

Feasibility of Warm-up Attack using the Capella version

```
[2024-01-24 12:19:59] INFO validator: Submitted new block blockRoot=0xbb80e6fb8313 fork=capella gasUtilized=0 graffiti= numAttestations=1 numDeposits=0 parentHash=0x7999b4bde4f payloadHash=0x88badb011fd5 pubKey=0xac5c580dfa27 slot=31 txCount=0 withdrawalCount=0
```

Figure 1: Block 31 (root 0xbb) is proposed in slot 31.

```
[2024-01-24 12:20:20] INFO validator: Submitted new block blockRoot=0xcc1c6bc8005a fork=capella gasUtilized=0 graffiti= numAttestations=1 numDeposits=0 parentHash=0x88badb011fd5 payloadHash=0x0362fe4963d5 pubKey=0x9785636dc5c5 slot=32 txCount=0 withdrawalCount=0
```

Figure 2: Block 32 (root 0xcc) is withheld by a Byzantine validator and delayed for 8 seconds.

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[2024-01-24 12:20:20] INFO validator: Submitted new attestations AggregatorIndices=[293] AttesterIndices=[293 305 63 110 347 156 250 353 202 313 134 277 217 227 214 262 492 550 598] BeaconBlockRoot=0xbb80e6fb8313 CommitteeIndex=0 Slot=32 SourceEpoch=0 SourceRoot=0x000000000000 TargetEpoch=1 TargetRoot=0xbb80e6fb8313
[2024-01-24 12:20:31] INFO validator: Submitted new attestations AggregatorIndices=[103] AttesterIndices=[577 387 359 431 216 265 381 258 476 340 87 536 125 311 103 385 441 115 269 622 317] BeaconBlockRoot=0xcc1c6bc8005a CommitteeIndex=0 Slot=33 SourceEpoch=0 SourceRoot=0x000000000000 TargetEpoch=1 TargetRoot=0xcc1c6bc8005a
[2024-01-24 12:20:35] INFO validator: Submitted new block blockRoot=0x223a3bcdec8 fork=capella gasUtilized=0 graffiti= numAttestations=2 numDeposits=0 parentHash=0x0362fe4963d5 payloadHash=0xf6a0ba0ee2bb pubKey=0x847230d7b775 slot=34 txCount=0 withdrawalCount=0
[2024-01-24 12:20:43] INFO validator: Submitted new attestations AggregatorIndices=[169] AttesterIndices=[17 454 145 211 572 523 585 412 35 354 169 595 292 580 547 36 12 31] BeaconBlockRoot=0x223a3bcdec8 CommitteeIndex=0 Slot=34 SourceEpoch=0 SourceRoot=0x000000000000 TargetEpoch=1 TargetRoot=0xcc1c6bc8005a
[2024-01-24 12:20:55] INFO validator: Submitted new attestations AggregatorIndices=[173] AttesterIndices=[241 588 444 522 645 322 151 644 173 462 67 501 524 613 54 526 434 244 204 318 105 207 626 506] BeaconBlockRoot=0x223a3bcdec8 CommitteeIndex=0 Slot=35 SourceEpoch=0 SourceRoot=0x000000000000 TargetEpoch=1 TargetRoot=0xcc1c6bc8005a
```

Figure 3: Attestations from honest validators in slot 32 to 35. As block 32 is delayed, the target of attestations in slot 32 is set as block 31 (the first INFO). After block 32 is released, the attestations from honest validators will have their target as block 32 (2nd to the 5th INFO).

Staircase Attack re-produced using the Capella Version

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[2024-01-24 12:34:59] INFO blockchain: Synced new block block=0x81eb81db... epoch=3 justifiedEpoch=0 justifiedRoot=0x00000000... slot=106
[2024-01-24 12:34:59] INFO blockchain: Finished applying state transition attestations=6 payloadHash=0xf291e0dfdd2d slot=106 syncBitsCount=512 txCount=0
[2024-01-24 12:34:59] INFO blockchain: Forkchoice updated with payload attributes for proposal blockRoot=0x81eb81dbb7f5 headSlot=106 payloadID=0x20b4b799d731
[2024-01-24 12:35:12] INFO blockchain: Chain reorg occurred commonAncestorRoot=0x23c7fec30f8acf43503f87f388f051c8a65df2e67182265e25f7b72ca0360a28 depth=14 distance=15 newRoot=0x3ec89b4990d181f7725329c92f5dc09cf54eb63e51aaa09c0d8b38b3865d740d newSlot=93 newWeight=0 oldRoot=0x81eb81dbb7f5852f0f660dc3f8154d3b9d4f155fb92d97304d1970204994c8d1 oldSlot=106 oldWeight=512000000000
[2024-01-24 12:35:12] INFO blockchain: Synced new block block=0x3ec89b49... epoch=2 justifiedEpoch=2 justifiedRoot=0xc9c20baa... slot=93
[2024-01-24 12:35:12] INFO blockchain: Finished applying state transition attestations=29 payloadHash=0x2277c74bf672 slot=93 syncBitsCount=512 txCount=0
[2024-01-24 12:35:12] INFO rpc/validator: Begin building block sinceSlotStartTime=1.216203245s slot=107
[2024-01-24 12:35:12] INFO rpc/validator: Finished building block sinceSlotStartTime=1.961644956s slot=107 validator=631
[2024-01-24 12:35:13] INFO blockchain: Synced new block block=0xc8064efd... epoch=3 justifiedEpoch=2 justifiedRoot=0xc9c20baa... slot=107
[2024-01-24 12:35:13] INFO blockchain: Finished applying state transition payloadHash=0xd41448cf65a2 slot=107 syncBitsCount=0 txCount=0
```

Figure 4: Re-produced results using the Capella version.

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[2024-01-24 12:35:07] INFO validator: Submitted new attestations AggregatorIndices=[26] AttesterIndices=[425 342 184 310 26 8
7 526 586 633 515 185 75 24 207 294 77] BeaconBlockRoot=0x81eb81dbb7f5 CommitteeIndex=0 Slot=106 SourceEpoch=0 SourceRoot=0x00
00000000 TargetEpoch=3 TargetRoot=0x32c6773b3b13
[2024-01-24 12:35:13] INFO validator: Submitted new block blockRoot=0xc8064efd071c fork=capella gasUtilized=0 graffiti= numAt
testations=0 numDeposits=0 parentHash=0x2277c74bf672 payloadHash=0xd41448cf65a2 pubKey=0xb40abfd178ff slot=107 txCount=0 withd
rawalCount=0
[2024-01-24 12:35:19] INFO validator: Submitted new attestations AggregatorIndices=[5] AttesterIndices=[50 507 5 657 90 543 3
3 52 186 536 645 243 344 187 275 351 227 42 163 365 563 41 299 11 242 273] BeaconBlockRoot=0xc8064efd071c CommitteeIndex=0 Slo
t=107 SourceEpoch=2 SourceRoot=0xc9c20baa824f TargetEpoch=3 TargetRoot=0x3ec89b4990d1
[2024-01-24 12:35:31] INFO validator: Submitted new attestations AggregatorIndices=[541] AttesterIndices=[221 167 148 268 13
424 475 203 129 140 386 383 450 49 193 54 94 223 541] BeaconBlockRoot=0xc8064efd071c CommitteeIndex=0 Slot=108 SourceEpoch=2 S
ourceRoot=0xc9c20baa824f TargetEpoch=3 TargetRoot=0x3ec89b4990d1
[2024-01-24 12:35:36] INFO validator: Submitted new block blockRoot=0x24a10d0de95d fork=capella gasUtilized=0 graffiti= numAt
testations=2 numDeposits=0 parentHash=0xd41448cf65a2 payloadHash=0x6206feaf9aea pubKey=0x976ecc14c14c slot=109 txCount=0 withd
rawalCount=0
[2024-01-24 12:35:43] INFO validator: Submitted new attestations AggregatorIndices=[467] AttesterIndices=[606 119 137 265 205
429 510 437 630 23 149 330 467 430 634 160 444 173 321] BeaconBlockRoot=0x24a10d0de95d CommitteeIndex=0 Slot=109 SourceEpoch=
2 SourceRoot=0xc9c20baa824f TargetEpoch=3 TargetRoot=0x3ec89b4990d1

```

Figure 5: Attestations from honest validators before and after reorganization. It can be seen that the fork is Capella.