

# Simulation Results steps

Daniel Moreno Manzano

November 22, 2018

## 1 First Step

Table 1: Benchmark used

Benchmark	# qubits	# gates	two-qubit gates (%)
4gt11 <sub>82</sub>	5	27	67

Table 2: Step 1 results after 100 iterations

Mapper	Init. place	$t_1$	$t_2$	meas. err.	p. success	$f$	$V_Q$
No	No	3000	3000	0.03	0.99	0.98879	390
minextendrc	No	3000	3000	0.03	0.96	0.9404637	1582
minextendrc	Yes	3000	3000	0.03	0.98	0.9675513	1038
minextend	No	3000	3000	0.03	0.98	0.944128	1264
minextend	Yes	3000	3000	0.03	0.98	0.9585909	834
base	No	3000	3000	0.03	0.97	0.92331	1062
base	Yes	3000	3000	0.03	0.98	0.9568084	780

Table 3: Other mapper statistics

Mapper	Init. place	# qubits (after mapping)	depth	# SWAPS	# meetings in between
No	No	5	84	0	0
minextendrc	No	7	237	17	3
minextendrc	Yes	6	174	10	2
minextend	No	8	228	16	1
minextend	Yes	6	165	9	0
base	No	6	228	16	
base	Yes	6	147	7	



## 1.1 Routing comparison

### 1.1.1 No initial placement

#### With Resource constraints

---

```
1 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=10
2     path from source[1]=[2]
3     path from target[2]=[1->5] implying:
  ⇨ swap(q1,q5)
4 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=9
5     path from source[1]=[3]
6     path from target[2]=[2->0] implying:
  ⇨ swap(q2,q0)
7 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=20
8     path from source[3]=[4->7->5] implying:
  ⇨ swap(q4,q7) swap(q7,q5)
9     path from target[3]=[3->0->2] implying:
  ⇨ swap(q3,q0) swap(q0,q2)
10 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=9
11     path from source[1]=[0]
12     path from target[2]=[5->2] implying:
  ⇨ swap(q5,q2)
13 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=12
14     path from source[2]=[7->5] implying:
  ⇨ swap(q7,q5)
15     path from target[2]=[0->2] implying:
  ⇨ swap(q0,q2)
16 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=9
17     path from source[1]=[5]
18     path from target[2]=[0->2] implying:
  ⇨ swap(q0,q2)
19 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=9
20     path from source[1]=[5]
21     path from target[2]=[0->2] implying:
  ⇨ swap(q0,q2)
22 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=10
23     path from source[1]=[0]
24     path from target[2]=[5->2] implying:
  ⇨ swap(q5,q2)
25 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=13
26     path from source[2]=[0->2] implying:
  ⇨ swap(q0,q2)
27     path from target[2]=[7->5] implying:
  ⇨ swap(q7,q5)
28 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=10
29     path from source[1]=[2]
30     path from target[2]=[3->0] implying:
  ⇨ swap(q3,q0)
31 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=10
32     path from source[1]=[2]
33     path from target[2]=[3->0] implying:
  ⇨ swap(q3,q0)
34 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=10
35     path from source[1]=[7]
36     path from target[2]=[2->5] implying:
  ⇨ swap(q2,q5)
```

---

#### Without Resource constraints

---

```
1 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=10
2     path from source[1]=[2]
3     path from target[2]=[1->5] implying:
  ⇨ swap(q1,q5)
4 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=0
5     path from source[2]=[3->0] implying:
  ⇨ swap(q3,q0)
6     path from target[1]=[2]
7 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=9
8     path from source[3]=[4->1->5] implying:
  ⇨ swap(q4,q1) swap(q1,q5)
9     path from target[2]=[0->2] implying:
  ⇨ swap(q0,q2)
10 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=0
11     path from source[3]=[3->6->8] implying:
  ⇨ swap(q3,q6) swap(q6,q8)
12     path from target[1]=[5]
13 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=10
14     path from source[1]=[1]
15     path from target[2]=[8->5] implying:
  ⇨ swap(q8,q5)
16 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=10
17     path from source[1]=[1]
18     path from target[2]=[8->5] implying:
  ⇨ swap(q8,q5)
19 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=10
20     path from source[1]=[1]
21     path from target[2]=[8->5] implying:
  ⇨ swap(q8,q5)
22 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=10
23     path from source[1]=[8]
24     path from target[2]=[1->5] implying:
  ⇨ swap(q1,q5)
25 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=0
26     path from source[1]=[8]
27     path from target[2]=[2->6] implying:
  ⇨ swap(q2,q6)
28 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=8
29     path from source[1]=[8]
30     path from target[3]=[0->2->5] implying:
  ⇨ swap(q0,q2) swap(q2,q5)
31 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=4
32     path from source[1]=[8]
33     path from target[2]=[2->6] implying:
  ⇨ swap(q2,q6)
34 ... the minimally extending path with swaps is:
  ⇨ cycleExtend=2
35     path from source[2]=[1->5] implying:
  ⇨ swap(q1,q5)
36     path from target[1]=[8]
```

---

## 1.1.2 With initial placement

### With Resource constraints

---

```

1 ... Virt2Real(v->r) ... result Virt2Real map of
  ↳ InitialPlace before adding unused virtual
  ↳ qubits and unused locations : (0->10)
  ↳ (1->4) (2->1) (3->5) (4->7) (5->2147483647)
  ↳ (6->2147483647) (7->2147483647)
  ↳ (8->2147483647) (9->2147483647)
  ↳ (10->2147483647) (11->2147483647)
  ↳ (12->2147483647) (13->2147483647)
  ↳ (14->2147483647) (15->2147483647)
  ↳ (16->2147483647)
2 ... Virt2Real(v->r) ... final result Virt2Real
  ↳ map of InitialPlace: (0->10) (1->4) (2->1)
  ↳ (3->5) (4->7) (5->0) (6->2) (7->3) (8->6)
  ↳ (9->8) (10->9) (11->11) (12->12) (13->13)
  ↳ (14->14) (15->15) (16->16)
3 ... the minimally extending path with swaps is:
  ↳ cycleExtend=10
4     path from source[1]=[4]
5     path from target[2]=[10->7] implying:
  ↳ swap(q10,q7)
6 ... the minimally extending path with swaps is:
  ↳ cycleExtend=10
7     path from source[1]=[4]
8     path from target[2]=[10->7] implying:
  ↳ swap(q10,q7)
9 ... the minimally extending path with swaps is:
  ↳ cycleExtend=10
10    path from source[1]=[4]
11    path from target[2]=[10->7] implying:
  ↳ swap(q10,q7)
12 ... the minimally extending path with swaps is:
  ↳ cycleExtend=10
13    path from source[1]=[10]
14    path from target[2]=[4->7] implying:
  ↳ swap(q4,q7)
15 ... the minimally extending path with swaps is:
  ↳ cycleExtend=10
16    path from source[1]=[10]
17    path from target[2]=[5->8] implying:
  ↳ swap(q5,q8)
18 ... the minimally extending path with swaps is:
  ↳ cycleExtend=10
19    path from source[2]=[10->8] implying:
  ↳ swap(q10,q8)
20    path from target[2]=[1->5] implying:
  ↳ swap(q1,q5)
21 ... the minimally extending path with swaps is:
  ↳ cycleExtend=10
22    path from source[1]=[8]
23    path from target[2]=[7->5] implying:
  ↳ swap(q7,q5)
24 ... the minimally extending path with swaps is:
  ↳ cycleExtend=12
25    path from source[2]=[4->1] implying:
  ↳ swap(q4,q1)
26    path from target[2]=[8->5] implying:
  ↳ swap(q8,q5)

```

---

### Without Resource constraints

---

```

1 ... Virt2Real(v->r) ... result Virt2Real map of
  ↳ InitialPlace before adding unused virtual
  ↳ qubits and unused locations : (0->10)
  ↳ (1->4) (2->1) (3->5) (4->7) (5->2147483647)
  ↳ (6->2147483647) (7->2147483647)
  ↳ (8->2147483647) (9->2147483647)
  ↳ (10->2147483647) (11->2147483647)
  ↳ (12->2147483647) (13->2147483647)
  ↳ (14->2147483647) (15->2147483647)
  ↳ (16->2147483647)
2 ... Virt2Real(v->r) ... final result Virt2Real
  ↳ map of InitialPlace: (0->10) (1->4) (2->1)
  ↳ (3->5) (4->7) (5->0) (6->2) (7->3) (8->6)
  ↳ (9->8) (10->9) (11->11) (12->12) (13->13)
  ↳ (14->14) (15->15) (16->16)
3 ... the minimally extending path with swaps is:
  ↳ cycleExtend=10
4     path from source[1]=[4]
5     path from target[2]=[10->7] implying:
  ↳ swap(q10,q7)
6 ... the minimally extending path with swaps is:
  ↳ cycleExtend=10
7     path from source[1]=[4]
8     path from target[2]=[10->7] implying:
  ↳ swap(q10,q7)
9 ... the minimally extending path with swaps is:
  ↳ cycleExtend=10
10    path from source[1]=[4]
11    path from target[2]=[10->7] implying:
  ↳ swap(q10,q7)
12 ... the minimally extending path with swaps is:
  ↳ cycleExtend=10
13    path from source[1]=[10]
14    path from target[2]=[4->7] implying:
  ↳ swap(q4,q7)
15 ... the minimally extending path with swaps is:
  ↳ cycleExtend=0
16    path from source[1]=[10]
17    path from target[2]=[5->8] implying:
  ↳ swap(q5,q8)
18 ... the minimally extending path with swaps is:
  ↳ cycleExtend=8
19    path from source[1]=[10]
20    path from target[3]=[1->5->7] implying:
  ↳ swap(q1,q5) swap(q5,q7)
21 ... the minimally extending path with swaps is:
  ↳ cycleExtend=4
22    path from source[1]=[10]
23    path from target[2]=[5->8] implying:
  ↳ swap(q5,q8)
24 ... the minimally extending path with swaps is:
  ↳ cycleExtend=2
25    path from source[2]=[4->7] implying:
  ↳ swap(q4,q7)
26    path from target[1]=[10]

```

---

Table 4: Step 1 results after 1000 iterations

Mapper	Init. place	$t_1$	$t_2$	meas. err.	p. success	$f$	$V_Q$
No	No	3000	3000	0.03	0.96	0.97823066	390
minextendrc	No	3000	3000	0.03	0.929	0.92937318	1582
minextendrc	Yes	3000	3000	0.03	0.939	0.94685216	1038
minextend	No	3000	3000	0.03	0.947	0.9312172	1264
minextend	Yes	3000	3000	0.03	0.949	0.94748374	834
base	No	3000	3000	0.03	0.932	0.906571	1062
base	Yes	3000	3000	0.03	0.9509	0.9459456	780

## 2 1000 iterations

## 3 10000 iterations

Table 5: Step 1 results after 10000 iterations

Mapper	Init. place	$t_1$	$t_2$	meas. err.	p. success	$f$	$V_Q$
--------	-------------	-------	-------	------------	------------	-----	-------

## 4 Simplest benchmarks results