

Center for Quantum Networks

NSF Engineering Research Center

The Virtual Testbed

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UNIVERSITY OF
MARYLAND

University of
Massachusetts
Amherst

RE REVOLUTIONARY



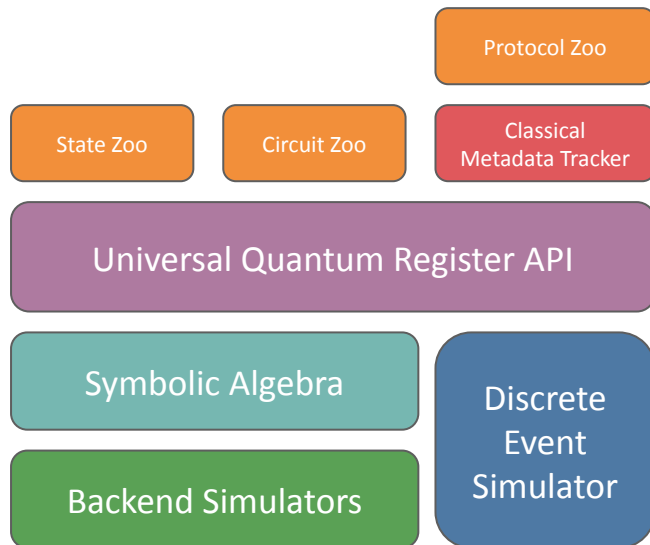
NAU
NORTHERN
ARIZONA
UNIVERSITY



UNIVERSITY OF
OREGON



System Integration Stage i.e. The whole is greater than its parts





User Story – Integration between Thrusts

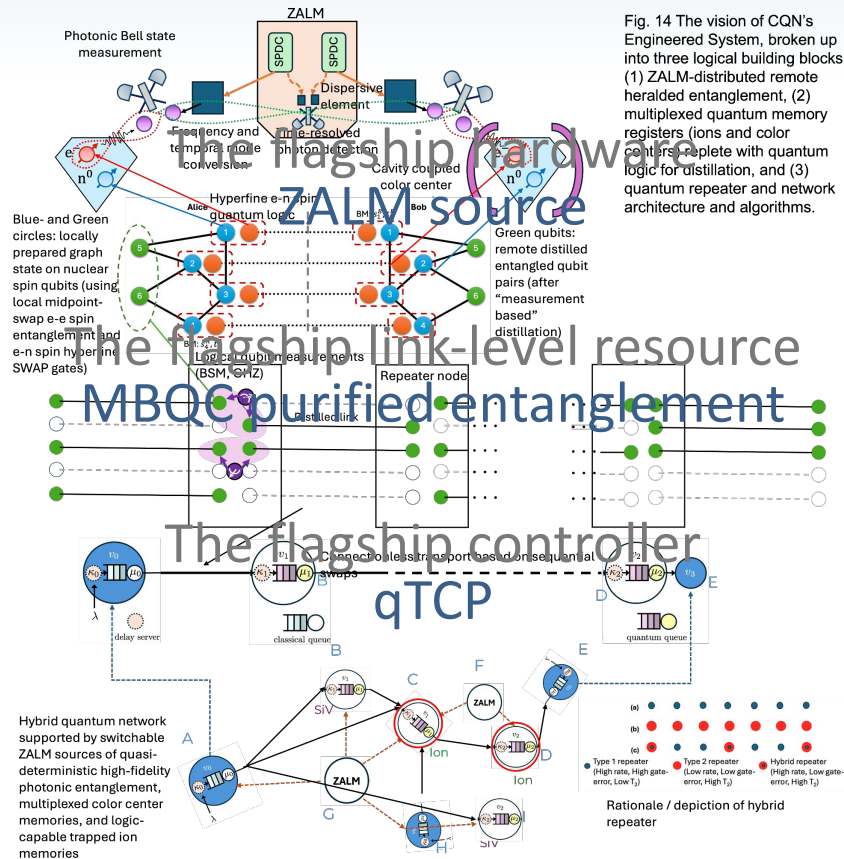
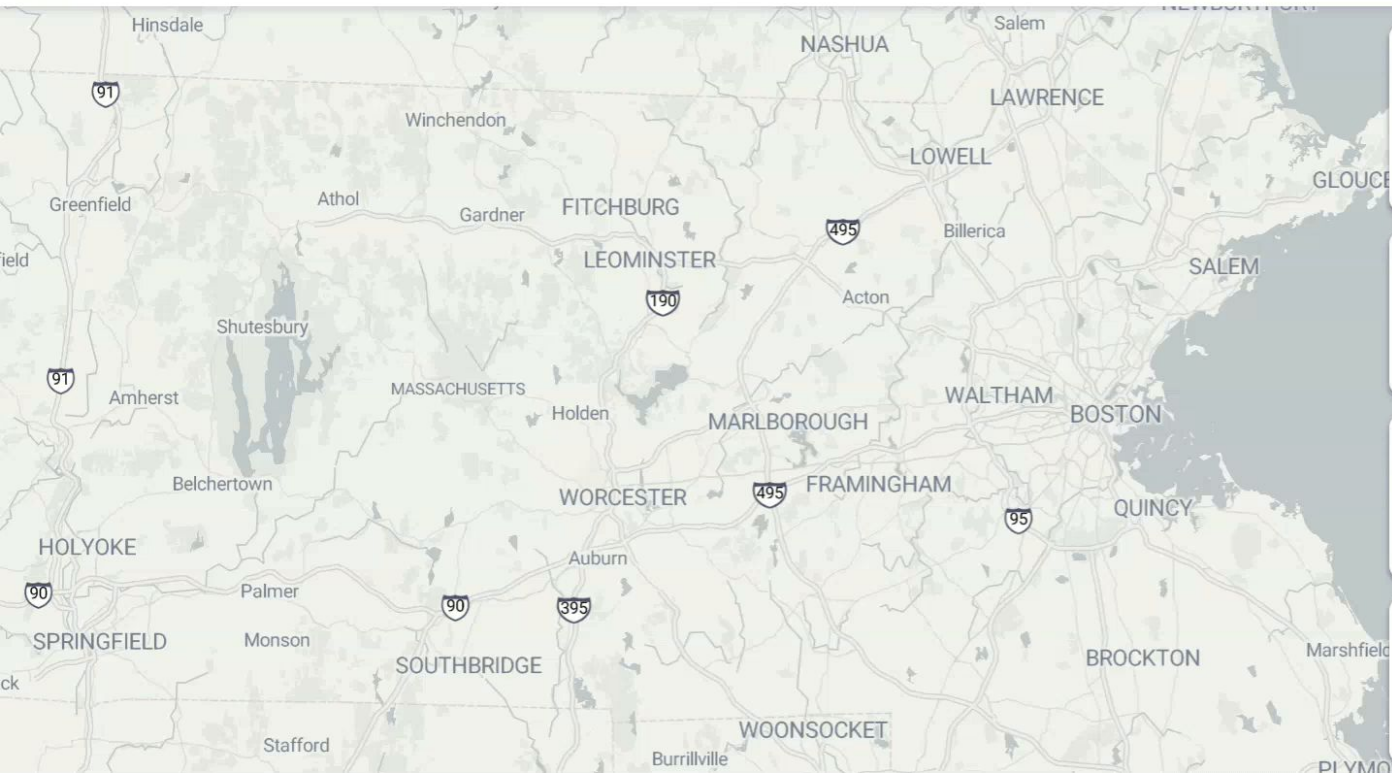


Fig. 14 The vision of CQN's Engineered System, broken up into three logical building blocks: (1) ZALM-distributed remote heralded entanglement, (2) multiplexed quantum memory registers (ions and color centers) complete with quantum logic for distillation, and (3) quantum repeater and network architecture and algorithms.



Simulation Runner

Time: 1s



Parse Graph Prepare Run

Selected Element

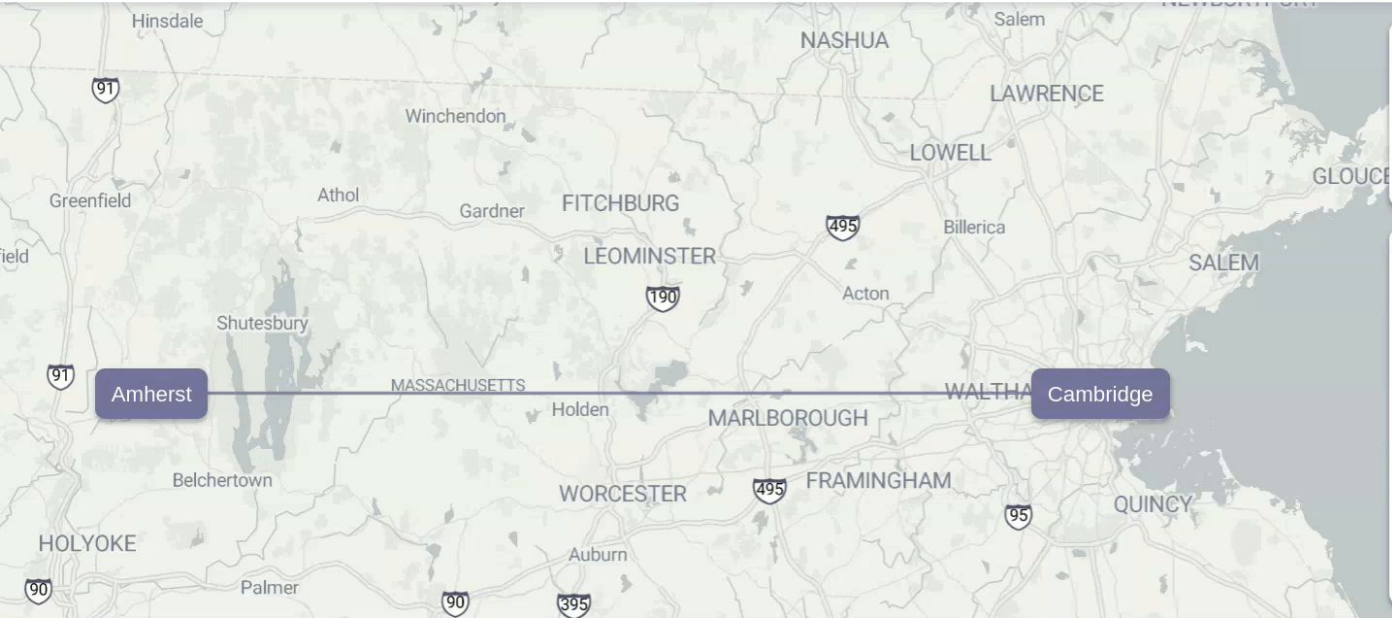
Nothing selected

Nodes

No nodes

Edges

No edges



Simulation Runner

Time: 1s

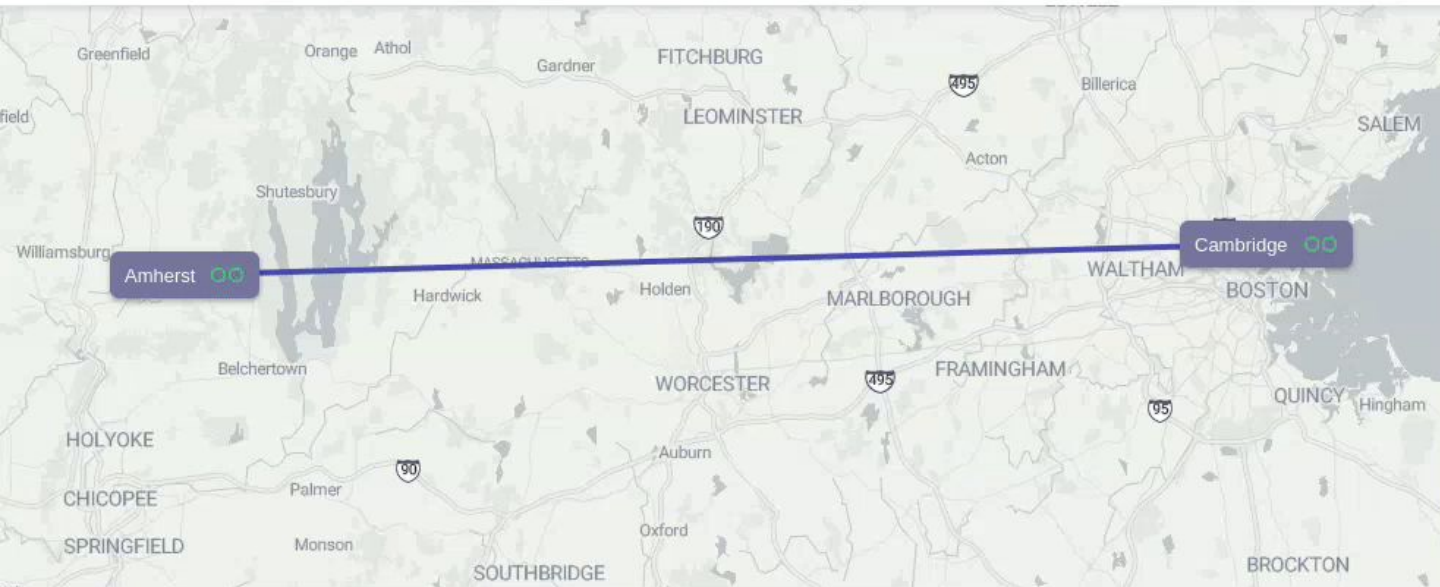
Parse Graph

Prepare

Run

Selected Element

Nothing selected



Simulation Runner

Time: 1s



Parse Graph

Prepare

Run

Selected Edge

Cambridge

Amherst

PROTOCOLS (1)

EntanglerProt

pairstate default

success_prob default

attempt_time default

local_busy_time_pre default

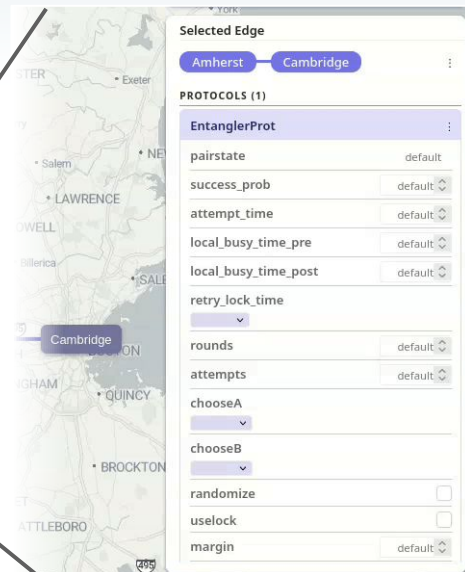
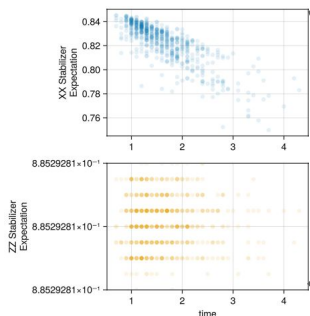
Friendly abstractions both in GUI and Scripting

```
regA = Register(2)
regB = Register(2)
net = RegisterNet([regA, regB])
sim = get_time_tracker(net)

entangler = EntanglerProt(sim, net, 1, 2)
@process entangler()
consumer = EntanglementConsumer(sim, net, 1, 2)
@process consumer()

run(sim)

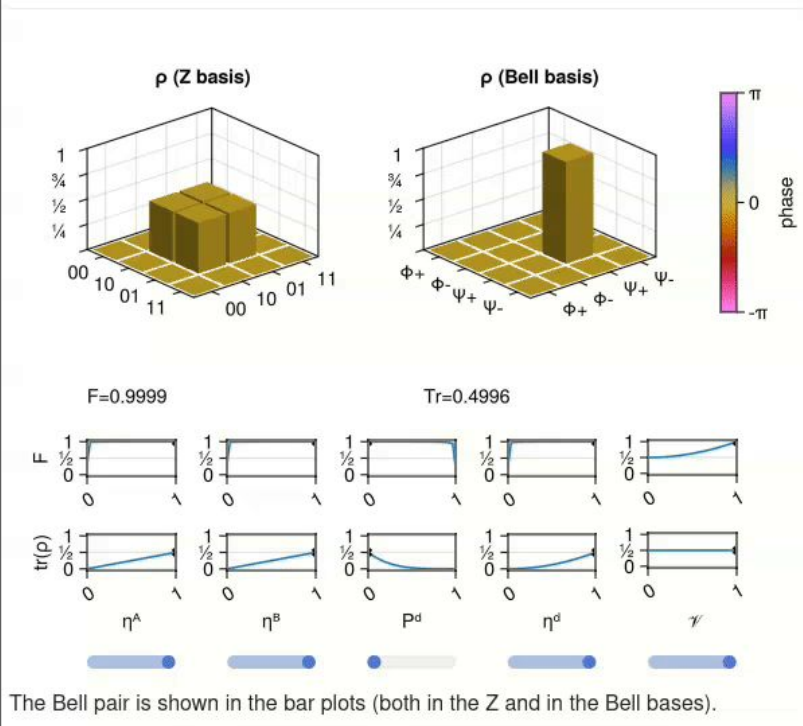
show(..., consumer)
```





Common Entanglement Models

BarrettKokBellPairW



Arbitrary symbolic states

and

Highly Parameterized Intricate Models

Barret Kok

SPDC

ZALM

...

Integrating many
T2&T3 research results



Available Protocols

Entangler / Swapper / Information Tracker / Purifier / Consumer

Simple Switch (Yale)

Graph Preparer (Arizona/Maryland)

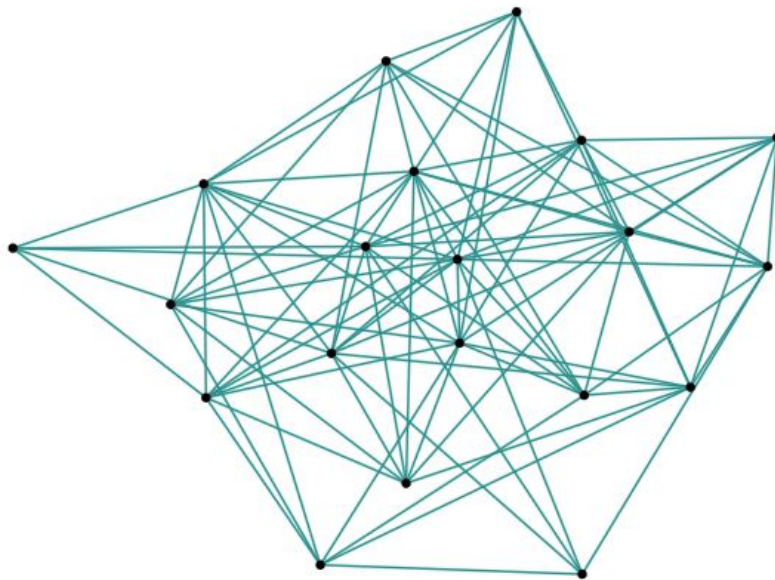
Piecemaker / GHZ distributor (Amherst)

qTCP: link controller, node controller, end node controller (Amherst)

Integrating many T1 research results

Advanced Compilation Capabilities

e.g. Optimal MBQC resource preparation



Independent Edge “coloring” for
maximizing network utilization



Running MBQC

- Pick a code
- Convert to graph state
- Optimize graph state compilation
- Compile graph state
- Run MBQC purification protocol



The Virtual Testbed

The flagship hardware
ZALM source

The flagship link-level resource
MBQC purified entanglement

The flagship controller
qTCP

Not Discussed:

State representation

QuantumSymbolics.jl

Gabs.jl

QuantumClifford.jl (non-Clifford too)

GPU acceleration

Simulation management

classical metadata management and queries

surrogates

stochastic autodifferentiation

Supplementary resources and databases

ECC database beyond the ECC Zoo

better entanglement distillation with optimizer UI

Community service

took over maintenance of Graphs software ecosystem

summer school

conference workshops

bounties program

Thrust 1 Protocols

optimal switches (Yale, UMass)

entanglement prep for sensor nets (Arizona)

projection based routing (Arizona)

qTCP (UMass)

MBQC resource prep (Arizona, UMass)