynamically) provide structures to realise these goals

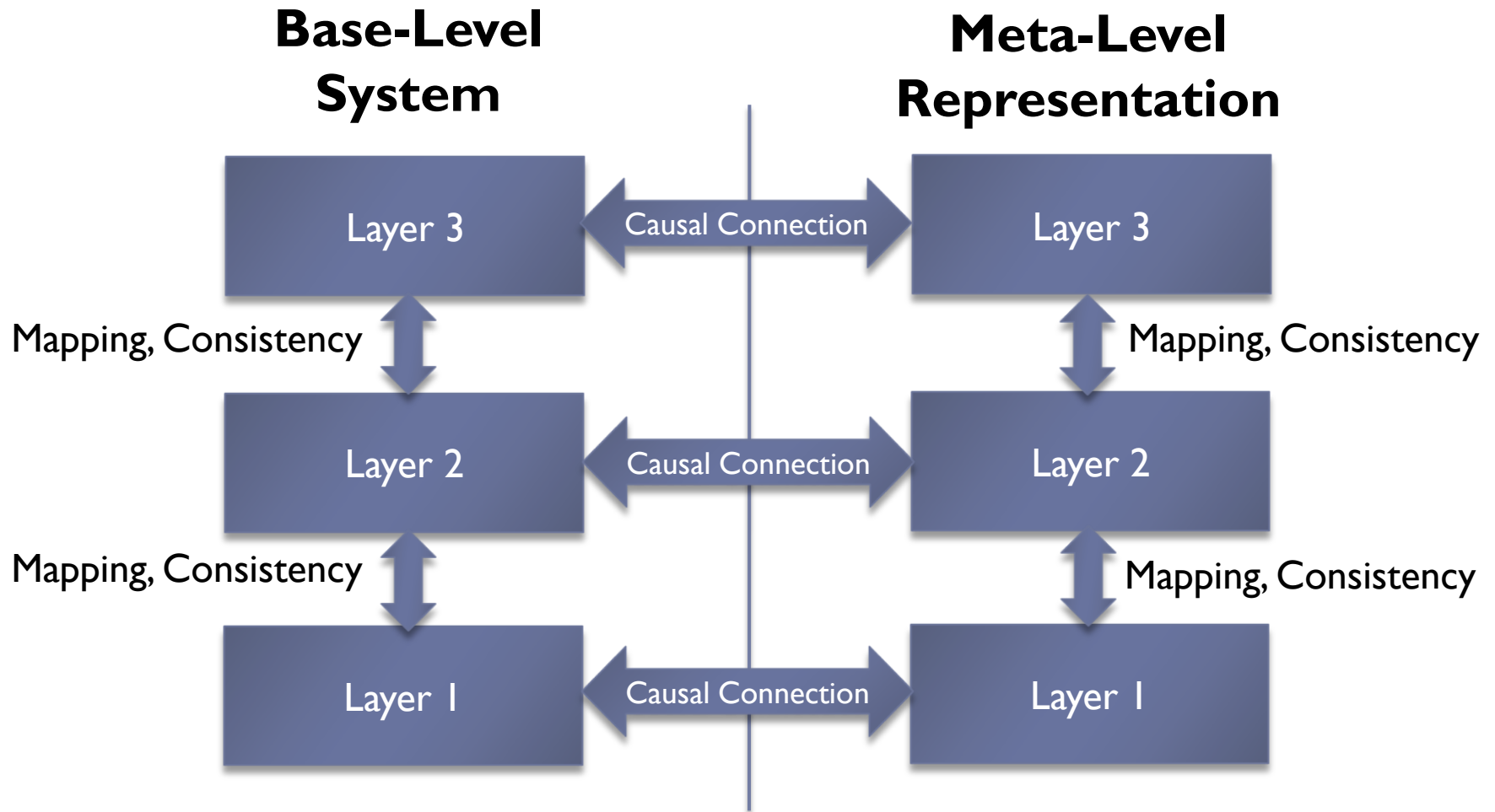


Summary

- ▶ Distributed systems are becoming increasingly complex, driven by trends such as mobility, ubiquity and utility
- ▶ Most research in distributed systems focuses on one specific area within this space, e.g. middleware for mobile computing
- ▶ There is a pressing need to re-consider the fundamentals of distributed systems:
 - ▶ seeking theories and systems techniques to achieve key properties such as interoperability and end-to-end QoS in systems of systems
- ▶ I hope I can stimulate some of you to join me in this quest



Multi-layer Reflective Systems (Fabio Costa)

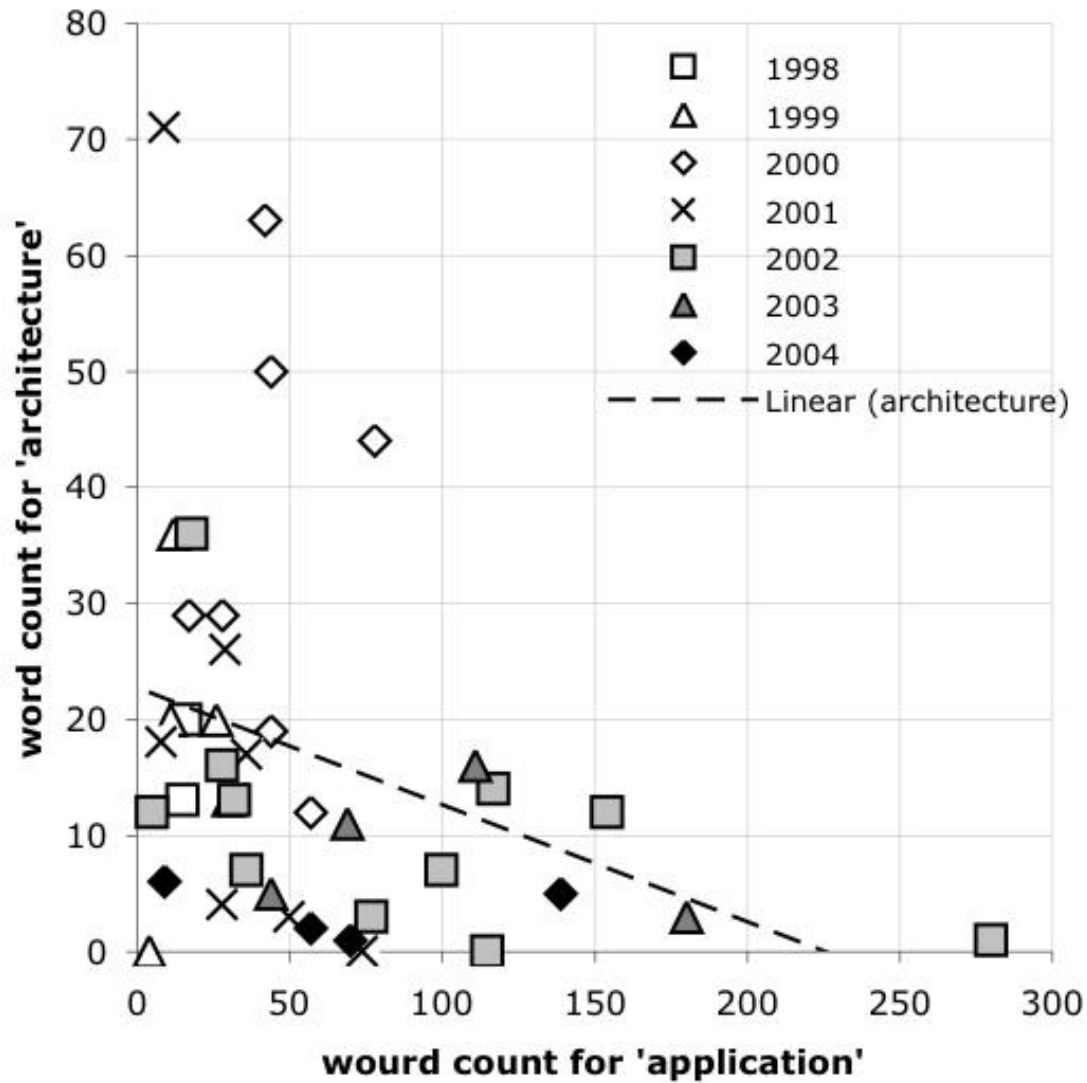


Luis Vega

- ▶ ARM and Adaptive Systems in Autonomic Computing
- ▶ Adaptive and Reflective Middleware Tomorrow:
- ▶ Option A (safe, but smaller):
 - ▶ Remain in the mobile computing and component-based development world
- ▶ Option B (risky, but bigger -we hope!) :
 - ▶ Become the driving force (not easy, strong competition) on autonomic computing and self-* systems to be used in cloud computing infrastructures.



Francois Taiani



Paul Grace

- ▶ **Adaptive Middleware in the middle**
 - ▶ High-level models
 - ▶ Underpinned by reflective middleware
- ▶ **Interoperability**
 - ▶ The next barrier {heterogeneous protocols/middleware}
 - ▶ Adaptation/Configurability/Flexibility as the cornerstone

