Object Management Group

140 Kendrick Street

Building A Suite 300

Needham, MA 02494

USA

Telephone: +1-781-444-0404

Facsimile: +1-781-444-0320

Agent Metamodel and Profile (AMP)

Request For Proposal

OMG Document: ad/08-09-05   
  
**Letters of Intent due: 16 February 2009**

**Submissions due: 25 May 2009**

Objective of this RFP

This Request for Proposal solicits submissions for an Agent Metamodel and Profile (AMP). Essentially, the AMP RFP requests a metamodel and profile for extending UML with capabilities applicable to agents and agent-based software.

Submissions developed in response to this RFP will achieve the following:

* Clarify semantics concerned with modeling agents.
* Establish Agent modeling best practices utilizing OMG technologies.
* Develop a MOF-compliant agent metamodel to be used either standalone or via extending the existing UML metamodel with agent modeling capabilities.
* Enable agent model interchange between tools via XMI.
* Optionally facilitate modeling of Peer-to-Peer, Grid and Cloud computing, and other technologies in terms of a collection of Agents.

It is expected that responses to this RFP will make good use of agent modeling capabilities already supported by the OMG. For further details see Chapter 6 of this document.

# General Requirements on Proposals

## Requirements

### Submitters are encouraged to express models using OMG modeling languages such as UML, MOF, CWM and SPEM (subject to any further constraints on the types of the models and modeling technologies specified in Chapter 6 of this RFP). Submissions containing models expressed via OMG modeling languages shall be accompanied by an OMG XMI [XMI] representation of the models (including a machine-readable copy). A best effort should be made to provide an OMG XMI representation even in those cases where models are expressed via non-OMG modeling languages.

### Chapter 6 of this RFP specifies whether PIM(s), PSM(s), or both are being solicited. If proposals specify a PIM and corresponding PSM(s), then the rules specifying the mapping(s) between the PIM and PSM(s) shall either be identified by reference to a standard mapping or specified in the proposal. In order to allow possible inconsistencies in a proposal to be resolved later, proposals shall identify whether the mapping technique or the resulting PSM(s) are to be considered normative.

### Proposals shall be precise and functionally complete. All relevant assumptions and context required for implementing the specification shall be provided.

### Proposals shall specify conformance criteria that clearly state what features all implementations must support and which features (if any) may optionally be supported.

### Proposals shall reuse existing OMG and other standard specifications in preference to defining new models to specify similar functionality.

### Proposals shall justify and fully specify any changes or extensions required to existing OMG specifications. In general, OMG favors proposals that are upwards compatible with existing standards and that minimize changes and extensions to existing specifications.

### Proposals shall factor out functionality that could be used in different contexts and specify their models, interfaces, etc. separately. Such minimalism fosters re-use and avoids functional duplication.

### Proposals shall use or depend on other specifications only where it is actually necessary. While re-use of existing specifications to avoid duplication will be encouraged, proposals should avoid gratuitous use.

### Proposals shall be compatible with and usable with existing specifications from OMG and other standards bodies, as appropriate. Separate specifications offering distinct functionality should be usable together where it makes sense to do so.

### Proposals shall preserve maximum implementation flexibility. Implementation descriptions should not be included and proposals shall not constrain implementations any more than is necessary to promote interoperability.

### Proposals shall allow independent implementations that are substitutable and interoperable. An implementation should be replaceable by an alternative implementation without requiring changes to any client.

### Proposals shall be compatible with the architecture for system distribution defined in ISO’s Reference Model of Open Distributed Processing [RM-ODP]. Where such compatibility is not achieved, or is not appropriate, the response to the RFP must include reasons why compatibility is not appropriate and an outline of any plans to achieve such compatibility in the future.

### In order to demonstrate that the specification proposed in response to this RFP can be made secure in environments requiring security, answers to the following questions shall be provided:

* What, if any, are the security sensitive elements that are introduced by the proposal?
* Which accesses to security-sensitive elements must be subject to security policy control?
* Does the proposed service or facility need to be security aware?
* What default policies (e.g., for authentication, audit, authorization, message protection etc.) should be applied to the security sensitive elements introduced by the proposal? Of what security considerations must the implementers of your proposal be aware?

The OMG has adopted several specifications, which cover different aspects of security and provide useful resources in formulating responses. [CSIV2] [SEC] [RAD].

### Proposals shall specify the degree of internationalization support that they provide. The degrees of support are as follows:

a) Uncategorized: Internationalization has not been considered.

b) Specific to <region name>: The proposal supports the customs of the specified region only, and is not guaranteed to support the customs of any other region. Any fault or error caused by requesting the services outside of a context in which the customs of the specified region are being consistently followed is the responsibility of the requester.

1. Specific to <multiple region names>: The proposal supports the customs of the specified regions only, and is not guaranteed to support the customs of any other regions. Any fault or error caused by requesting the services outside of a context in which the customs of at least one of the specified regions are being consistently followed is the responsibility of the requester.
2. Explicitly not specific to <region(s) name>: The proposal does not support the customs of the specified region(s). Any fault or error caused by requesting the services in a context in which the customs of the specified region(s) are being followed is the responsibility of the requester.

## Evaluation criteria

Although the OMG adopts model-based specifications and not implementations of those specifications, the technical viability of implementations will be taken into account during the evaluation process. The following criteria will be used:

### Performance

Potential implementation trade-offs for performance will be considered.

### Portability

The ease of implementation on a variety of systems and software platforms will be considered.

### Securability

The answer to questions in section 5.1.13 shall be taken into consideration to ascertain that an implementation of the proposal is securable in an environment requiring security.

### Conformance: Inspectability and Testability

The adequacy of proposed specifications for the purposes of conformance inspection and testing will be considered. Specifications should provide sufficient constraints on interfaces and implementation characteristics to ensure that conformance can be unambiguously assessed through both manual inspection and automated testing.

### Standardized Metadata

Where proposals incorporate metadata specifications, usage of OMG standard XMI metadata [XMI] representations must be provided as this allows specifications to be easily interchanged between XMI compliant tools and applications. Since use of XML (including XMI and XML/Value [XML/Value]) is evolving rapidly, the use of industry specific XML vocabularies (which may not be XMI compliant) is acceptable where justified.

# Specific Requirements on Proposals

## Problem Statement

Centralizing a corporation was once considered an efficient way to run an enterprise. Decisions and information processing occurred in an orderly, top-down, hierarchical manner. However, we are no longer in the era of mainframe computing, when both companies and applications were typically command-and-control oriented and organized in vertical silos. With the combination of the Internet, fiber optics, and PCs, the business and technology playing field has been flattened. No longer primarily top down, it has changed to more side by side—as individuals, small groups, and organizations interact around the world. Furthermore, globalization and changes in technology are causing today’s market to be in a state of constant flux. Companies that cannot adapt fast enough to thrive in new markets will be left behind.

Agent technology is a primary enabler to support this new era. In fact, *without* agent technology, our current technology will not scale to support the ever-increasing global interaction. In response, many companies are now building agent-based systems. These systems employ agents that can distribute functionality across a vast computing network. Furthermore, agents can not only adapt to their environment but also evolve by learning from the environment. In short, they are the ultimate in distributed computing. Such an approach prepares enterprises for an increasingly complex marketplace and enables them to respond rapidly to change.

The biggest breakthrough with agents is that they are an *evolution* of existing technologies. What makes it *revolutionary* is the way we think about and use agents to design IT systems. They are being built *from* today's technology and will work together *with* today's technology. While agents, objects, relational databases, legacy systems, service-oriented architectures, event-driven approaches, and so on each have their own niche, together they can orchestrate rich systems that none of these technologies could provide alone. For example, this RFP optionally requests support for Goal, P2P, and Cloud and Grid modeling for agents. While these technologies are general in nature, agent-based approaches can be used to support, enable and exploit these technologies in new and useful ways.

## Scope of Proposals Sought

The primary goal of this RFP is to provide a foundation to enable the use of agent technology that can:

* Model agents and agent-enabled constructs that can aid in the design of agent-based systems and emphasize how they will interact and collaborate.
* Be used in conjunction with existing and upcoming OMG technologies, like UML, the UML Profile and Metamodel for Services (UPMS) and the Event Metamodel and Profile (EMP).
* Be completed in a timely manner (approximately one year). Multiple follow-on agent-related RFPs can be planned and issued over time. Here, each RFP needs to be tangible and deliverable in a timely manner and carefully coordinated with the other agent-related RFPs

This RFP, then, is the first in a series of agent-related RFPs. As such, it seeks to address those basic foundational elements of agent technology that are both commonly used and can be defined in a reasonable amount of time.

Submissions developed in response to this RFP will achieve the following:

* Provide a MOF-compliant agent metamodel and UML Profile that treats agents as first-class entities, and extends the existing UML metamodel with agent-modeling capabilities and a consistent UML Profile.
* May provide an optional model librarythat extends UML 2 for agents.
* Supporting the interchange of agent models between tools using XMI.
* Compiling a standard glossary of terms that is agent related.

## Related OMG Specifications, Documents and Activities

### Available OMG Specifications

Proposals are expected to be consistent with, extend or, in justified cases, override the following specifications. In each case, the most recent version is applicable unless the most recent version was adopted less than three months before the final submission to this RFP.

#### Notification / JMS Interworking

The JMS Interworking standard involves several agent-related aspects such as: automatic federation between Notification Service channel concept and topic/queue concepts; and transaction support.   
(OMG document formal/2004-10-11)

#### Production Rules Representation (PRR) (in finalization)

Production Rules Representation specifies Condition - Action rulesets that are a generalization of Event – Condition – Action rulesets. Both types can be used in agent processing models. (OMG document dtc/2007-11-04)

#### SysML

The OMG Systems Modeling Language (OMG SysML™) is a UML profile for specifying, analyzing, designing, and verifying complex systems that may include hardware, software, information, personnel, procedures, and facilities. (OMG document formal/2007-09-01)

#### Unified Modeling Language (UML)

The standard Unified Modeling Language (UML) defines a modeling language for visualizing, specifying, constructing, and documenting the artifacts of distributed object systems. (OMG document formal/2007-11-03 and formal/2007-11-04)

#### UML Profile for Schedulability, Performance and Time

Specifies a UML profile that defines standard representations for modeling of time-, schedulability-, and performance-related aspects of real-time systems, (OMG document [formal/2005-01-02](http://www.omg.org/cgi-bin/doc?formal/2005-01-02) )

#### UML Profile for Modeling and Analysis of Real-time and Embedded Systems (MARTE)

Adds capabilities to UML for model-driven development of Real Time and Embedded Systems (RTES). This extension, called the UML profile for MARTE (in short MARTE), provides support for specification, design, and verification/validation stages. This new profile is intended to replace the existing UML Profile for Schedulability, Performance and Time.   
(OMG document formal/03-09-01).

#### Meta Object Facility (MOF)

MOF is an extensible model driven integration framework for defining, manipulating and integrating metadata and data in a platform independent manner. MOF-based standards are in use for integrating tools, applications and data. (OMG document formal/2006-01-01)

#### Business Process Modeling Notation (BPMN)

BPMN provides a Business Process Diagram (BPD), which is a Diagram designed for use by the people who design and manage business processes. BPMN also provides a formal mapping to an execution language of BPM Systems (BPEL4WS). In short, BPMN provides a standard visualization mechanism for business processes defined in an execution optimized business process language. The document deals with several specific exchange patterns that may be of interest for Agents. (OMG document formal/2008-01-17)

#### Business Process Definition Metamodel (BPDM)

BPDM provides the capability to represent and model business processes independent of notation or methodology, thus bringing these different approaches together into a cohesive capability. Using BPDM, various tools, methods and technologies can map their way to view, understand and implement processes to and through BPDM. The document deals with several specific exchange patterns that may be of interest for Agents.   
(OMG document dtc/08-05-07)

#### Data Distribution Service (DDS)

Predictable distribution of data with minimal overhead is of primary concern to these real-time applications. Since it is not feasible to infinitely extend the needed resources, it is important to be able to specify the available resources and provide policies that allow the middleware to align the resources to the most critical requirements. The document deals with several specific exchange patterns that may be of interest for Agents.   
(OMG document formal/2007-01-01)

#### UML Profile for Data Distribution

Specifies a UML Profile for the analysis and design of object-oriented systems using Data Distribution Service. The document deals with several specific exchange patterns that may be of interest for Agents.   
(OMG document ptc/08-07-02)

#### UML Profile for Modeling QoS and Fault Tolerance Characteristics

These extensions reduce the problems of UML 2.0 for the description of Quality of Service and Fault-Tolerance properties, and integrate the extensions in two basic general frameworks (QoS Modeling Framework, and FT Modeling Framework). The general framework for the description of QoS requirements and properties gives the support to describe vocabulary that is used in high quality technologies (e.g., real-time, fault-tolerant).   
(OMG document formal/2008-04-05)

#### Business Motivation Model (BMM)

The Business Motivation Model specification provides a scheme or structure for developing, communicating, and managing business plans in an organized manner. Specifically, the BMM does all of the following:

• It identifies factors that motivate the establishing of business plans.

• It identifies and defines the elements of business plans.

• It indicates how all these factors and elements inter-relate.

(OMG document dtc/06-08-03)

### Other OMG Documents and Work in Progress

#### UML Profile and Metamodel for Services “SoaML” (UPMS) (work in progress)

A UML Profile and Metamodel for Services “SoaML” submission for a developing OMG standard for modeling services using an SOA is currently underway.   
The Agent class is specified as an SOA Participant. As such, UPMS submissions should consider this when it extends the existing UML metamodel with agent-modeling capabilities.   
(OMG document ad/08-05-03)

#### Executable UML (work in progress)

The Executable UML RFP solicits a definition of a computationally complete and compact subset of UML 2.0, along with a full specification of the execution semantics of this subset.   
Executable models based on a foundational subset of UML, then, may provide a highly useful mechanism for agents and agent-based approaches.   
(OMG document ad/08-05-02)

#### Event Metamodel and Profile (EMP) Request for Proposal

The Event Metamodel and Profile (EMP) RFP solicits proposals for an extension of OMG specifications with Event modeling capabilities.   
The monitoring, detecting, analyzing, aggregating, and otherwise processing of events is commonly handled using agent-based techniques. Furthermore, events are an important technique for agents to “perceive” and act on their environment. Therefore, coordination with the EMP specification effort is recommended, if at all possible. (OMG document ad/08-05-03)

## Related Non-OMG Standards, Documents and Activities

Standards for agents and agent-based applications are incomplete. Organizations such as the Organization for the Advancement of Structured Information Systems (OASIS), the World Wide Web Consortium (W3C), FIPA (Foundation of Intelligent Physical Agents), and the OMG have taken steps toward more standards that will help agent and agent-based applications. Submissions to the AMP RFP do not require consistency with the documents below. However, their usefulness should be considered for AMP, as they indicate and provide direction from an already-existing marketplace.

### Java Agent Services (JSR-87) Specification (JCP standard)

The Java Agent Services (JSR-87) Specification was developed as part of the Java Community Process (JCP2) initiative. JSR-87 defined the Java Agent Services architecture, or JAS, as a set of interfaces supporting the deployment and operation of agent-based distributed software. The architecture supports message composition, transport services, directory services and encoding services required to manage distributed agent populations in a scalable, interoperable fashion. JSR-87 was started in December 2000 issue interim specifications, but was never completed or adopted  
http://jcp.org/en/jsr/detail?id=87

### Web Services Architecture (WSA) (Effort terminated)

The W3C’s “Web Services Architecture” working group produced a document (Note 11 February 2004) that addressed agents within web services. However, effort ceased after one year. http://www.w3.org/TR/ws-arch/

### Reference Architecture for Service Oriented Architecture SOA-RA (work in progress)

An OASIS effort is currently in progress and elements of agents in the SOA-RA document. This effort is based on the earlier basic foundation of the SOA-RM (Reference Model for Service Oriented Architecture). The SOA-RA provides a bridge between the concepts and vocabulary defined by the SOA Reference Model (SOA-RM) and the implementation of a SOA. In other words, the SOA reference architecture models the abstract architectural elements for a SOA independent of the technologies, protocols, and products that are used to implement a SOA. (Note: the SOA-RM does not contain the Agent concept.)  
http://docs.oasis-open.org/soa-rm/soa-ra/v1.0/soa-ra-pr-01.pdf

### FIPA Agent Communication Language (ACL)

This normative FIPA specification deals with Agent Communication Language (ACL) messages, message exchange interaction protocols, speech act theory-based communicative acts and content language representations.  
<http://www.fipa.org/specs/fipa00061/SC00061G.pdf> *and* <http://www.fipa.org/specs/fipa00037/SC00037J.pdf>

### KQML Agent Communication Language (ACL)

This document is a draft of an initial specification for the KQML agent communication language being developed by the external interfaces working group of the DARPA Knowledge Sharing Effort. KQML is intended to be a high-level language to be used by knowledge-based system to share knowledge at run time. <http://www.cs.umbc.edu/kqml/papers/kqmlspec.pdf>

### SOA Ontology

This document is the Draft Technical Standard for Service-Oriented Architecture Ontology. It has been developed by The Open Group. <http://www.opengroup.org/projects/soa-ontology/doc.tpl?CALLER=index.tpl&gdid=16940>

## Mandatory Requirements

Background material to the following sections can be found in 6.1 and 6.2.

### Required Metamodel and Profile

#### Submissions shall provide a MOF metamodel and a UML Profile for Agent Modeling with capabilities further specified in the following requirements. The metamodel and UML profile shall be consistent with each other.

### Agent Messaging

#### Submissions shall provide a means for messaging that can be used for agent interaction. The main requirement is the ability to deal with messaging at the modeling level. Such message should also include agent-related aspects, such as multi-send and multi-receive. This mandatory item is not requesting a normative Agent Communication Language (ACL, in glossary); instead it requests a specification of modeling elements, concepts, and notations necessary to support agent-based message content, as well as the sending and receiving of agent-based messages. (Note: an ACL specification is expected to be a result of a forthcoming ACL RFP.)

#### Submissions shall provide capabilities that model message interaction patterns.

### Agent extensions for Modeling Languages

#### Submissions shall provide modeling capabilities to represent roles for agents (see *role* in Glossary A.2). This will include, the ability to represent roles as elements in their own right. The underlying representation must be able to support multiple roles assignments with agents.

#### Submissions shall provide modeling capabilities for dynamic assignment of roles to agents (i.e., where roles can change over time for an agent).

#### Submissions shall provide modeling capabilities to represent agent groups in their different forms (such as teams, organizations, institutions, holonic organizations, and so on).

#### Submission shall provide notations for representing the notion of environment, and ways in which agents can perceive and act on that environment.

#### Submissions shall provide modeling capabilities defining the usage of resources by agents. These resources can represent internal resources, external resources, and resources in the environment.

### Notation

#### Submissions shall specify a notation, reusing UML2 symbols where appropriate. The notation shall follow the guidelines for UML-2 notations and shall not conflict with any existing UML-2 notation.

### Reflection of Capabilities

#### Submissions shall provide modeling capabilities to define a unified reflection mechanism for agent capabilities. Using or extending MOF reflection or the Executable UML Models specification may apply here. NOTE: This mandatory requirement applies to agents, in general. However, individual agents may decline to provide reflection on a case-by-case basis based on their choice (e.g., a requester of reflection information is not authorized to know).

#### Submissions shall provide modeling capabilities to specify interoperable definitions of agent identity and agent capabilities. (The UPMS specification provides a basic modeling foundation for this. )

### Platform Independent

#### Submissions shall express the intent of agent models rather than any specific means by which that intent may be realized by some runtime platform.

### Agent Model Interchange

#### The resulting metamodel and profile shall be made available as an XMI documents based on the UML and MOF to XMI mapping specifications and the UML rules for exchanging profiles using XMI.

#### Instances of the agent metamodel shall be exchanged using XMI as specified in the MOF to XMI mapping specification. Instances of agent models created using the equivalent UML profile shall be exchanged using XMI as specified by the UML rules for exchanging instances of UML models with applied profiles. Submissions shall define interchange compliance levels for each for these XMI document formats.

### Glossary of Agent Terms

#### Submissions shall provide a glossary of terms for Agents that can be used to support interoperability. At a minimum, submissions will provide an alphabetical list of technical terms that specifically relate to agents and agent-based systems addressed by a submission to this RFP. However, submissions may provide a formal agent ontology, in addition. (Use of OMG's SBVR standard should be considered in developing this glossary.)

## Optional Requirements

The following requirements would enhance the value of a specification but are not mandatory.

### Alternative Notations

#### Submissions may extend UML to represent the modeling of internal and external behavior for agents. Such extensions may include languages that are based on UML, including (but not limited to) SysML, and Executable UML (6.3.1.3 and 6.3.2.2)

### Mappings to Existing Platforms and Languages

#### Proposals may provide mappings to existing implementation platforms and languages for agent specification and execution.

### Optional Model Library

#### Submissions may provide an optional model library that extends UML 2 for agents.

### Agent Messaging

#### Submissions may suggest ways of employing and adapting existing agent communication languages and when to use them. (For examples of ACLs, see 6.4.4 and 6.4.5)

### Agent-Supporting Notions (that are useful for agents but not necessary for this RFP)

#### *Goals* – Submissions may provide a way to model and specify goals. This can include languages for specifying goals, goal relationships, and the attributes to describe and quantify them. This view should support the modeling of goal hierarchies, enable the introduction of different types of goals (e.g., so-called soft and hard goals) and should enable goals to be associate with plans (see *plan* in the Glossary A.2). The notion of goal may also reflect similar notions such as objective, critical success factor (CSF), and key performance indicators (KPIs). Additionally, the submission can provide a language for relating the goals to agents, roles, organizations, processes, plans, and any other modeling construct deemed appropriate. In the OMG context it would be interesting to link to the objectives and goals within the BMM model (6.3.1.8 & 6.3.1.9). It is also necessary to include BDI support (See *BDI* in glossary, Appendix A) where intentions are related to goals.

#### *Ontology* - Submissions may provide non-normative suggestions for enablers in specifying ontology using ODM that can be employed by and applied to agent-based usage (e.g., ACL). If an approach other than ODM is chosen, the decision to do so shall be justified.

#### *P2P (Peer-to-Peer)* - Submissions may provide the modeling constructs needed by agents and agent-based approaches to support, enable, and exploit P2P, and include agent-based service and interaction modeling for P2P design.   Note: any specification for peer groups should be consistent with the submission’s specification for modeling of agent groups.

#### *Grid and Cloud -* Submission*s* may provide the modeling constructs needed by agents and agent-based approaches support, enable, and exploit Grid and Cloud, and include agent-based service and interaction modeling for Grid and Cloud design. Note: any specification for representing Grid and Cloud service modeling as distributed resources should be consistent with the submission’s specification of resources by agents.

#### *Other -* Submissions may provide non-normative suggestions for languages and techniques for any other notions that will support, enable or exploit agents and agent-based systems.

## Issues to be discussed

These issues will be considered during submission evaluation. They should not be part of the proposed normative specification. (Place them in Part I of the submission.)

### Incorporating Academic Research Work

#### Specifications shall address the incorporation of existing University Research in such areas as terminology, use cases and reference architectures.

### Non-normative Use of Existing UML Constructs

#### Submissions shall address any non-normative use of existing UML constructs in order to model agents concepts.

### Compatibility with agent usage styles

#### Submissions shall address the issue of compatibility with different approaches to agent-based usage.

### Coordination with EMP Submission(s)

#### Many EMP and AMP submitters see synergistic possibilities the two submissions: handling and managing Events is an important feature of agent technology and employing Agents to support and enable Events is vital for Complex Event Process (CEP).

#### Separating APM and EMP in time is understandable, because of team coordination difficulties, in general.  However, both submissions are important for their own reasons and therefore to mandate a delay on one submission and not the other is neither fair nor efficient to those involved.

#### In lieu of a delay, the AMP and EMP submission teams should be directed to demonstrate good-will collaboration and coordination between/among the submission teams. Naturally, what submitters are able to say about this will depend a lot on the relative speed with which the two processes proceed. But notwithstanding, the AMP submitters will be expected to say something about its current state and its relation to the EMP submission—and visa versa.

## Evaluation Criteria

### Address an area of agent technology that is understood well enough to create such a document. Research and development for agents and agent-based systems is vital to producing effective and efficient agent systems. This RFP respects submissions that are vetted by the R&D community. However, it places importance on those approaches that have also demonstrated the practical and competent application of its principles in developed-and-delivered systems.

### Submissions that establish UML as the foundation for agent modeling and extend (i.e., define a new capability of) UML will be preferred.

### Submissions will be evaluated against the completeness of the mapping and the use of OMG MDA principles and related work such as MOF QVT and IMM (for XML Schemas).

### The precision, completeness, compactness, and clarity of the proposed specification for the purpose of implementing conforming tools for modeling services and ease of reviewing for correctness.

### The ability to draw notation elements easily by hand and use them in collaborative modeling sessions.

## Other information unique to this RFP

Not applicable.