# Simulation Results steps

### Daniel Moreno Manzano

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## 1 First Step

	Table 1:	Benchmark used			
Benchmark	# qubits	# gates	two-qubit gates (%)		
$4gt11_{82}$	5	27	67		

Table 2: Step 1 results after 100 iterations

Mapper	Init. place	$t_1$	$t_2$	meas. err.	p. success	f	$\overline{V_Q}$
No	No	3000	3000	0.03	0.99	0.98879	390
minextendre	No	3000	3000	0.03	0.96	0.9404637	1582
$\operatorname{minextendrc}$	Yes	3000	3000	0.03	0.98	0.9675513	1038
$\min extend$	No	3000	3000	0.03	0.98	0.944128	1264
$\min extend$	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	# used qubits	depth	# gates	# SWAPS	# meetings in between
No	No	5	78	84	0	0
minextendrc	No	7	226	237	17	3
$\operatorname{minextendrc}$	Yes	6	173	174	10	2
$\min extend$	No	8	158	228	16	1
$\min extend$	Yes	6	139	165	9	0
base	No	6	177	228	16	
base	Yes	6	130	147	7	

#### 1.1 Routing comparison

#### 1.1.1 No initial placement

#### With Resource constraints

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

#### Without Resource constraints

```
... the minimally extending path with swaps is:
 1
      \hookrightarrow cycleExtend=10
             path from source [1] = [2]
 2
 3
             path from target[2]=[1->5] implying:
      \hookrightarrow swap(q1,q5)
     ... the minimally extending path with swaps is:
 4
          cycleExtend=0
             path from source[2]=[3->0] implying:
 5
          swap(q3,q0)
             path from target[1]=[2]
     ... the minimally extending path with swaps is:
      path from source [3]=[4->1->5] implying:
          swap(q4,q1) swap(q1,q5)
 9
             path from target[2]=[0->2] implying:
      \hookrightarrow swap(q0,q2)
10
     ... the minimally extending path with swaps is:
         cycleExtend=0
              path from source [3] = [3 -> 6 -> 8] implying:
11
          swap(q3,q6) swap(q6,q8)
12
             path from target[1]=[5]
     ... the minimally extending path with swaps is:
1.3
         cycleExtend=10
14
              path from source[1]=[1]
             path from target[2]=[8->5] implying:
1.5
      \hookrightarrow swap(q8,q5)
     ... the minimally extending path with swaps is:
16
         cycleExtend=10
             path from source[1]=[1]
17
             path from target[2]=[8->5] implying:
18
      \hookrightarrow swap(q8,q5)
19
     ... the minimally extending path with swaps is:
      \hookrightarrow cycleExtend=10
20
              path from source[1]=[1]
             path from target[2]=[8->5] implying:
21
      \hookrightarrow \quad \mathtt{swap}(\,\mathtt{q8}\,\mathtt{,q5}\,)
22
     ... the minimally extending path with swaps is:
          cycleExtend=10
             path from source[1]=[8]
23
24
             path from target[2]=[1->5] implying:
      \hookrightarrow swap(q1,q5)
     ... the minimally extending path with swaps is:
25
          cvcleExtend=0
             path from source[1]=[8]
26
             path from target[2]=[2->6] implying:
27
      \hookrightarrow swap(q2,q6)
28
     ... the minimally extending path with swaps is:
          cycleExtend=8
             path from source[1]=[8]
29
             path from target[3]=[0->2->5] implying:
30
      \rightarrow swap(q0,q2) swap(q2,q5)
     ... the minimally extending path with swaps is:
31
          cycleExtend=4
             path from source[1]=[8]
32
             path from target[2]=[2->6] implying:
      \hookrightarrow swap(q2,q6)
34
     ... the minimally extending path with swaps is:
         cycleExtend=2
             path from source[2]=[1->5] implying:
35
          swap(q1,q5)
             path from target[1]=[8]
36
```

#### 1.1.2 With initial placement

#### With Resource constraints

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

#### Without Resource constraints

```
1 ... Virt2Real(v->r) ... result Virt2Real map of
     \hookrightarrow \quad \hbox{InitialPlace before adding unused virtual} \quad
          qubits and unused locations : (0->10)
          (1->4) (2->1) (3->5) (4->7) (5->2147483647)
          (6->2147483647) (7->2147483647)
      \hookrightarrow (8->2147483647) (9->2147483647)
          (10->2147483647) (11->2147483647)
          (12->2147483647) (13->2147483647)
          (14->2147483647) (15->2147483647)
     2 ... Virt2Real(v->r) ... final result Virt2Real
     \hookrightarrow 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)
     ... the minimally extending path with swaps is:
     \hookrightarrow cycleExtend=10
             path from source[1]=[4]
             path from target[2]=[10->7] implying:
 5
     \hookrightarrow swap(q10,q7)
     ... the minimally extending path with swaps is:
 6
     \hookrightarrow cycleExtend=10
             path from source[1]=[4]
             path from target[2]=[10->7] implying:
 8
     \hookrightarrow swap(q10,q7)
9
     ... the minimally extending path with swaps is:
      \hookrightarrow cycleExtend=10
             path from source [1] = [4]
10
1.1
             path from target[2]=[10->7] implying:
     \hookrightarrow swap(q10,q7)
12
     ... the minimally extending path with swaps is:
      \hookrightarrow cycleExtend=10
13
             path from source[1]=[10]
             path from target[2]=[4->7] implying:
14
     \hookrightarrow swap(q4,q7)
     ... the minimally extending path with swaps is:
1.5
      \hookrightarrow cycleExtend=0
16
             path from source[1]=[10]
             path from target[2]=[5->8] implying:
17
     \hookrightarrow swap(q5,q8)
     ... the minimally extending path with swaps is:
18
         cvcleExtend=8
             path from source[1]=[10]
19
             path from target[3]=[1->5->7] implying:
20
      \rightarrow swap(q1,q5) swap(q5,q7)
     ... the minimally extending path with swaps is:
21
         cycleExtend=4
             path from source[1]=[10]
22
             path from target[2]=[5->8] implying:
      \hookrightarrow swap(q5,q8)
     ... the minimally extending path with swaps is:
24
      \hookrightarrow cycleExtend=2
             path from source[2]=[4->7] implying:
25
          swap(q4,q7)
             path from target[1]=[10]
26
```

Table 4: Step 1 results after 1000 iterations

Mapper	Init. place	$t_1$	$t_2$	meas. err.	p. success	f	$\overline{V_Q}$
No	No	3000	3000	0.03	0.96	0.97823066	390
minextendrc	No	3000	3000	0.03	0.929	0.92937318	1582
$\operatorname{minextendrc}$	Yes	3000	3000	0.03	0.939	0.94685216	1038
$\operatorname{minextend}$	No	3000	3000	0.03	0.947	0.9312172	1264
$\operatorname{minextend}$	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

## 4 Simplest benchmarks results