A proposal for Local Smartphone-based Adhoc Network in Disaster Areas.

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A project by:

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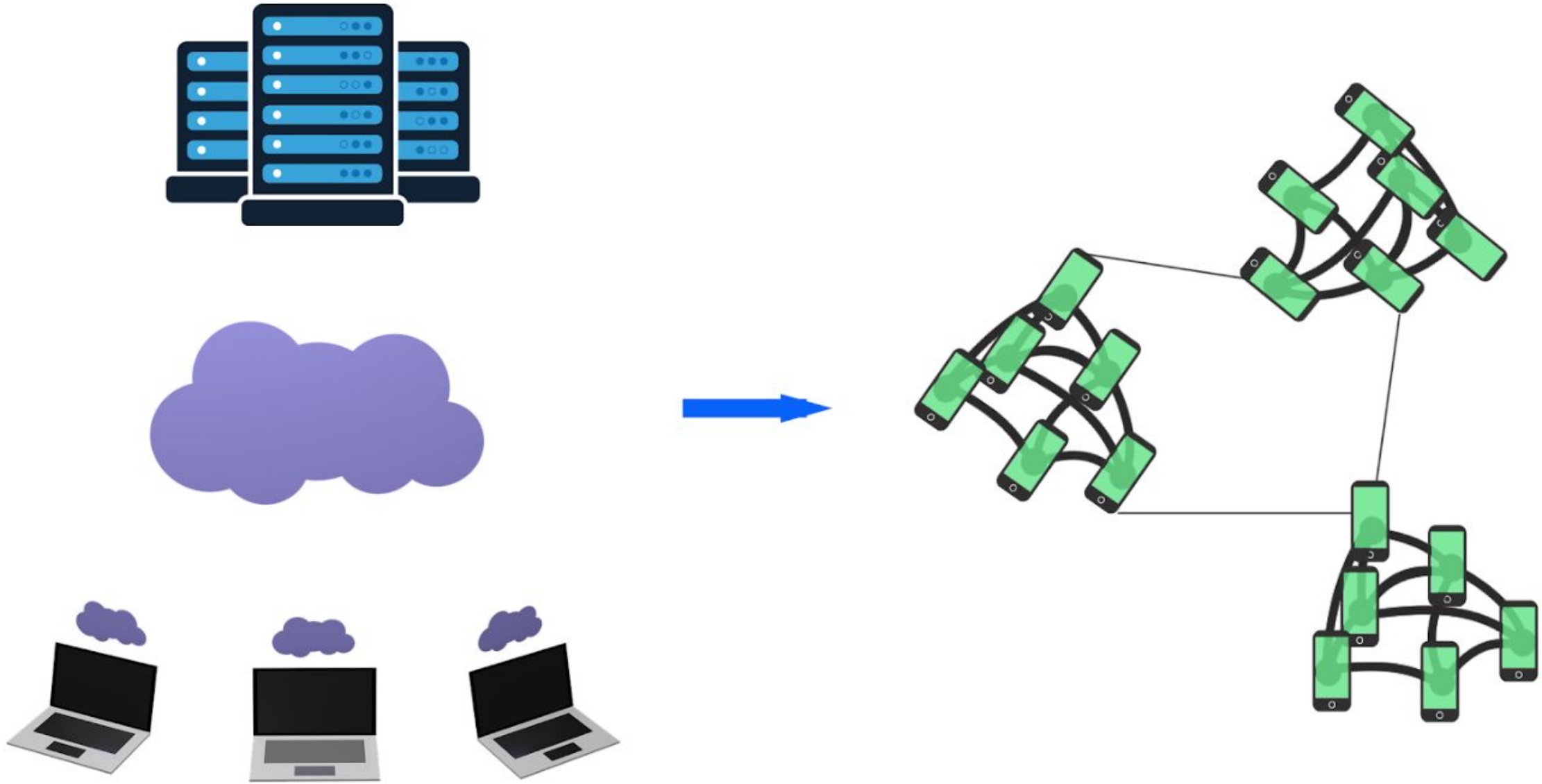
&

SMARTUP ZERO:
The first Smartup


Lenovo
ThinkBook
FONTAINE



Problem statement

Conventional communication infrastructure is not reliable when disaster strikes.

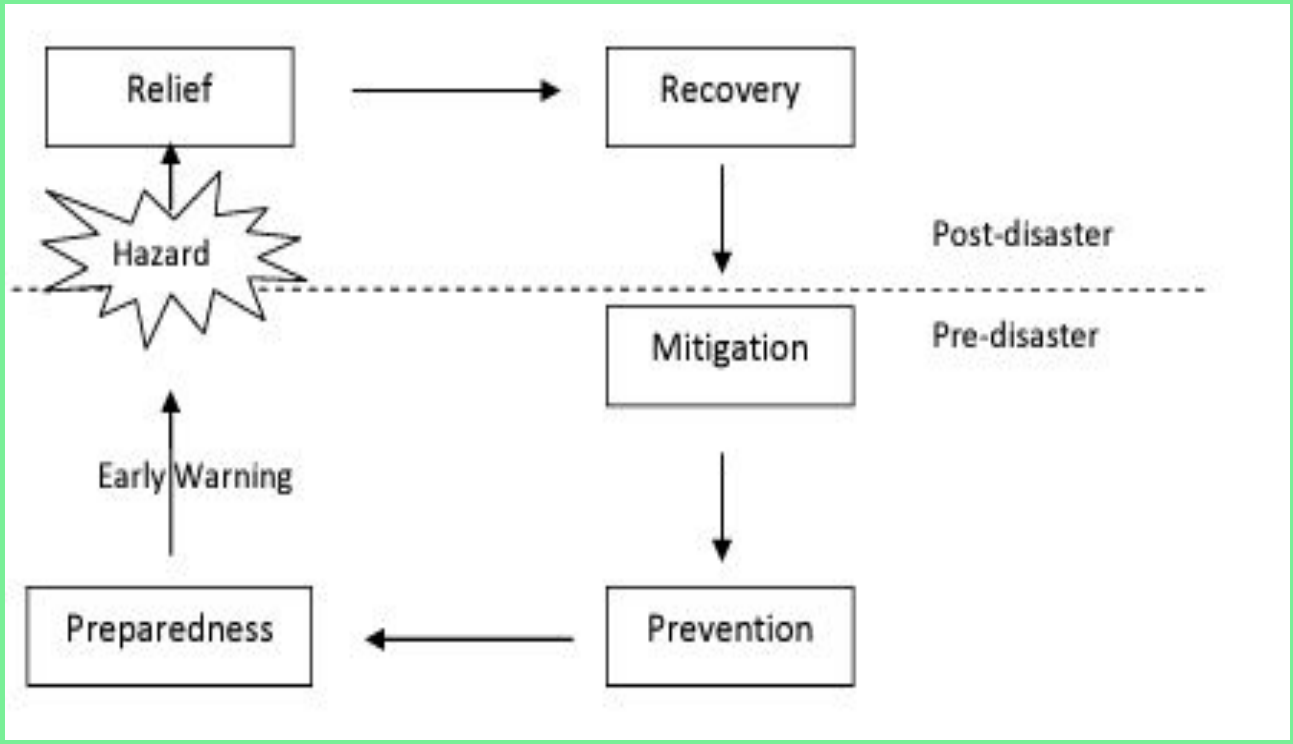
We need an ***emergency network*** *that is reliable.*

FOR the people
BY the people

Turkey earthquake 2020

What is the problem

IT plays a crucial role in all phases of disaster management



BUT: “The cables can break; the towers can topple; the power sources (and the backups) can fail; the people who operate the systems may die, be injured, or be unable to get to their stations. Depending on the technological platform, ICT infrastructure is vulnerable in varying degrees to damage and disruption from the physical causes described above.” -

The Resilience of ICT Infrastructure and Its Role during Disasters - Rohan Samarajiva and Shazna Zuhyle - United Nations Economic and Social Commission for Asia and the Pacific - 2013

Why is it a problem

Relieve AID organizations can't do their work effectively and efficiently.

More people die

Solution

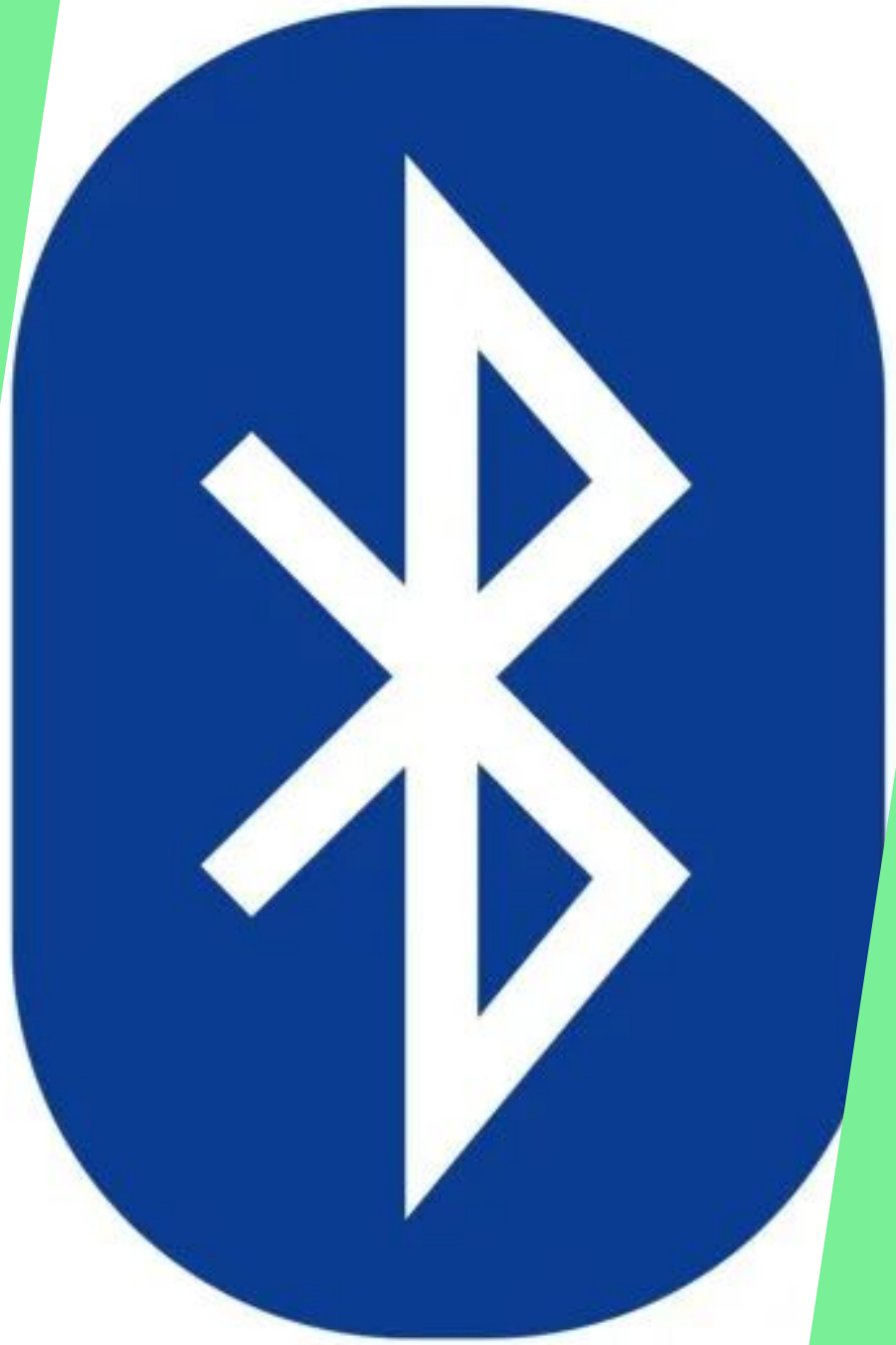
There are lots of smartphones in this area that can run their own network that AID organizations can use to do their work even better.

The challenges

- The network is made up exclusively of smartphones(nodes) without the need for extra hardware.
- The network nodes are not static and move over time, once a network is set up.
- The network needs to be able to reliably transport packets from point A to point B.
- The nodes can ungracefully leave the network.
- Nodes need to be able to quickly establish new connections as they continuously move within an area.

Target device

- Android 13
- BLE 5.3
- Wi-Fi 6
- LTE



Bluetooth 5.3

- 20mbit transfer speeds
- 10mbit transfer speed in LR mode
- Connectionless broadcast
- Mesh implementation
  - low data throughput

Wi-Fi 6

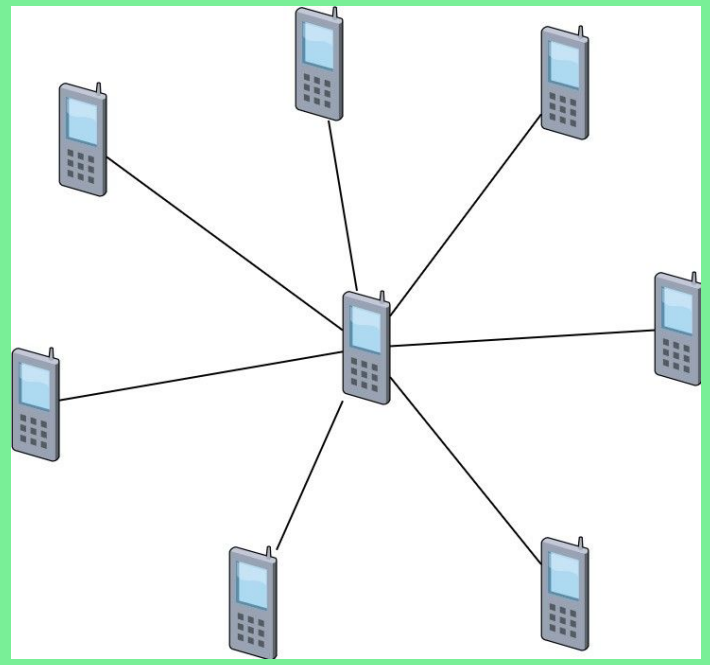
- High transfer rate
- No mesh implementation on smartphones as of august 2023
- Multiple bands
- STA/AP concurrancy on Android 13

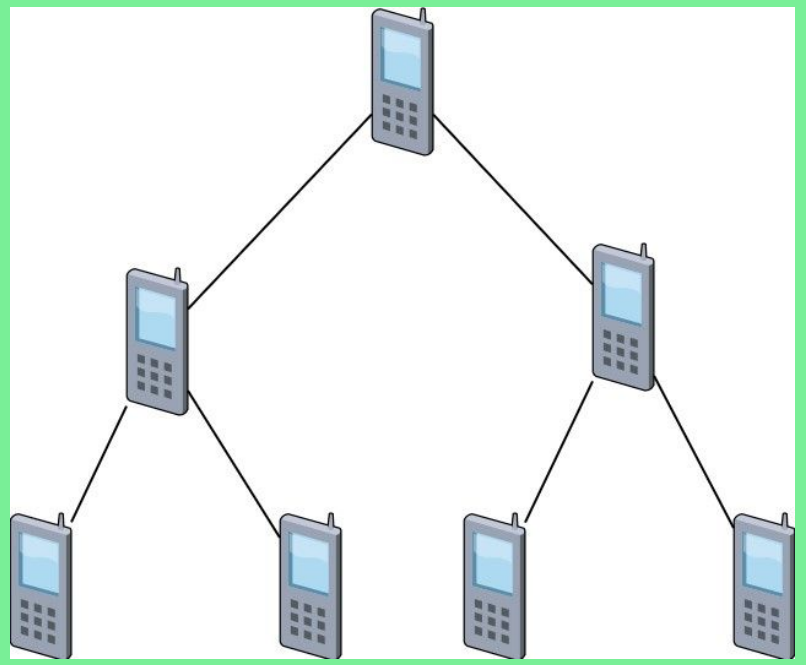
Technical challenges

- Creating a network using Wi-Fi as implemented on Android 13
- Dealing with broadcast storms
- Providing full routing functionality to al participants of the network
- Automatically connect devices within the network

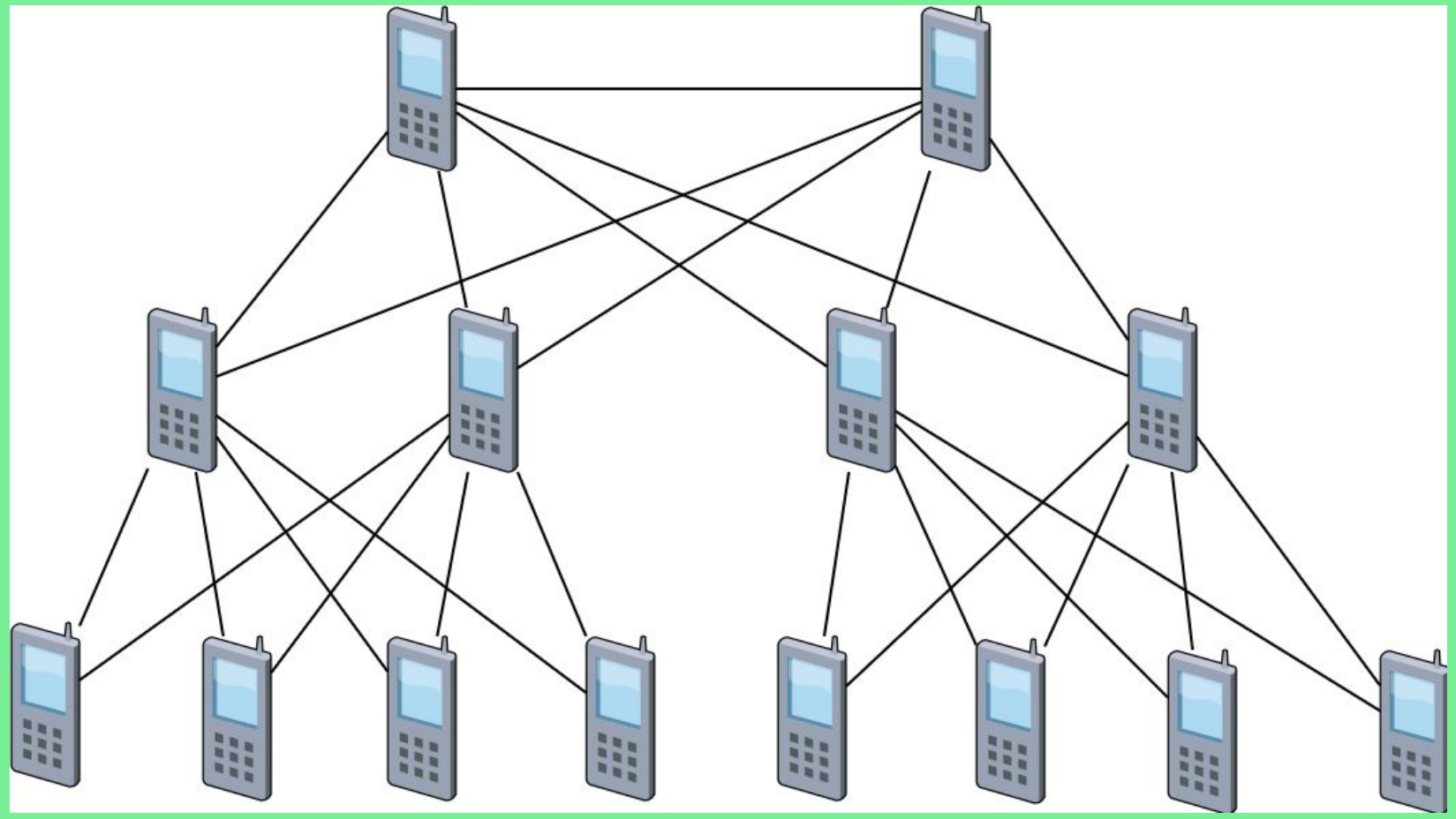
What is a possible solution?

- Cluster of small star-pattern networks
- Combine into one large content distribution network.





The topology



How do we achieve this?

- Ruleset for discovery and connection
- Ruleset for adding and removing nodes from the distribution network
- Ruleset for routing
- Ruleset for recovery

Discovery

- Connection based on a predefined SSID pattern
- Preshared keys

Connection and Promotion

- A distribution node reaches its threshold capacity
  - The distribution node sends out a request to all its clients to assess their capabilities
    - Clients respond
      - Distribution node sends a promotion request to the best client

- Removal of dead distribution nodes through timeouts

Routing logic - IP based routing

192.168.*0.1*

The third octet tells us the number level of the destination
Fourth octet tells us the position in a row counting from 1

We always send data to the destination distribution node
For client network a custom NATing solution is used

Recovery

- Graceful disconnect with in place promotion
- Ungraceful disconnect, keepalive timer fails.
  - Client does a complete reset and reconnect

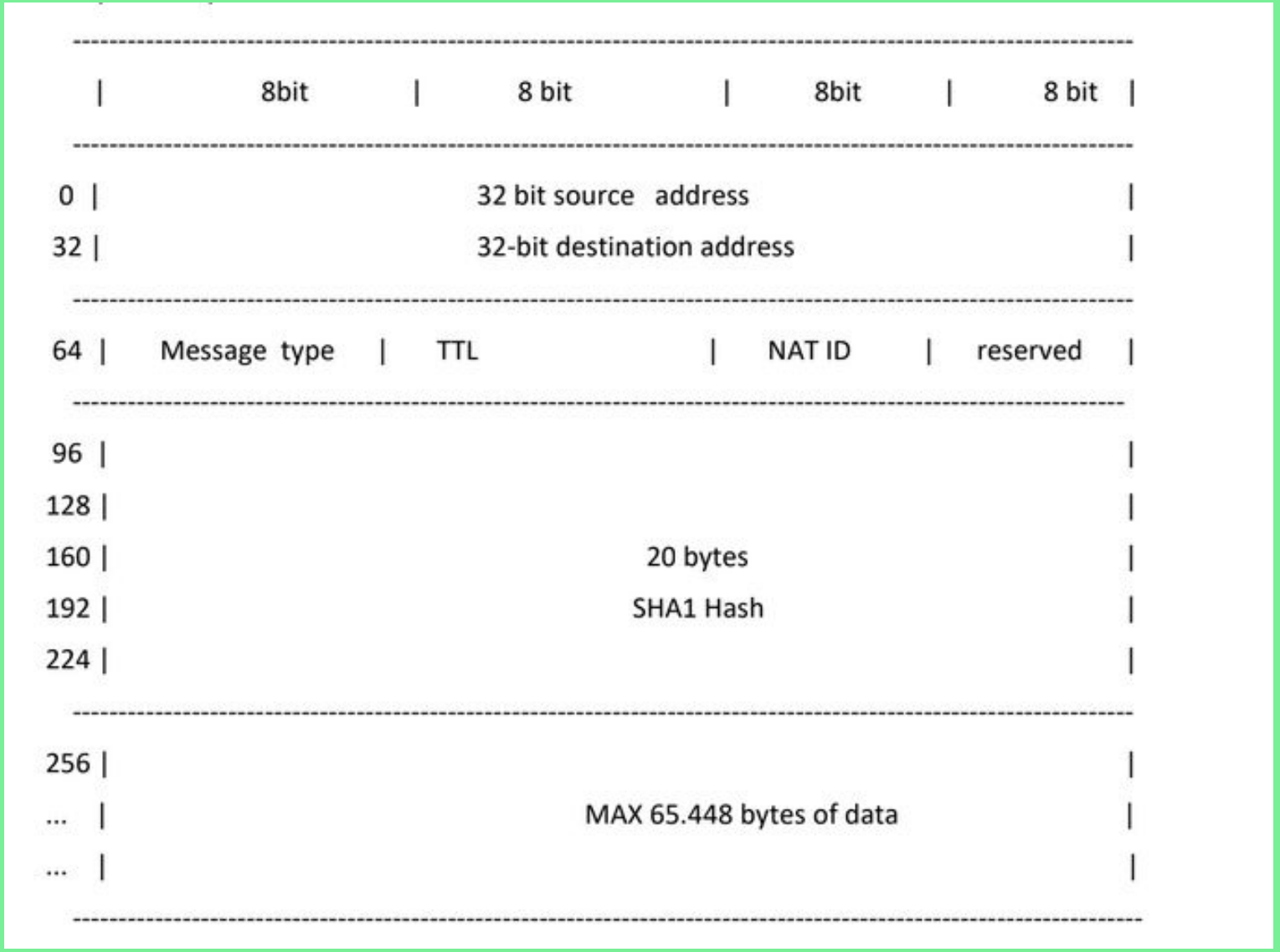
Content distribution

- Data manifest holding the adres and human readable text of any non peer to peer data.
- Data manifest is pushed from the root node, a full backup is available on the root replicant.

How did we implement this madness?

- UDP encapsulation
- Custom packet header
- Custom Simple NAT solution for client networks
- Predefined message types
- Keep alive tables
- Data manifest

Custom packet header



Custom data types

message type	value	cacheable
default message	0	no
Hello message	1	no
Promotion message	2	no
Promotion ack message	3	no
Keep alive message	4	no
data manifest request	5	no
data manifest ack	6	no
cacheable data message	7	yes
data manifest broadcast	8	no
data manifest delta broadcast	9	no
Promotion fitness request	10	no
Promotion fitness response	11	no
publication request	12	no
publication request response	13	no
Disconnect message	14	no
User defined	20-30	yes
User defined	30-40	no

Questions & feedback