Redstone Dust Update Research Report [MC: Get to the bottom of things #1]

Basic Definition

Connectivity

Concept:

A direction is considered connected if there is redstone dust connected to the source redstone dust, including glass-block downward transmission (having connectivity but not transmitting a signal), excluding being obstructed by blocks.

Redstone Dust Updates: PP, NC, Prepare

PP Updates (PostPlacement Updates)

Regular *PP Updates*: Sends *PP Updates* to the **adjacent west, east, north, south, down, and up** blocks.

Prepare Updates:

Before 1.19 22w13a - When redstone dust is placed, broken, or changes state, it sends *PP Updates* to any block horizontally pointing towards it, excluding another redstone dust, and to the blocks above and below it (excluding observers).

1.19 22w13a and later - Redstone dust only sends *Prepare Updates* to diagonally adjacent blocks if they are other redstone dusts.

——Minecraft Wiki – Redstone Dust

Properties:

Prepare Updates essentially involve: checking blocks and their states and performing 0~8 *PP Updates*.

Update Process:

Source redstone dust follows the steps below in the order of **north, east, south, and west**:

1. Check connectivity, if connected then continue.
2. Check if the block below the immediate neighbor in that direction is an observer; if not, send *PP Updates* to the block below.
3. Same as 2, but the direction becomes upward (check if the block above the immediate neighbor in that direction is an observer).

NC Updates (NeighborChanged Updates)

Process:

Redstone dust performs second-order adjacent updates: the source redstone dust itself and its six immediate neighbors act as seven update sources, emitting a total of 6*7=42 *NC Updates* in the **west, east, down, up, north, and south directions**.

Update Source Order:

The order of the seven update sources is based on the hash information of the redstone dust coordinates, randomly arranged. These sources have a 97% chance of being divided into three groups.

Group 1	Group 2	Group 3	Probability
-Y, +Z, +X	O	+Y, -Z, -X	24.267%
+Y, -Z, -X	O	-Y, +Z, +X	24.267%
O	-Y, +Z, +X	+Y, -Z, -X	12.133%
O	+Y, -Z, -X	-Y, +Z, +X	12.133%
-Y, +Z, +X	+Y, -Z, -X	O	12.133%
+Y, -Z, -X	-Y, +Z, +X	O	12.133%
Others			<0.2%

O in the table represents the source redstone dust, -X represents the update sources relative to the source redstone dust's direction.

The update sequence within each group is fixed, but the order of the groups is random. In addition to this, there are some other very low probability arrangement options.

Overall Update Process:

Affected by NC Updates

When redstone dust is affected by *NC Updates*, it checks its own power level:

1. Change its power level -> the maximum power value of the connected redstone dust nearby minus one (i.e., max-1).
2. Send *Prepare Updates*.
3. Send *PP Updates*.
4. Send *Prepare Updates*.

5. Send *NC Updates*.

Affected by pp updates

When redstone dust is affected by *PP Updates*, it checks its own connectivity status:

1. Change the connectivity status: *side*.
2. Send *Prepare Updates*.
3. Send *PP Updates*.
4. Send *Prepare Updates*.

Common "update counts" explanations

"42 updates":

Refers to the total of 42 *NC Updates* emitted by the redstone dust itself and its six adjacent update sources.

"Up to 22 updates":

Refers to the two *Prepare Updates* (including up to 8*2=16 *PP Updates*) and regular *PP Updates* (6 times), totaling up to 22 *PP Updates* emitted by the redstone dust.

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