Satish Reddy V   # 16-BIT DADDA MULTIPLIER   IIT BOMBAY

Dadda multiplier algorithm:

1. First partial products are generated using multiplier and multiplicand as they are available at same time at t=0.

2. collecting the partial products bits with the same place value in groups of wires and reduces these in several layers till only 2 wires are left in each weight.

3. At last these 2 wires in each weight are added with a fast adder like Brent-kung etc.

Layer reduction technique:

In dadda algorithm, we come from last layer in which we only need to have 2 bits. and the last before stage are allowed to have $\leq \left\lfloor \frac{3}{2}(\text{last stage bits}) \right\rfloor$. like wise we come all the way to first layer.

For example if we have 16 bit multiplier, we will have layers like

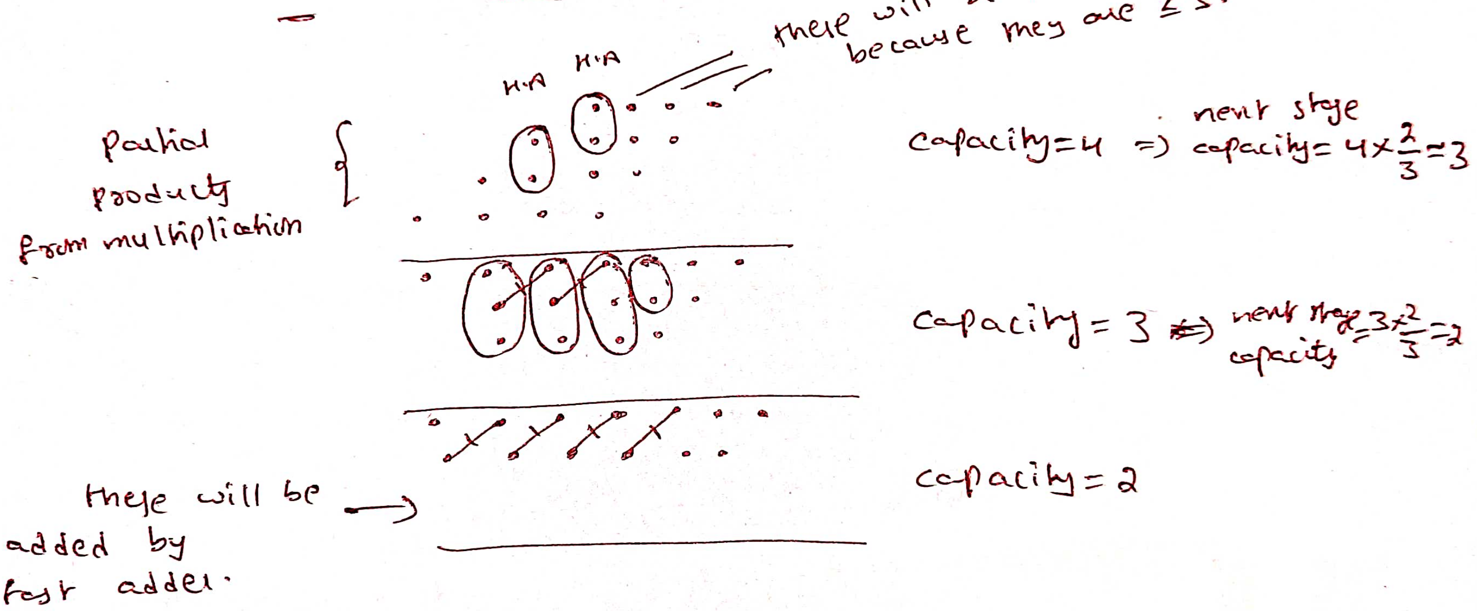
	$\times 3/2$	$\times 3/2$	$\times 3/2$	$\times 3/2$	$\times 3/2$	$\times 3/2$	
bits =	2	3	4	6	9	13	16
	last stage (n)	(n-1) stage	(n-2) stage	(n-3) stage	(n-4) stage	(n-5) stage	1st stage

So total, we have 7 stages.

In last stage, we have 32 bits of 2 rows each, we Just give these bits to a brent kung adder for fast addition. If we want to reduce 3 bits to 2 bits, we use a full adder and ~~pass~~ it produces a sum in the same weight and carry in the heigher weight.

The below example can give a better understanding with the help of dot diagram.

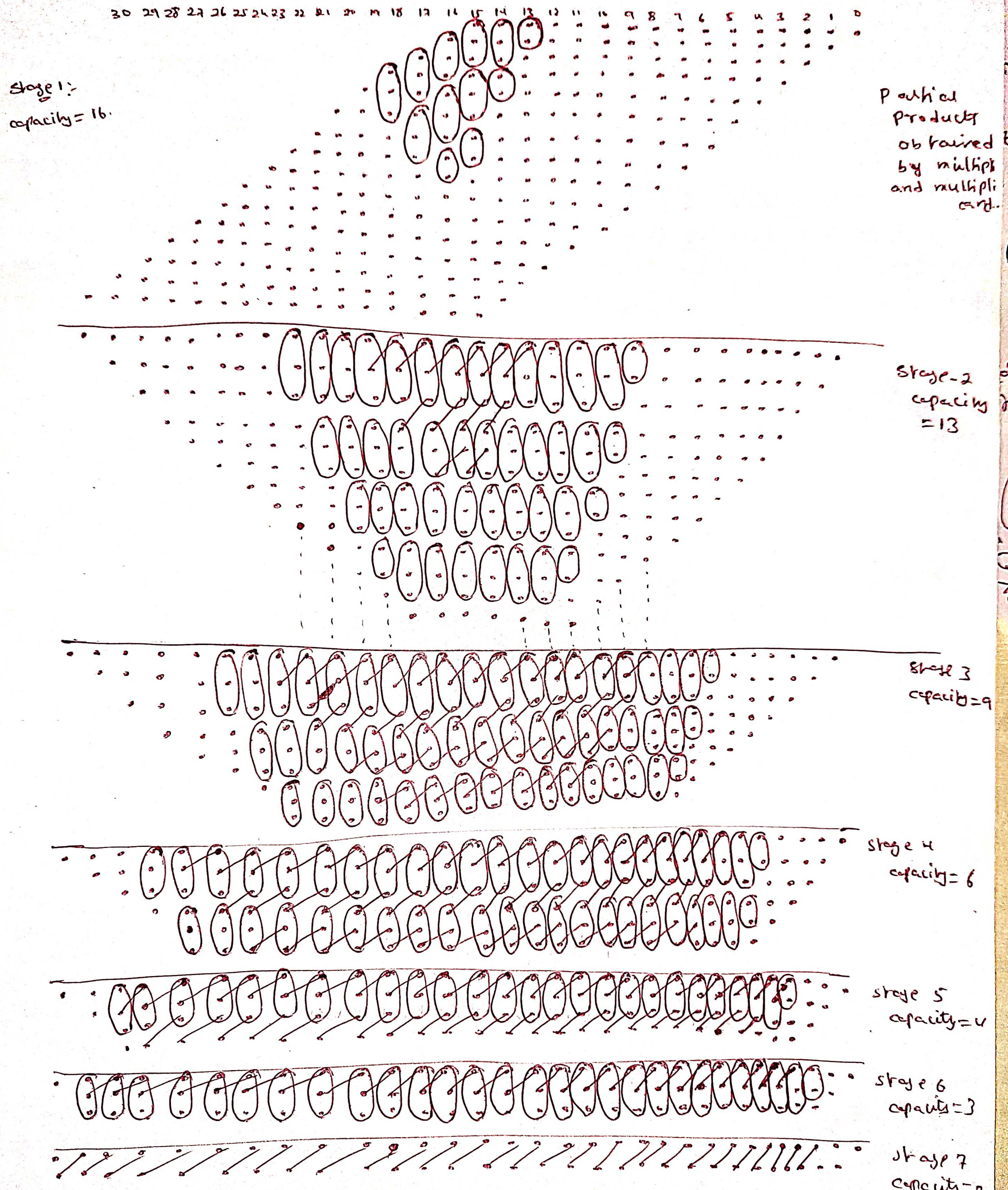
4x4 multiplication:


these will be passed to next layer as it is because they are ≤3.
H.A
H.A
Partial products from multiplication
capacity=4 ⇒ next stage capacity = 4×2/3=3
capacity = 3 ⇒ next stage capacity = 3×2/3=2
capacity = 2
these will be added by fast adder.

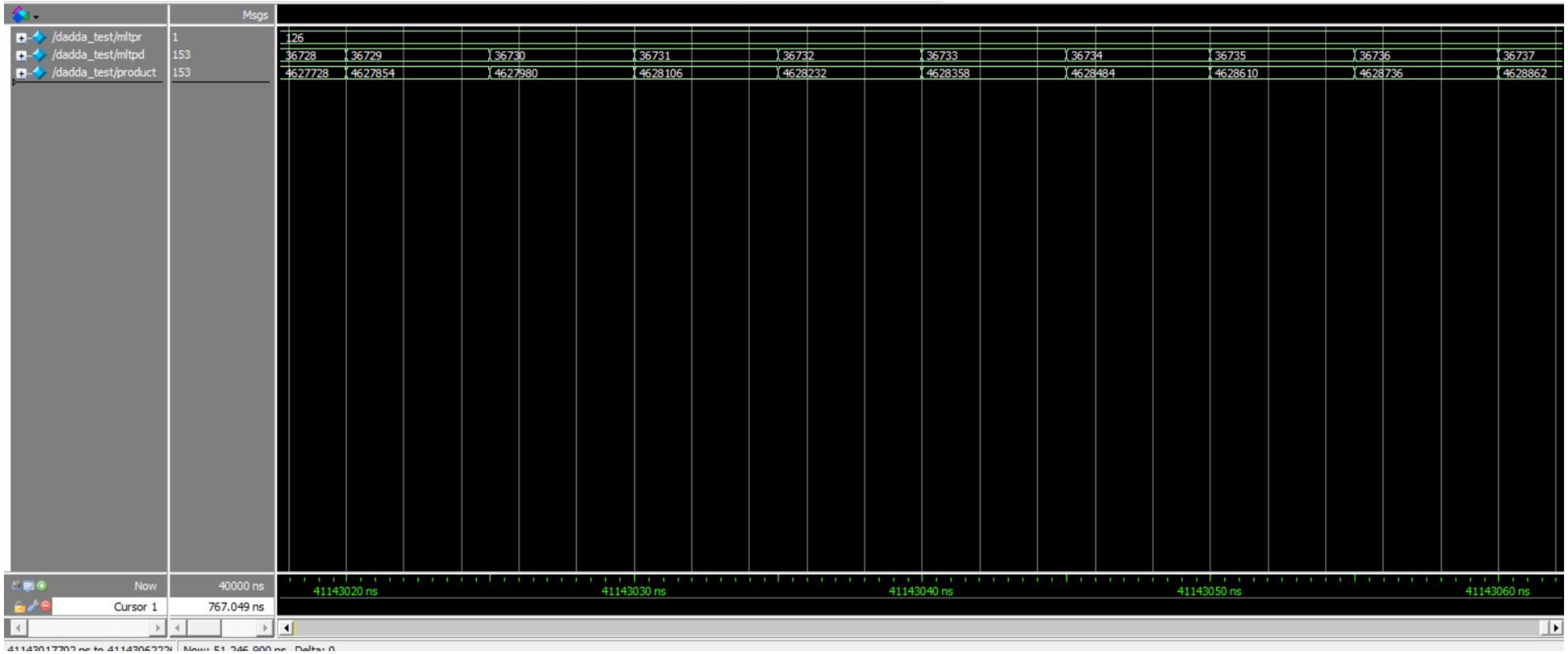
In the first layer, we know second layer capacity is 3 bits at each weight. So we use a half adder to reduce by 1 bit but we have to take care that an extra bit will be added to current weight if a full adder or adder is used at the previous weight.

16x16 dadda multiplier reduction by dot diagram:

(:) → half adde
(⋮) → full adde



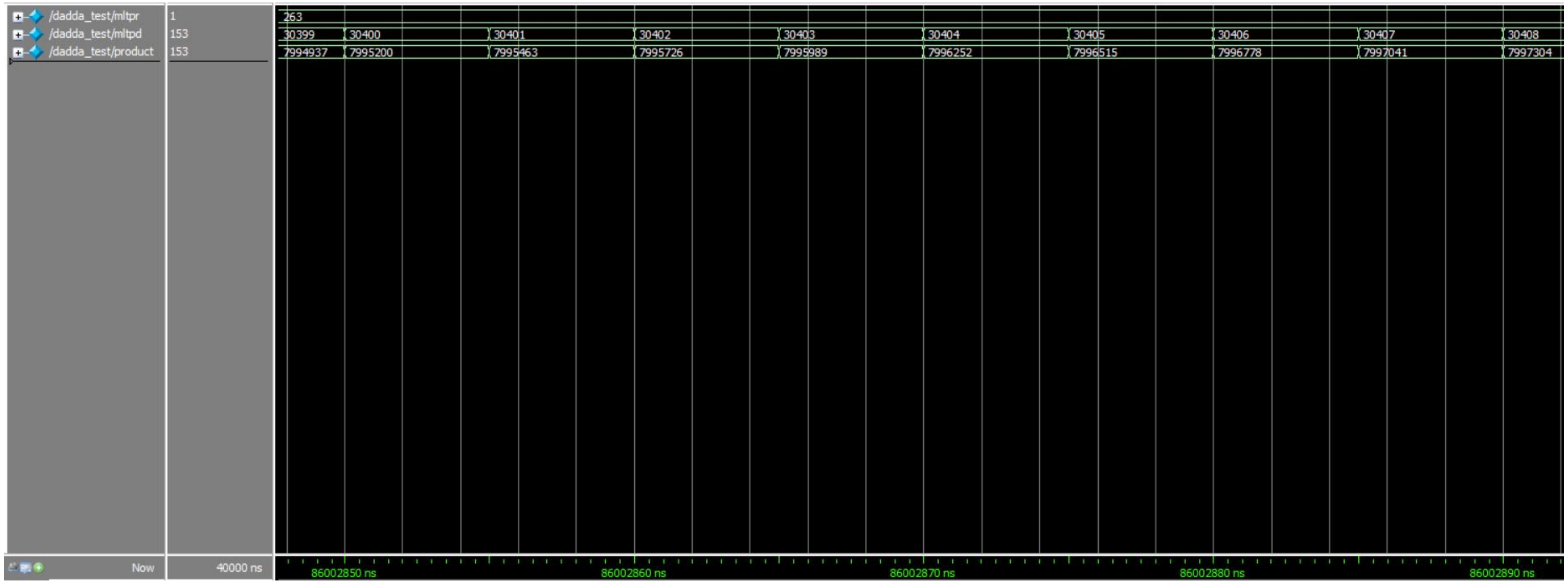
last stage to brent-kung adder to produce product.//



```
                        Msgs
/dadda_test/mltpr       1      126
/dadda_test/mltpd       153    36728    36729    36730    36731    36732    36733    36734    36735    36736    36737
/dadda_test/product     153    4627728  4627854  4627980  4628106  4628232  4628358  4628484  4628610  4628736  4628862

Now       40000 ns        41143020 ns    41143030 ns    41143040 ns    41143050 ns    41143060 ns
Cursor 1  767.049 ns

41143017702 ns to 4114306222   Now: 51,246,900 ns  Delta: 0
```



```
/dadda_test/mltpr    1    263
/dadda_test/mltpd    153  30399    30400    30401    30402    30403    30404    30405    30406    30407    30408
/dadda_test/product  153  7994937  7995200  7995463  7995726  7995989  7996252  7996515  7996778  7997041  7997304

Now  40000 ns   86002850 ns   86002860 ns   86002870 ns   86002880 ns   86002890 ns
```