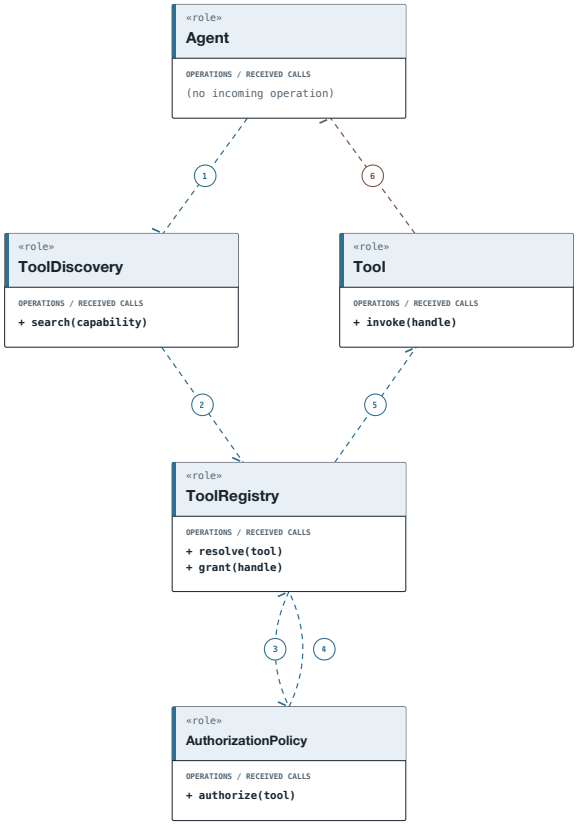
P09 Deferred tool loading

Primitive / UML CLASS VIEW / ANALYTICAL MODEL

Discover capabilities only when needed.

UML CLASS VIEW

dashed arrow: call dependency · brown: return/failure · analytical, not an observed trace



POINTCUT / PATTERN INTERFACE

CONTEXT	Available tools are too numerous or expensive to expose eagerly.
TRIGGER	The agent searches, discovers, or lazily resolves a tool.
STRUCTURE	Discovery descriptor, registry, authorization check, and invocation handle.
EFFECT	Tool schema is loaded on demand and authority is checked before execution.

CONTRACT / REQUIRED BEHAVIOR

REQUIRES	Tools have discoverable metadata and a stable invocation identity.
ENSURES	A discovered tool can be invoked once with its own schema and current permissions.
INVARIANT	Lazy loading does not cache a stale authorization decision.
VIOLATION	Unknown, stale, or unauthorized tools fail explicitly before side effects.

RELATIONSHIPS / ANALYTICAL CALLS

number · caller → callee · message

1 Agent → ToolDiscovery search(capability)
2 ToolDiscovery → ToolRegistry resolve(tool)
3 ToolRegistry → AuthorizationPolicy authorize(tool)
4 AuthorizationPolicy → ToolRegistry grant(handle)
5 ToolRegistry → Tool invoke(handle)
6 Tool ↩ Agent return(result)

VARIATION / TEST / NEGATIVE CONTROL

VARIATION	Search tool, registry, namespace, loading scope, and cache policy.
TEST_OBLIGATION	Test discovery latency path, missing tool, revoked permission, and schema refresh.
NEGATIVE_CONTROL	A large static tool list does not satisfy deferred loading.