# Cloudrone: Micro Clouds in the Sky

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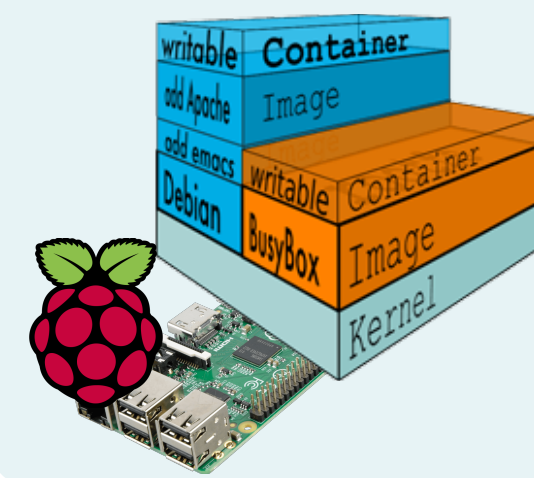+National Institute of Technology, Trichy , India

## Cloudrone

InaSAFE    LINE

**Building a lightweight micro-datacenter in the air**

Wireless Link

Satellite Link connects to the Internet

**BASE CAMP COMMAND CENTRE**

**EMERGENCY SITUATIONS**

**MIGRANT CRISIS**

Users access the services from the ground.

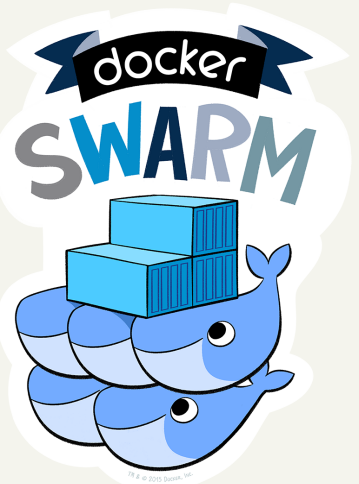**Lightweight and self-contained service:**
Unikernel, Docker, IncludeOS
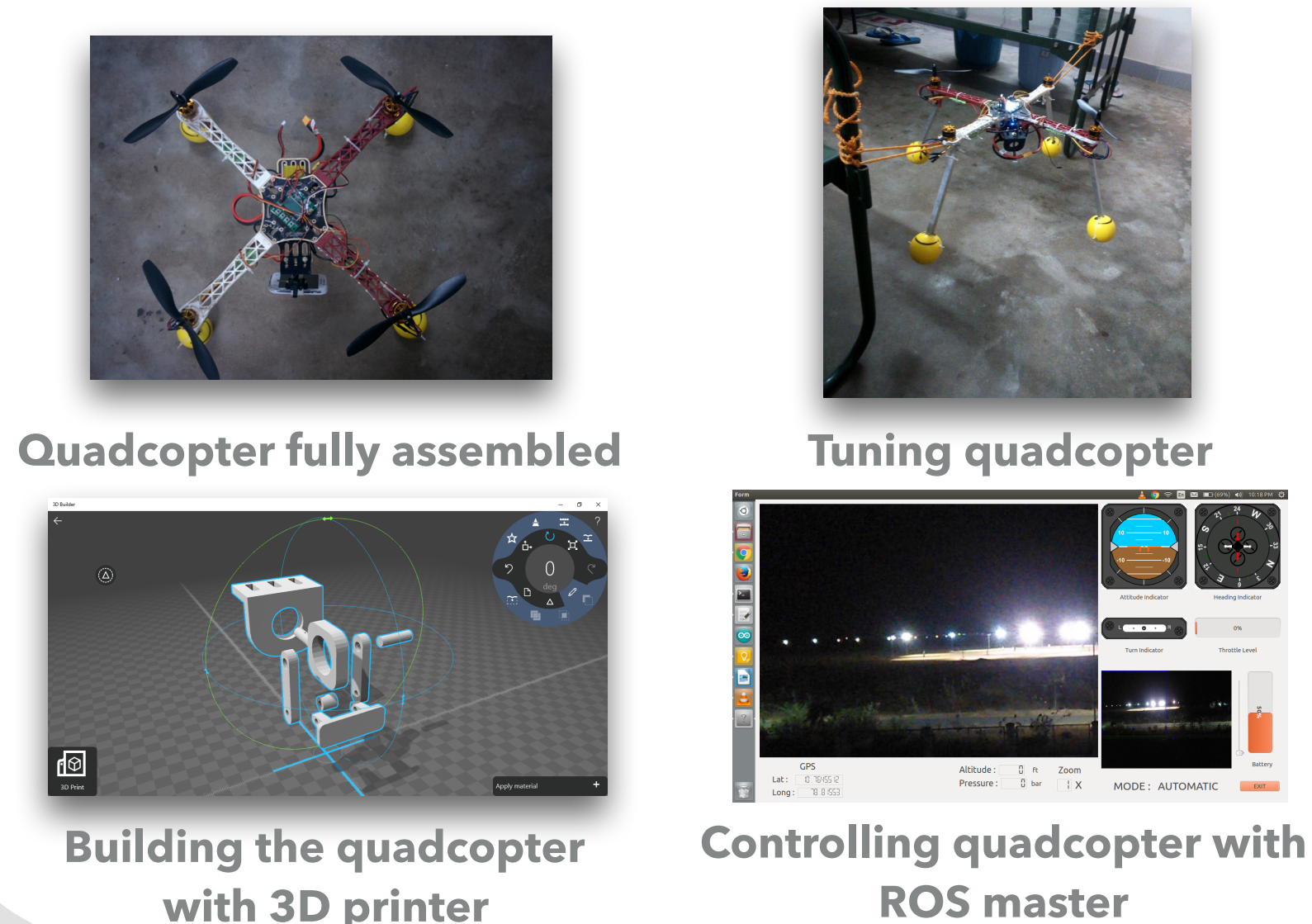
Build: Ship :
Run on small devices

### Integrating the micro cloud with the drone
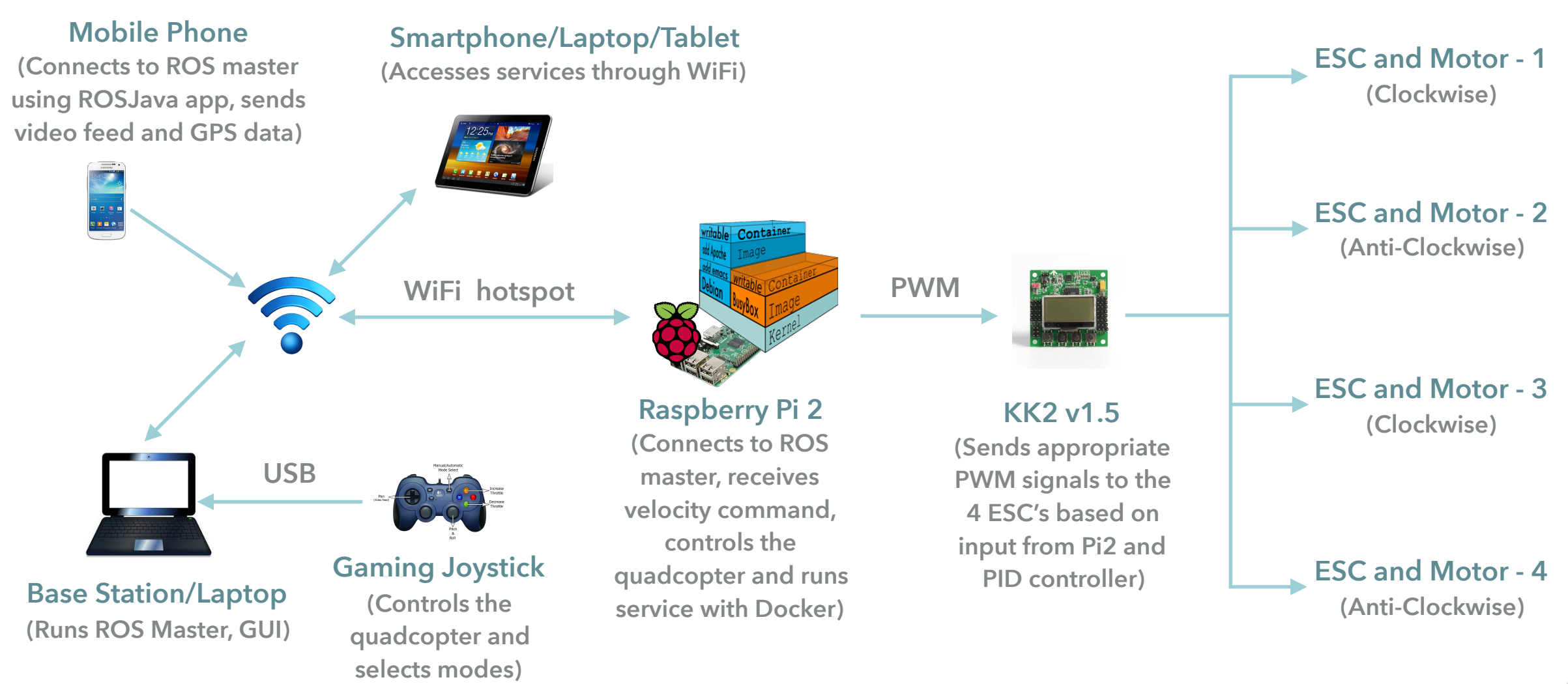
**OLSR-MANET:** Constructing a mesh of Drones

docker SWARM

Creating a cluster of multiple docker hosts and migrate the service containers across the cluster

## Building a low cost Quadcopter
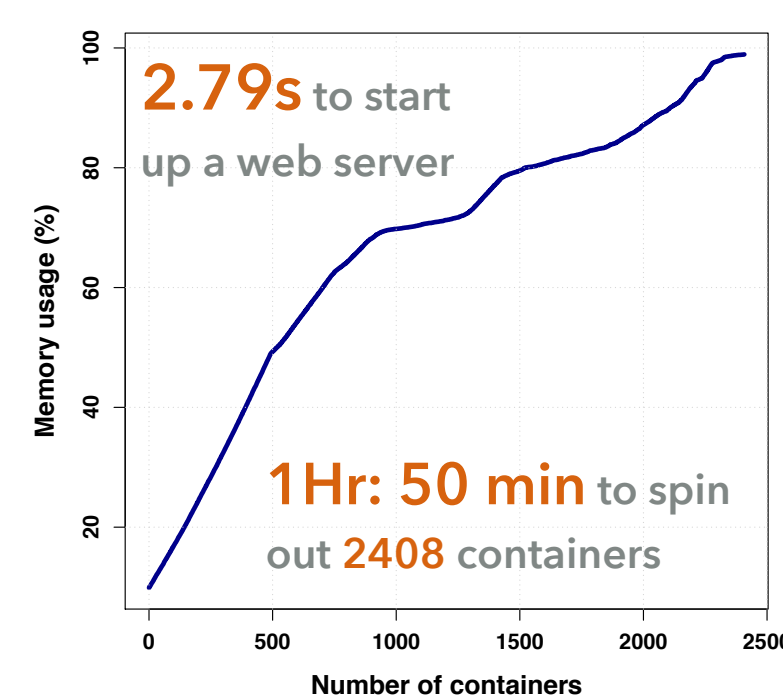
**Quadcopter fully assembled**

**Tuning quadcopter**

**Building the quadcopter with 3D printer**

**Controlling quadcopter with ROS master**

## System Design

Mobile Phone
(Connects to ROS master using ROSJava app, sends video feed and GPS data)

Smartphone/Laptop/Tablet
(Accesses services through WiFi)

WiFi hotspot

WiFi hotspot

USB

Base Station/Laptop
(Runs ROS Master, GUI)

Gaming Joystick
(Controls the quadcopter and selects modes)

Raspberry Pi 2
(Connects to ROS master, receives velocity command, controls the quadcopter and runs service with Docker)

PWM

KK2 v1.5
(Sends appropriate PWM signals to the 4 ESC's based on input from Pi2 and PID controller)

ESC and Motor - 1 (Clockwise)
ESC and Motor - 2 (Anti-Clockwise)
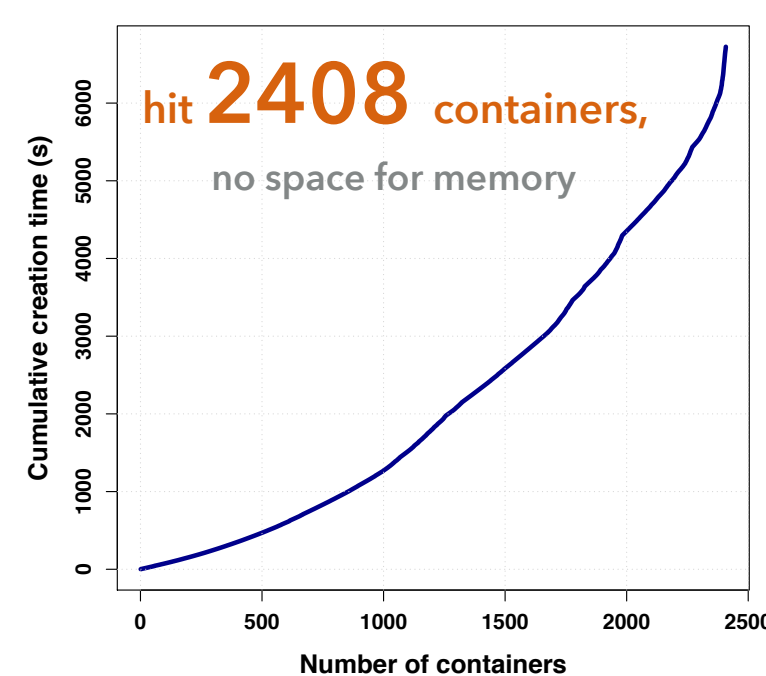ESC and Motor - 3 (Clockwise)
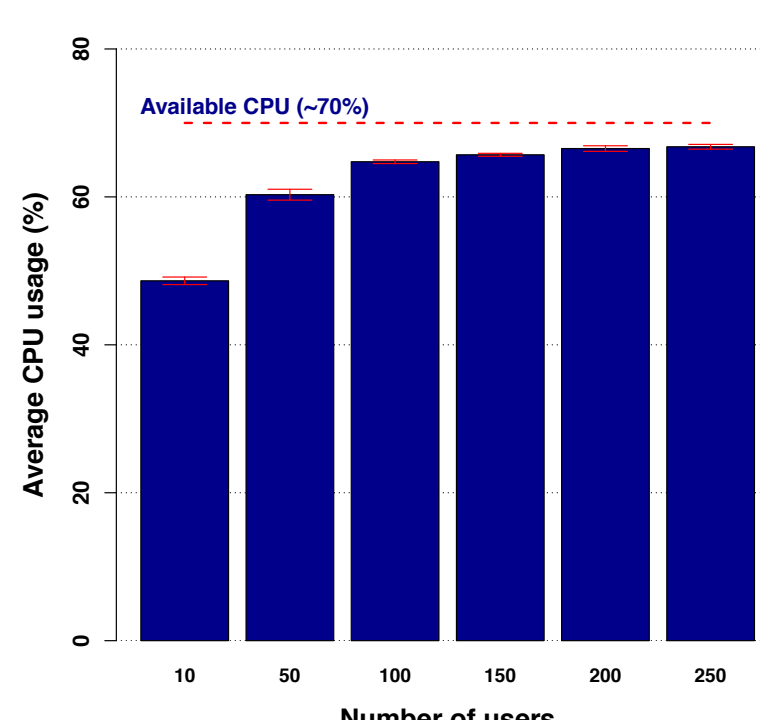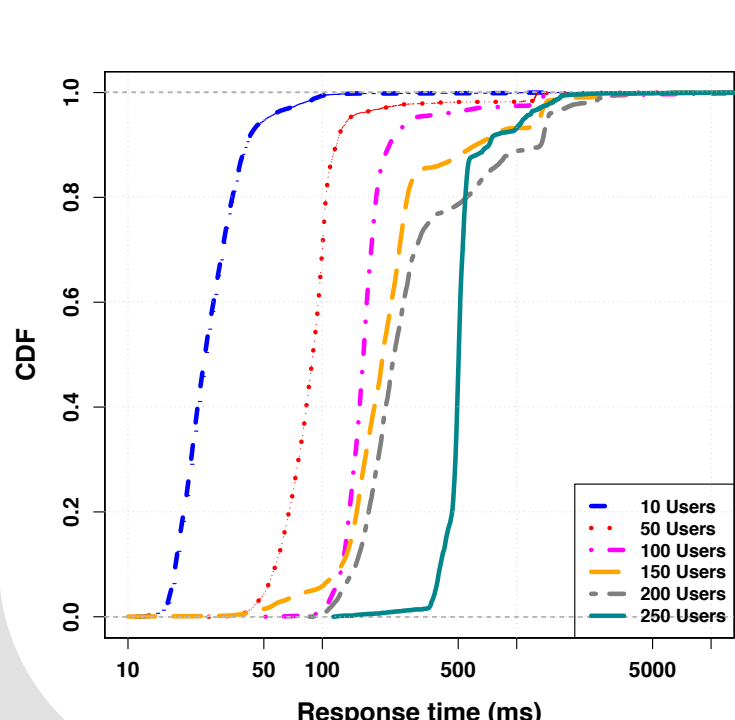ESC and Motor - 4 (Anti-Clockwise)

## Scaling up the number of deployed containers within a PI

- **Using a nano web server** (size is less than 90 KB).
- **Using *sysstat* to measure memory consumption, CPU utilisation and creation time**
- ***Key takeaway message:*** A single PI (PI 2 model B) can support significant amount of concurrent lightweight services.

hit **2408** containers, no space for memory

**2.79s** to start up a web server

**1Hr: 50 min** to spin out **2408** containers

## Scaling up the number of users accessing a single service

Available CPU (~70%)

- Using the Ab - Apache HTTP server
- Scaling concurrent users from **10 to 250**
- **10000** transactions per experiment
- ***Key takeaway message:*** A Docker container running on a single PI (PI 2 model B) can support significant amount of concurrent users

## Cloudrone's Challenges

- **Scalability**
  - Heavier services (e.g.,Openstreetmaps)
  - Load balancing techniques such as application layer anycast
- **Service Retrieval**
  - How to identify the location of the services across a mesh of drones?
  - Exploit techniques such as mDNS
  - Integrate with ICN such as NDN, SCANDEX (A.Sathiaseelan, Mobisys-DIY'15)
- **Deployment Issues**
  - Need innovative battery technology (e.g., hydrogen powered)
  - There are tight regulations in flying drones

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