

# Queueless, Uncentralized Resource Discovery: Formal Specification and Verification

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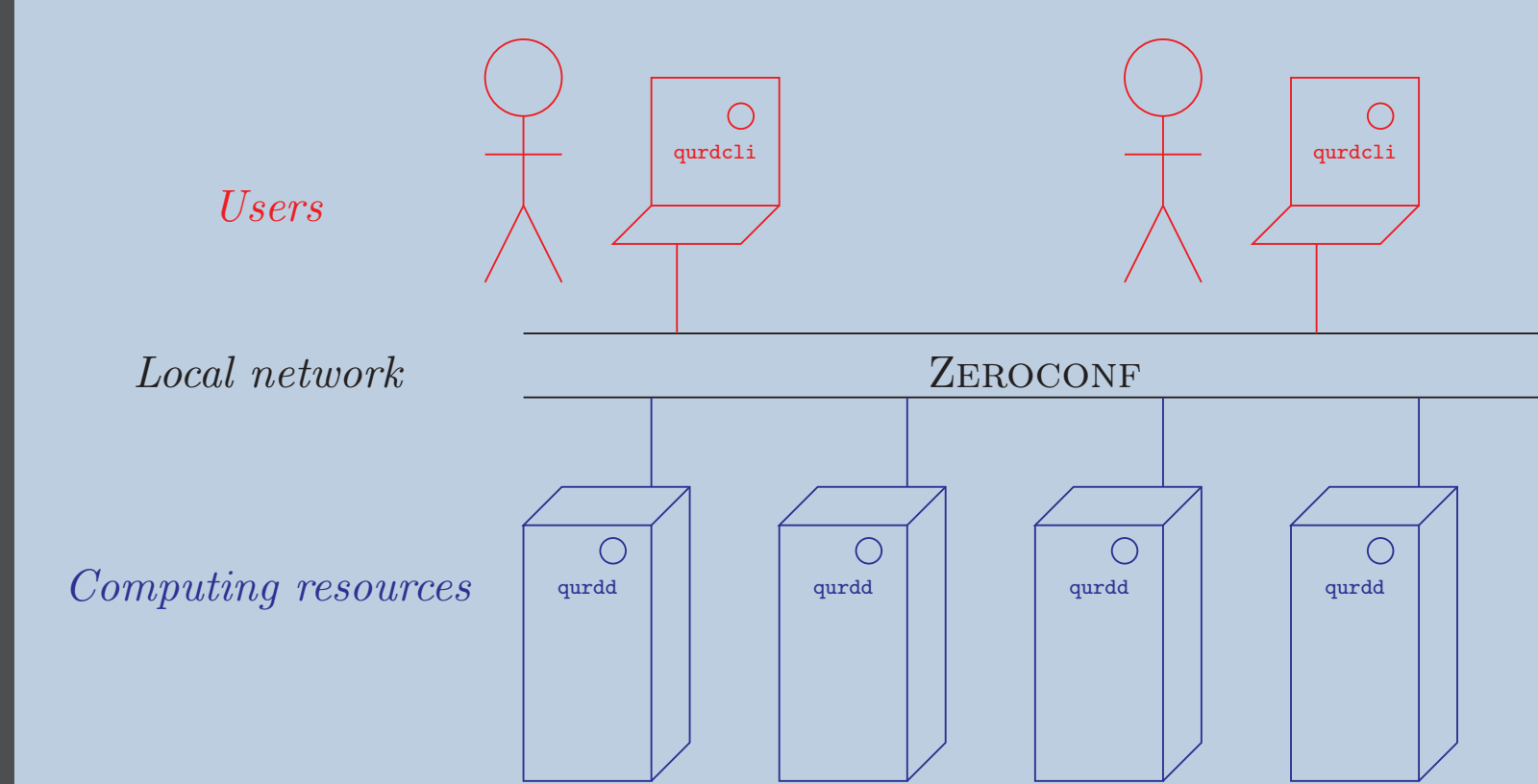
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## QURD Architecture

Discover available computing resources

- On the same network
- With *no centralized* reservation system



Relies on the Zeroconf protocol [1]

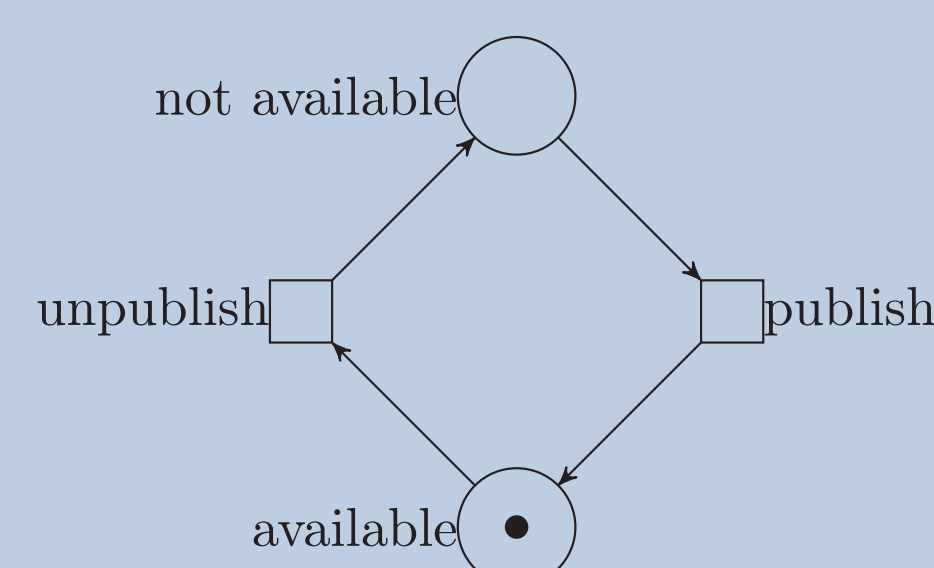
## Reservation semantics

Two reservation semantics:

- Wait until all the resources are obtained
- Return nothing if not enough machines are available

## Zeroconf model

Machines can withdraw from the Zeroconf bus and come back again



## Property specification

Generic properties:

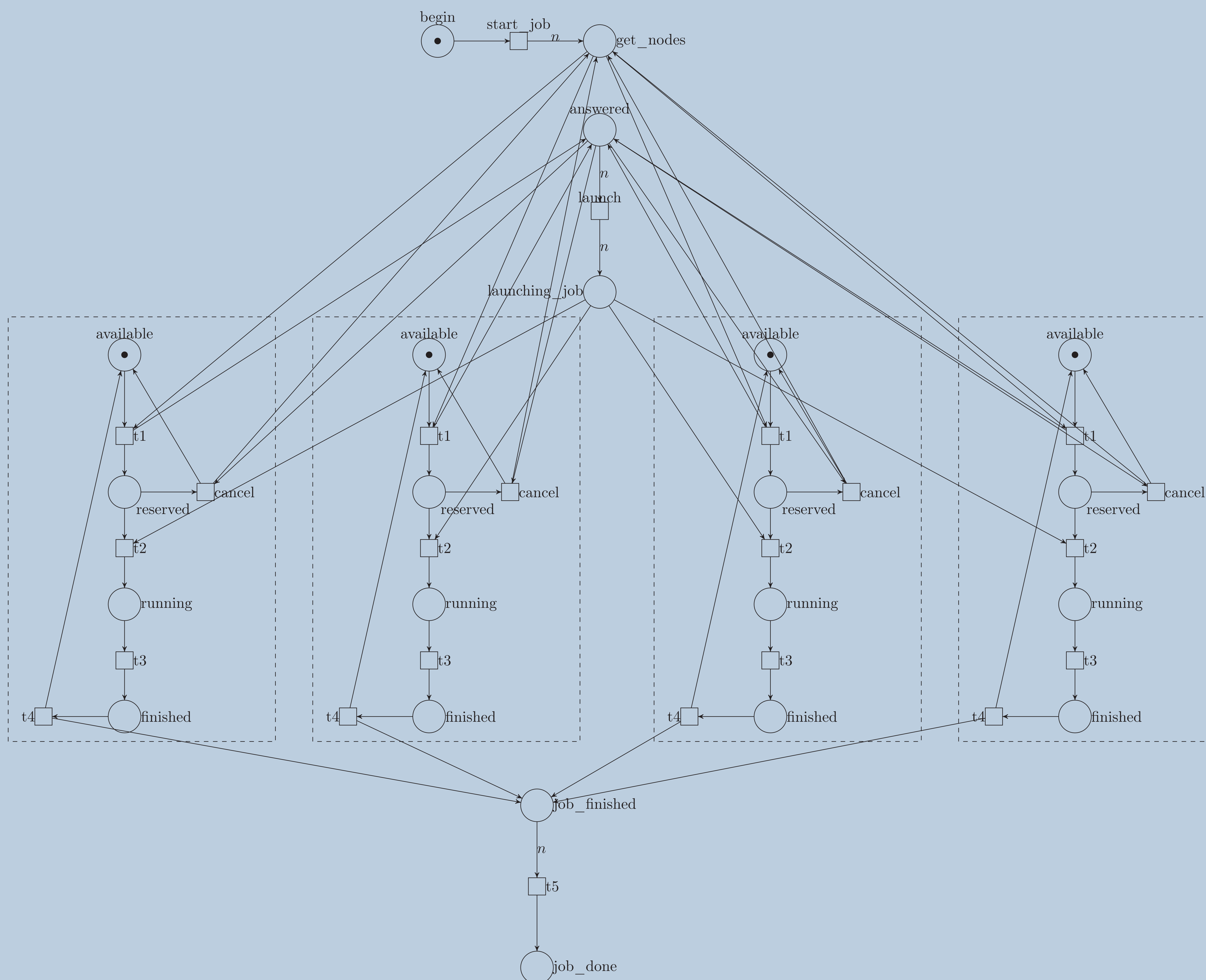
- Soundness: proper completion, option no complete, no dead transition
- Boundedness
- Deadlock freeness

Specific properties:

- Exclusive access to the resources
- Eventually, all the applications complete

Can include timers (execution, timeout) and be expressed in TCTL.

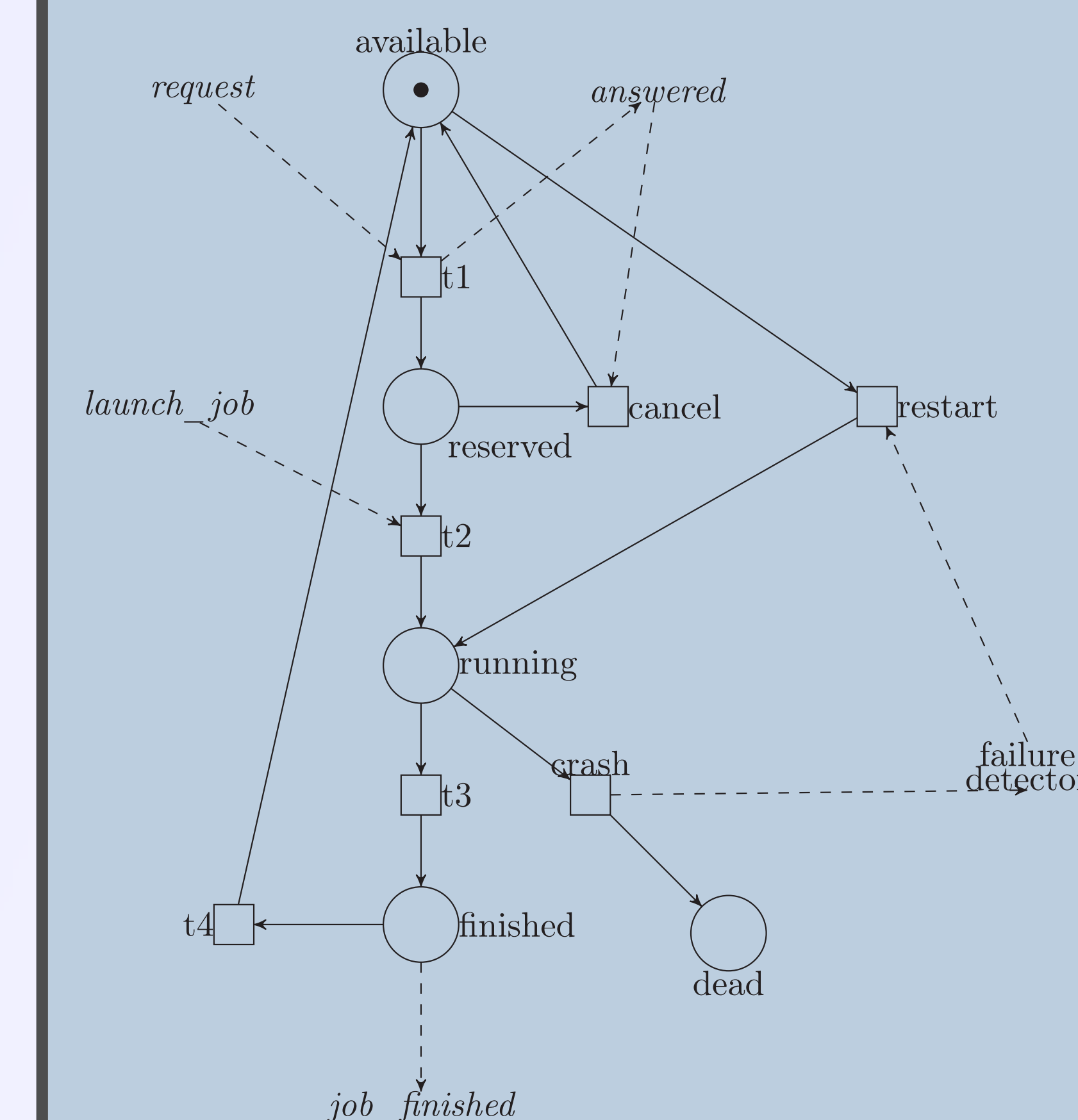
## QURD Model



## Fault tolerance

Handling machine failures:

- Failure detector
- Restart the failed processes on new resources



Jobs may not terminate after failures

- If not enough resources are available after the crash
- Eventually, the machine can be rejuvenated (human intervention)

## Analysis

J	M	P	Time	States	Term.	Arcs
4	3	1	2.50	4,564	1	8,388
5	3	1	2.49	18,357	1	34,165
6	3	1	2.60	64,966	1	121,734
4	6	4	3.92	1,369,236	1	2,849,412
5	6	4	13.10	8,407,677	1	17,557,805
6	6	4	85.25	43,094,470	1	90,124,518

State state analysis

- J = jobs, M = machines, P = machines per job
- Using Helena [3]

## References

- [1] Zero configuration networking (zeroconf). <http://www.zeroconf.org>.
- [2] Camille Coti, Sami Evangelista, and Kais Klai. Time petri net models for a new queueless and uncentralized resource discovery system. *CoRR*, abs/1502.03431, 2015.
- [3] Sami Evangelista. High Level Petri Nets Analysis with Helena. In *ATPN'2005*, volume 3536 of *LNCS*, pages 455–464. Springer, 2005.