What is Project Compression?

1. The goal is to reduce the project duration by speeding up various activities.
2. It speeds up an activity by adding resources at additional cost.
3. Also used to find the combination of activity times which meet the client's desired project duration with minimum project cost.

When to do project compression?

1. To give quotations
   i. When a company wants a supplier to do a project, it sends a Request for Quotation (RFQ) to several potential suppliers. RFQ describes the project, asks from suppliers for a price and best delivery time.
   ii. The supplier will answer the company, i.e. a Quotation, Proposal, Bid or Tender.
   iii. The Quotation will give the supplier's best price and delivery time. It may offer alternative designs – that's where project compression is needed.

Scenario of Quotations

Consider the case where a company wants the project to be completed in 30 days. The supplier need to quote a lead time of 30 days to win the job. The original plan for the job find that the supplier's fastest lead time is 38 days. The supplier then has to compress activities to bring the project lead time down to 30 days, with the lowest possible cost increase.

When to do project compression?

2. To catch up time

   i. Suppose a supplier has won a job and started to build it, but there are delays due to some problems. If the supplier continue with current plan, the project will have late completion.

   ii. For most commercial projects, there will be a penalty to supplier for late completion, e.g. penalty $50,000 per day.

   iii. In that case, the supplier has to compress activities to catch up time.

Which activities to be crashed*?

1. *Crash – decrease the duration of an activity.
2. There are several factors to be considered, e.g.
   i. The early activities - compress activities that are at the early stage in the project, to give more options for compression at later stage.
   ii. The lowest cost – for profit making projects.
   iii. Resource availability.

How to do projectcompression?

1. Which activity to be crashed?
   - Select the critical path activities and start crashing the activities with the lowest cost per unit time first.
2. How much to compress?
   - Continue until the activity cannot be compressed any more (it has reached the crash limit, full-crash) or new critical paths arise.
3. Then, start crashing the activities on the new critical paths.

Scenario 1

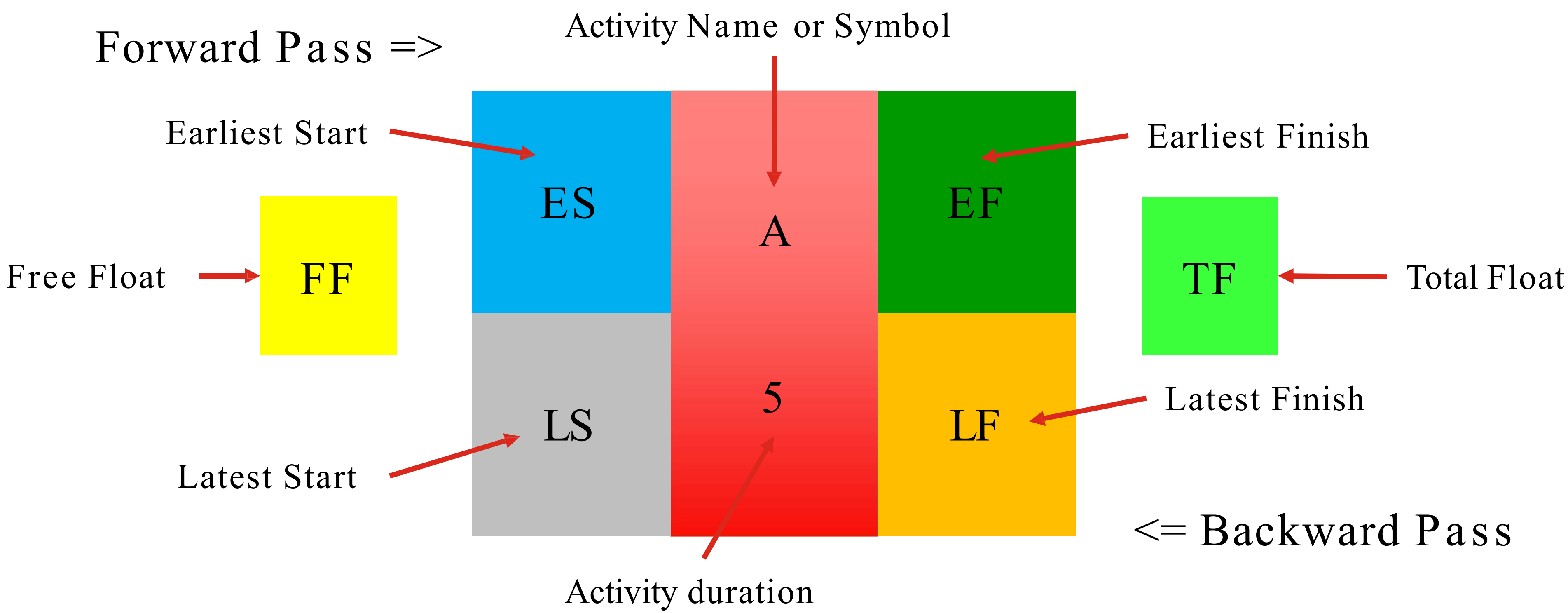
1. A critical path running through a network and a non-critical path running between two nodes on the critical path.

2. The non critical path has a duration of 17 days, with 3 days total float.

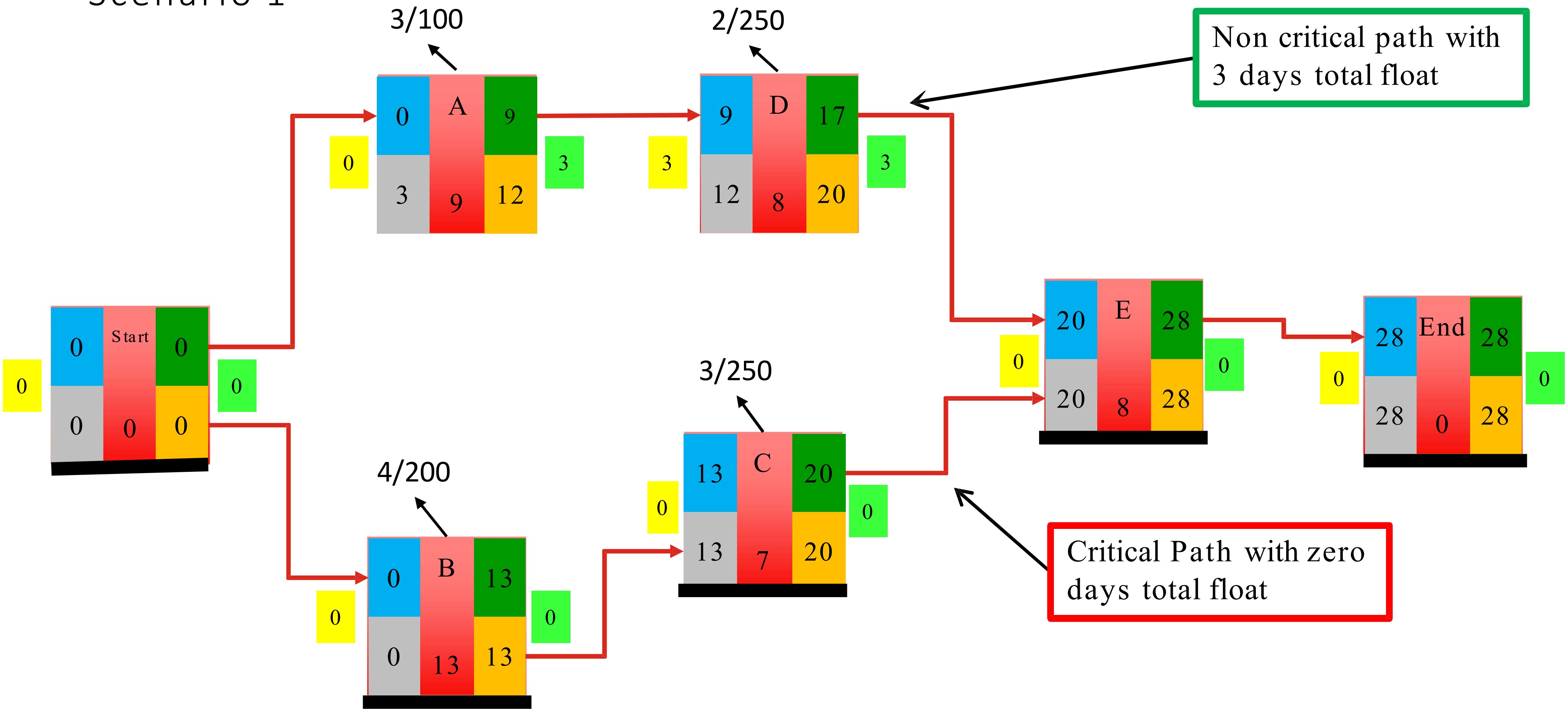
3. It cost $200/day to crash activity B, and possible crash is 4 days. It cost $250/day for activity C, possible crash 3 days.

4. It cost $100/day to crash activity A, and possible crash is 3 days. It cost $250/day for activity D, possible crash 2 days.

A node for AON



Scenario 1


3/100
2/250
Non critical path with 3 days total float
0 Start 0
0 0 0
0 0
0 A 9
3 9 12
0 3
9 D 17
12 8 20
3 3
20 E 28
20 8 28
0 0
28 End 28
28 0 28
0 0
3/250
4/200
0 B 13
0 13 13
0 0
13 C 20
13 7 20
0 0
Critical Path with zero days total float

Scenario 1: Which activity to be crashed?

1. Critical paths are the longest path in the network. To make the project shorter, need to compress the critical path.
2. So in compression, an activity along the critical paths will be chosen to crash.
3. Look for the activity which is cheapest to crash.
4. In this case, activity B.

Scenario 1: How much to compress?

1. Work out how much to compress.
2. Compress up to the point where there are changes in the network, either:
   - the activity reaching full-crash, or
   - another critical path developing, which changes the cost structure of the network.
3. In this case, compressing one critical path leads to the creation of another critical path.

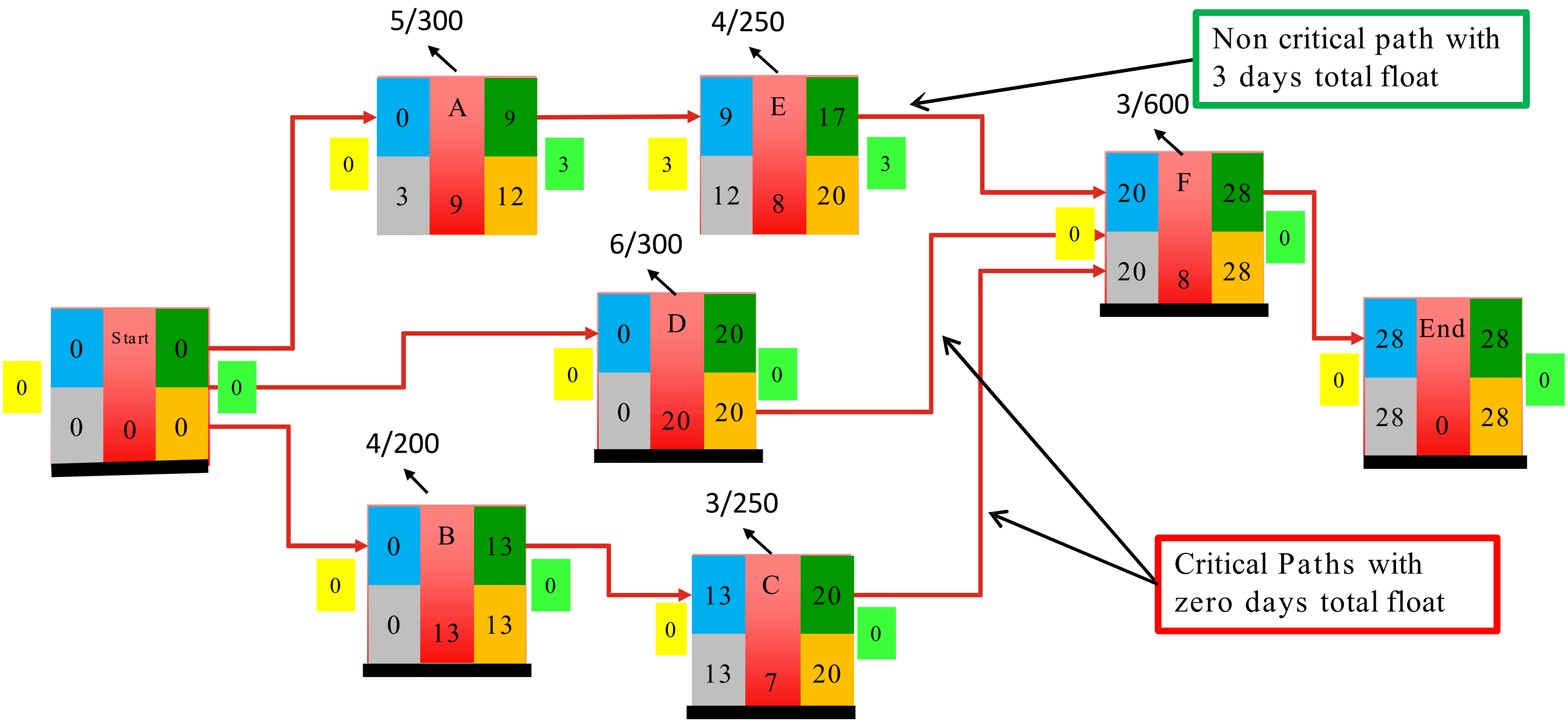
Scenario 1: How much to compress?

1. Do not over-compress an activity which creates more critical path(s) but the current critical path become non-critical.
2. This happen when the potential reduction is more than the float in the path about to become critical (in this case the non-critical path was reduced by 4, when it only had a total float of 3)

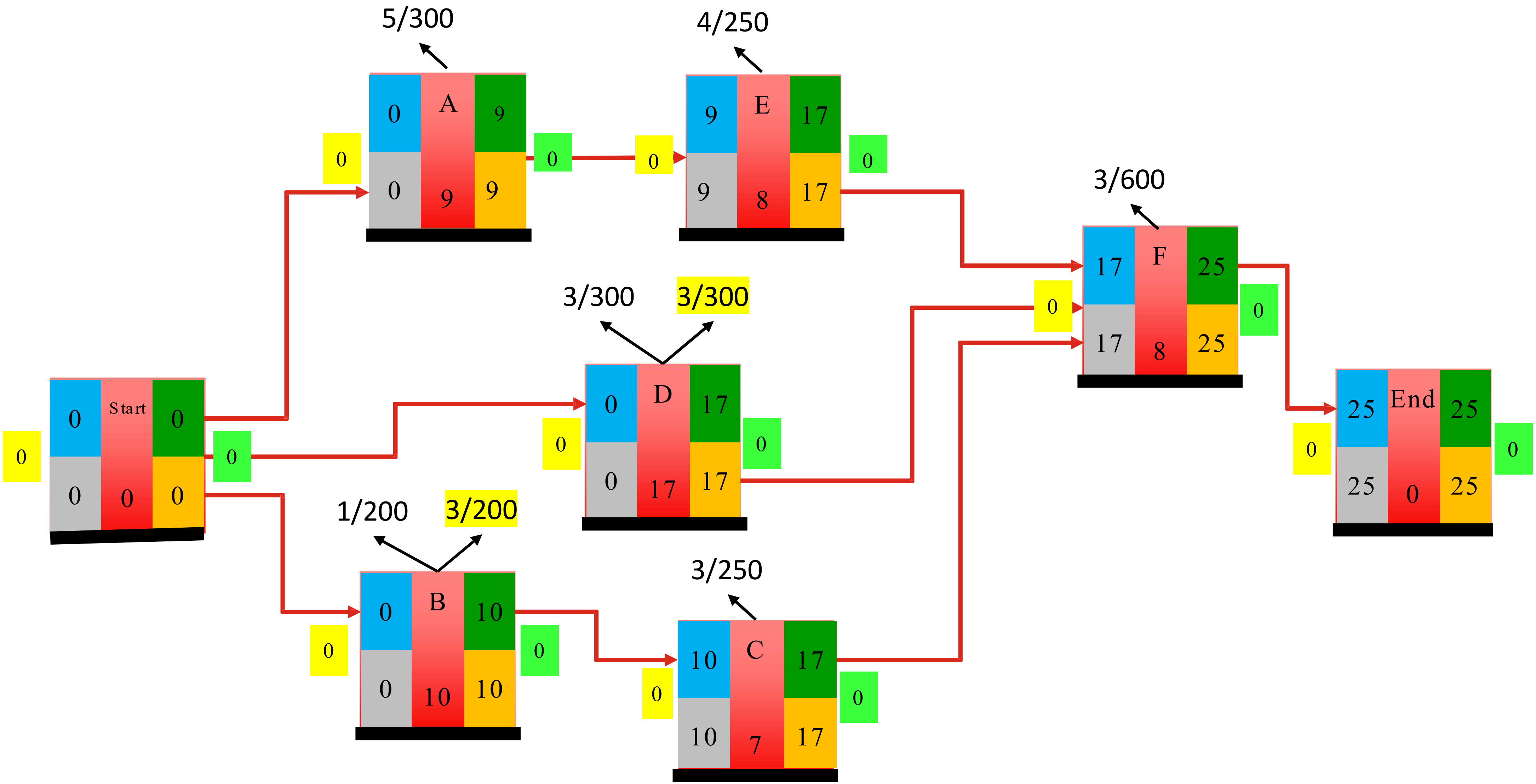
Scenario 2

1. Two critical paths running in parallel between start and F.
2. The non critical path is 17 days long, the critical paths are 20 days long – hence we can shrink the critical paths by 3 days.
3. In this case, both paths have to be compressed by the same amount of days.
4. It cost $300/day to crash A, $200/day to crash activity B, $250/day for activity C, $300/day for activity D, $250/day for E and $600/day for activity F.

Scenario 2: All Normal



Scenario 2: Compression 1



Scenario 2

1. If we cut three days out of each path, it costs $200+$300=$500/day (activities B and D), total cost is 3*$500=$1,500.
2. In this case, the non critical path becomes critical because the total float of three days were used up.
3. If we continue compressing the section between Start and F, then we have to compress the top path (A-E) as well, so the cost becomes $200+$300+$250=$750/day.
4. However, it may be cheaper to compress somewhere else in the network.
5. In this case, activity F at $600/day should be chosen.

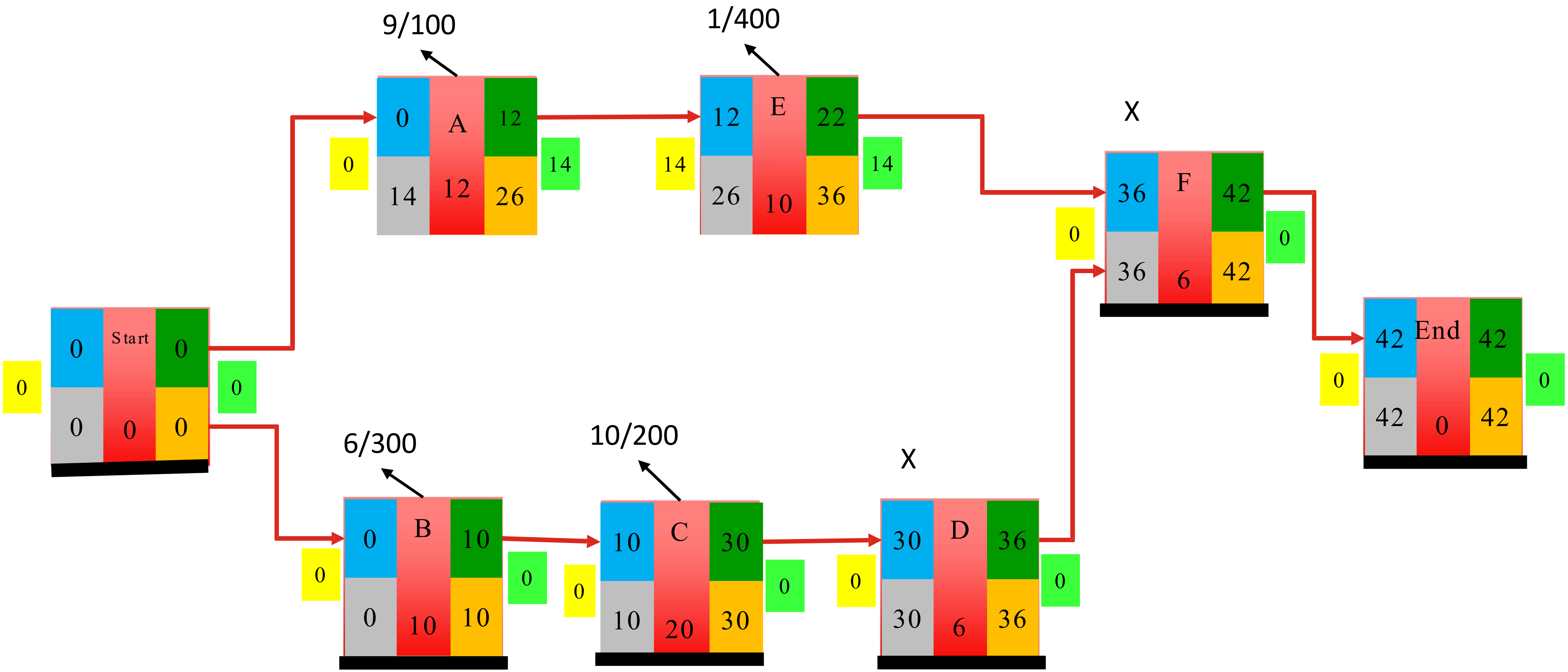
Working Days vs Calendar Days

1. All calculations for project networks are in working days rather than calendar days, i.e. the plan suppose the working days are seven days a week, and there are no holidays.
2. This is to simplify the calculation and scheduling process.
3. The schedule can be converted easily to calendar days and dates later.

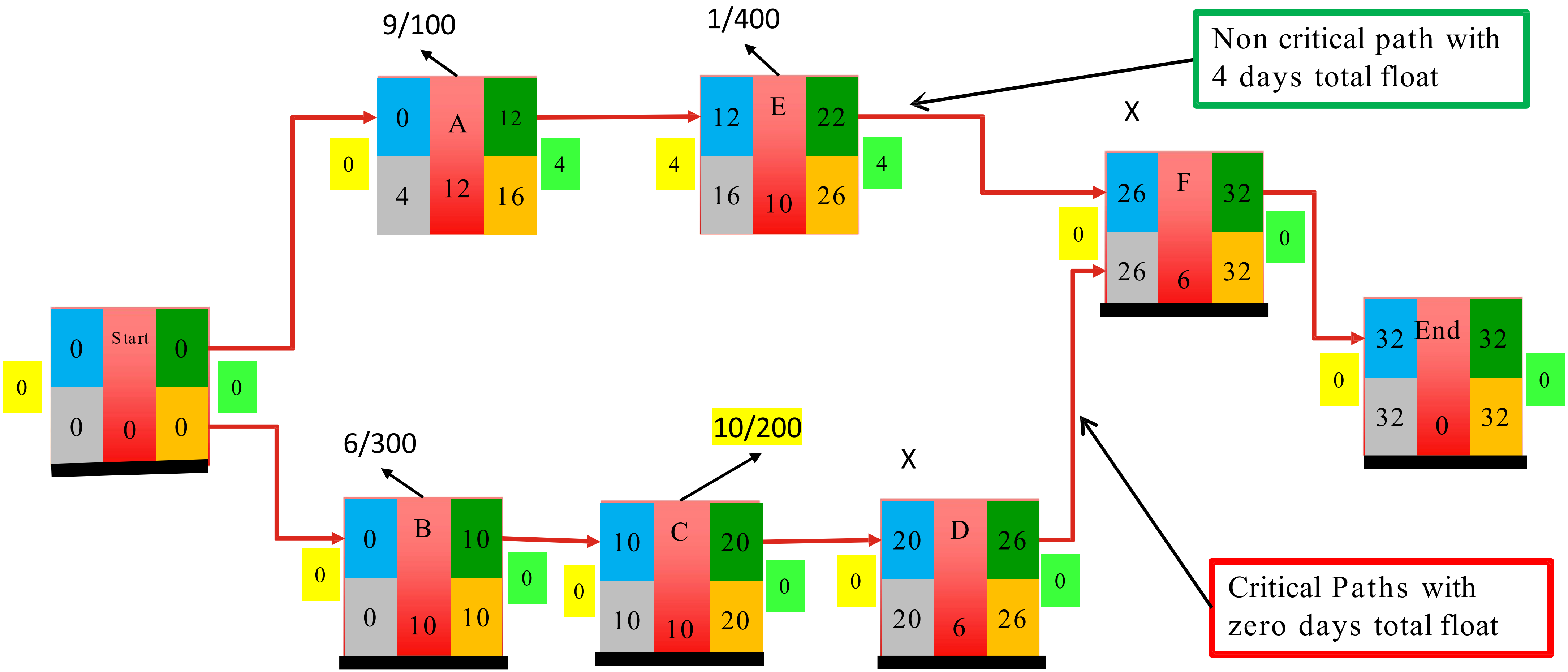
Practical Example

Activity	Duration (days)	Constraints	Crash Cost ($/day)	Possible Crash (days)
A	12	can start at any time	100	9
B	10	can start at any time	300	6
C	20	can start when B has ended	200	10
D	6	cannot start until C has ended	X	0
E	10	cannot start until A has ended	400	1
F	6	cannot start until D has ended cannot start until E has ended	X	0
The project has finished when F finished X Some activities have reached crash limit.				

Practical Example: All-Normal



Practical Example: Compression 1



Procedures: All-Normal & Compression 1

1. Do the all-normal calculations on the network, including forward pass and backward pass and calculation of total float. Mark in the critical path B-C-D.

2. Look along the critical path B-C-D for the cheapest activity to compress. In this case it is activity C which can be compressed up to 10 days at $200 per day. Next look at the float of parallel non-critical path. The parallel non-critical path is A-E with float 14 days. This float of 14 days is higher than the maximum compression of 10 days. The amount to compress is the minimum of the maximum compression and the float of all parallel path, i.e. compress 10 days, cost 10x$200=$2000.

3. Redraw the network with the new activity durations and do the forward and backward pass and calculate floats and mark in the critical path. This is compression 1.

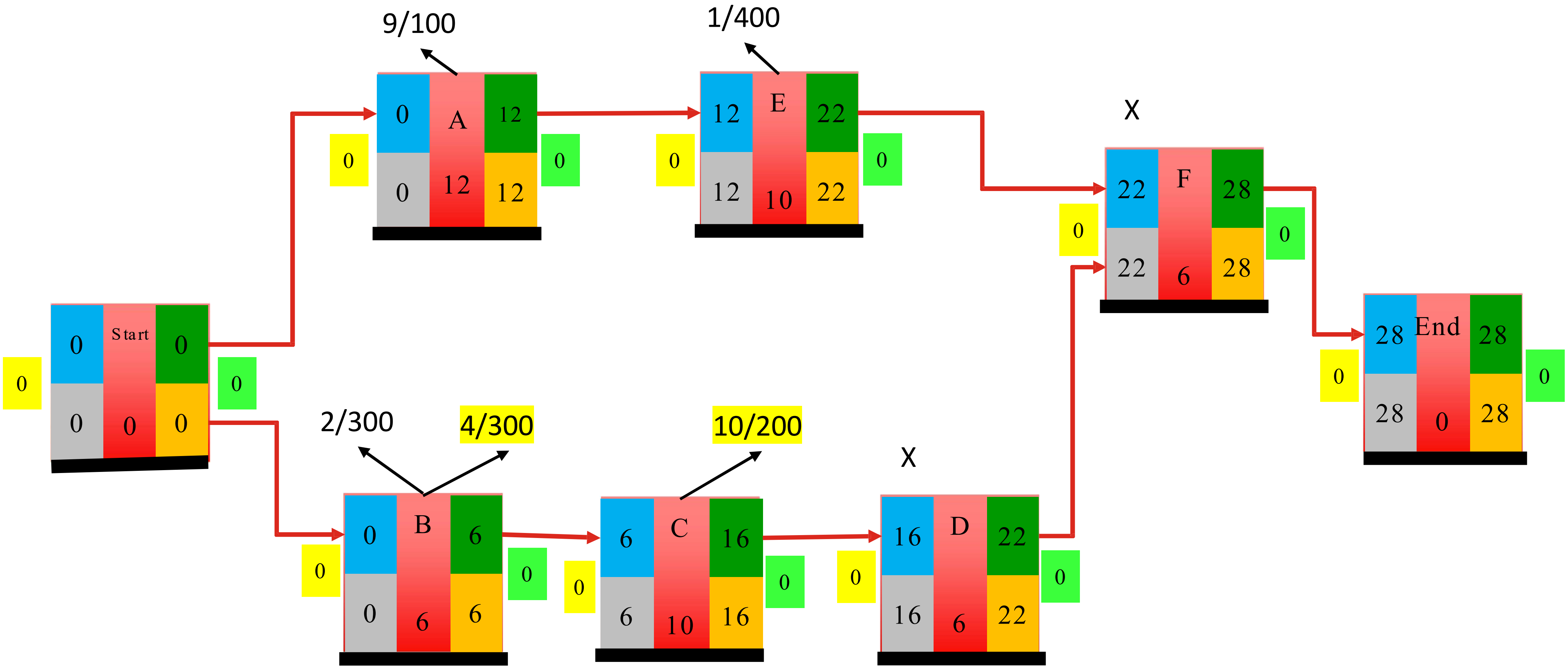
Compression 1

Compressions	Lead time	Crashed (day)	Compression Cost ($)
All Normal	42		
Compression 1	32	C x10	$200x10=$2000
Compression 2			
Compression 3			
Total			$2000

Practical Example: Compression 1

Activity	Duration (days)	Constraints	Crash Cost ($/day)	Possible Crash (days)	Additional cost
A	12	can start at any time	100	9	
B	10	can start at any time	300	6	
C	10	can start when B has ended	X	0	10x$200= $2000
D	6	cannot start until C has ended	X	0	
E	10	cannot start until A has ended	400	1	
F	6	cannot start until D has ended cannot start until E has ended	X	0	
The project has finished when F finished X Some activities have reached crash limit.					

Practical Example: Compression 2



Procedures: Compression 2

1. Using the result of compression 1, look along the critical path for the cheapest activity to compress.
2. There is only one critical path chain B-C-D and activity B is the only activity on the critical path which can be compressed, cost $300 per day. Its maximum compression is 6 days, the float of the parallel non-critical path A-E is 4 days, so compression 2 is activity B by 4 days.
3. The cost of compression 2 is 4x$300=$1200.
4. Total compression cost so far is $2000+$1200=$3200

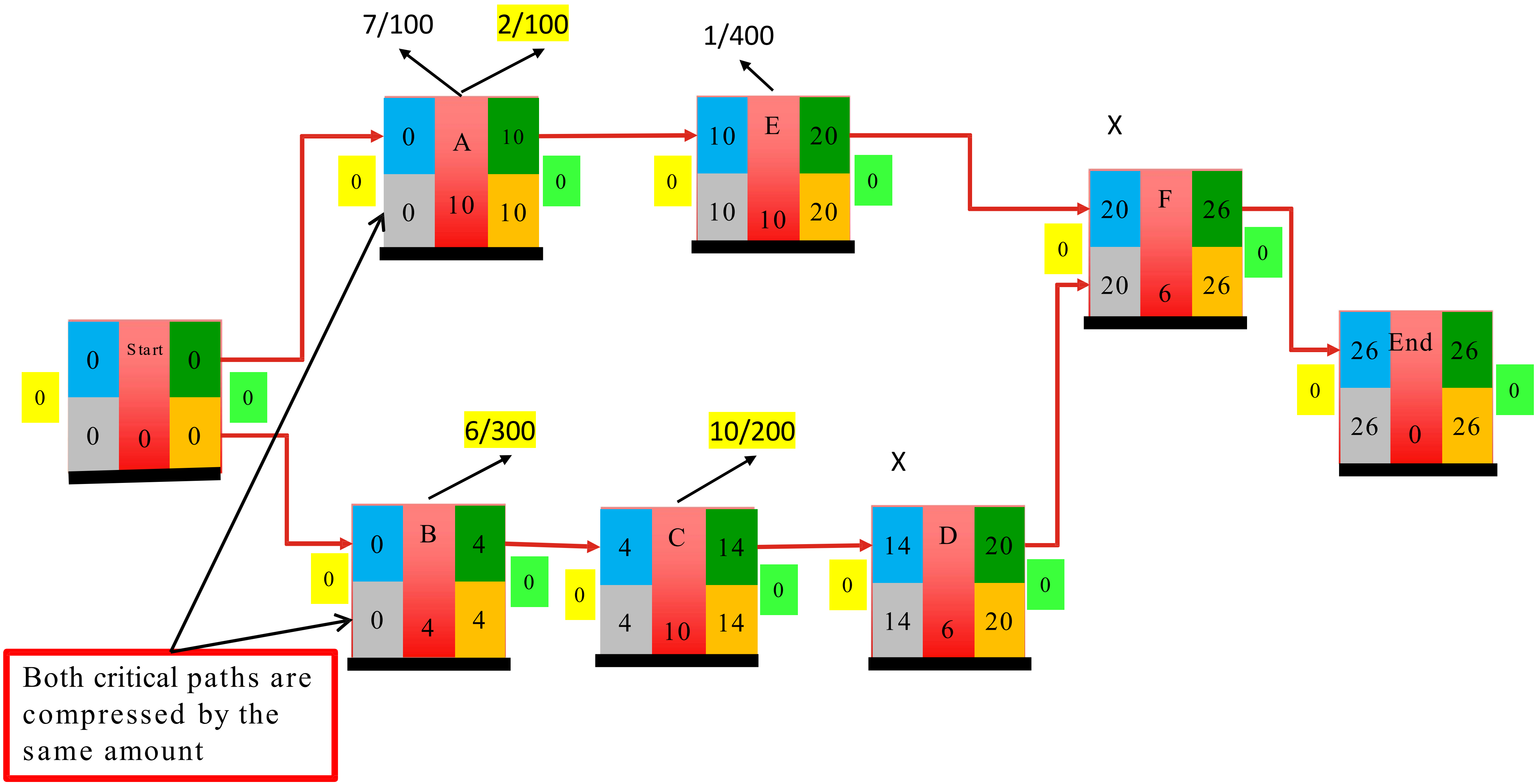
Compression 2

Compressions	Lead time	Crashed (day)	Compression Cost ($)
All Normal	42		
Compression 1	32	C x10	$200x10=$2000
Compression 2	28	B x4	$300x4=$1200
Compression 3			
Total			$3200

Practical Example: Compression 2

Activity	Duration (days)	Constraints	Crash Cost ($/day)	Possible Crash (days)	Additional cost
A	12	can start at any time	100	9	
B	6	can start at any time	300	2	4x$300= $1200
C	10	can start when B has ended	X	0	10x$200= $2000
D	6	cannot start until C has ended	X	0	
E	10	cannot start until A has ended	400	1	
F	6	cannot start until D has ended cannot start until E has ended	X	0	
The project has finished when F finished X Some activities have reached crash limit.					

Practical Example: Compression 3



Procedures: Compression 3

1. Use the result of compression 2 to perform compression 3.
2. There are parallel critical paths B-C-D and A-E. They have to be compressed by the same amount.
3. In critical path B-C-D, activity B is the only one which can be compressed, it cost $300 per day. In A-E, both activities A and E can be compressed. The cheapest activity is activity A at $100 per day.
4. Compress both activities B and A by the same amount. Activity B can be compressed by 2 days and activity A can be compressed by 9 days. The maximum compression for compression 3 is 2 days (the minimum of 2 days and 9 days)
5. Total cost for compression 3 is 2x($300+$100)=$800.
6. Total compression cost so far is $2000+$1200+$800=$4000

Procedures: Compression 3

1. Draw the result of compression 3 and put a cross X on each activity that is fully compressed.

2. As a result, every activity on the path B-C-D (from start to finish of the network) is full crash. This means that the project cannot be compressed any more – have to stop compression.

Compression 3

Compressions	Lead time	Crashed (day)	Compression Cost ($)
All Normal	42		
Compression 1	32	C x10	$200x10 = $2000
Compression 2	28	B x4	$300x4 = $1200
Compression 3	26	(A+B) x2	($100+$300)x2= $800
Total			$4000

Practical Example: Compression 3

Activity	Duration (days)	Constraints	Crash Cost ($/day)	Possible Crash (days)	Additional cost
A	12	can start at any time	100	7	(2x$100)= $200
B	6	can start at any time	X	0	(4x$300)+ (2x$300)=$1800
C	10	can start when B has ended	X	0	10x$200= $2000
D	6	cannot start until C has ended	X	0	
E	10	cannot start until A has ended	400	1	
F	6	cannot start until D has ended cannot start until E has ended	X	0	
The project has finished when F finished X Some activities have reached crash limit.					

Summary: Procedure of Compression

1. Select the critical path activities and start crashing the activities with the lowest cost per unit time first.
2. Continue until the project reaches the crash limits of the activity or new critical paths arise.
3. Then, start crashing the activities on the new critical paths.

Summary: Limitation of Compression

1. In most cases compression will be limited by either
   i. a crash limit on the activity, or fully crashed critical path
   ii. available float of another path about to become critical
   iii. parallel critical paths