

Graph Pattern	Hop Type	Expressions in $\mu - RA$
(a) - [FriendOf] -> (b), (b) - [Knows] -> (c)	One Hop And Branch	$\tilde{\pi}_m \left(\rho_{f_{id}}^m(F) \bowtie \rho_{p_{id}}^m(K) \right)$
(a) - [FriendOf] -> (b) - [FriendOf] -> (c), (b) - [Knows] -> (d)	Two Hops And Branch	$\tilde{\pi}_m \left(\rho_{f_{id}}^m(F) \bowtie \rho_{p_{id}}^m(F) \bowtie \rho_{p_{id}}^m(K) \right)$
(a) - [FriendOf] -> (b) - [FriendOf] -> (c), (c) - [FriendOf] -> (d), (c) - [Knows] -> (d)	Three Hops And Branch	$\tilde{\pi}_m \left(\rho_{f_{id}}^m \left(\tilde{\pi}_m \left(\rho_{f_{id}}^m(F) \bowtie \rho_{p_{id}}^m(F) \right) \bowtie \rho_{p_{id}}^m(F) \bowtie \rho_{p_{id}}^m(K) \right) \right)$
(a) - [FriendOf] -> (b) - [FriendOf] -> (c), (c) - [FriendOf] -> (d), (b) - [Knows] -> (d)	Three Hops And Branch	$\tilde{\pi}_{m,n} \left(\rho_{f_{id}}^m \left(\rho_{f_{id}}^m(F) \bowtie \rho_{p_{id}}^m(F) \right) \bowtie \rho_{f_{id}}^n(F) \bowtie \rho_{p_{id}}^m(K) \right)$
(a) - [FriendOf] -> (b) - [FriendOf] -> (c), (c) - [FriendOf] -> (d), (b) - [Knows] -> (d)	Three Hops And Branch	$\tilde{\pi}_{m,n} \left(\rho_{f_{id}}^m(F) \bowtie \rho_{p_{id},f_{id}}^{m,n}(F) \bowtie \rho_{p_{id}}^n(F) \bowtie \rho_{p_{id}}^m(K) \right)$
(a) - [FriendOf] -> (b) - [FriendOf] -> (c), (c) - [FriendOf] -> (d), (b) - [Knows] -> (e)	Three Hops And Two Branches	$\tilde{\pi}_{m,n} \left(\rho_{f_{id}}^m(F) \bowtie \rho_{p_{id}}^m \left(\rho_{f_{id}}^n(F) \right) \bowtie \rho_{p_{id}}^m \left(\rho_{k_{id}}^n(K) \right) \bowtie \rho_{p_{id}}^n(F) \bowtie \rho_{p_{id}}^n(K) \right)$
(a) - [FriendOf] -> (b) - [FriendOf] -> (c), (b) - [FriendOf] -> (d), (b) - [Knows] -> (e)	Star (Isomorphism based semantics)	$\tilde{\pi}_m \left(\sigma_{k < k_{id}} \left(\rho_{f_{id}}^m(F) \bowtie \rho_{p_{id}}^m(F) \bowtie \rho_{p_{id}}^m(K) \bowtie \rho_{p_{id}}^m \left(\rho_{k_{id}}^n(K) \right) \right) \right)$
(a) - [FriendOf] -> (b) - [FriendOf] -> (c), (b) - [FriendOf] -> (d), (b) - [Knows] -> (e)	Star (Homorphism based semantics)	$\tilde{\pi}_m \left(\rho_{f_{id}}^m(F) \bowtie \rho_{p_{id}}^m(F) \bowtie \rho_{p_{id}}^m(K) \bowtie \rho_{p_{id}}^m \left(\rho_{k_{id}}^n(K) \right) \right)$