On the Possibilities and Challenges of Organic UAV-Assisted MEC

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Abstract

Synthetic UAVs have been proposed to assist MEC task-offloading from remote IoT devices. So far, this has ignored the superiority of organic UAVs. In this paper, we thus present an architecture for organic UAV-assisted MEC and discuss opportunities and challenges of this approach. Our preliminary qualitative evaluation confirms that birds are cool.

(a) Dystopian and intimidating synthetic UAV

(b) Somewhat less intimidating organic UAV

Figure 1: This comparison shows that drones look more intimidating than birds.

1 Introduction

To support the Internet of Things (IoT), some recent proposals have suggested the use of unmanned aerial vehicles (UAV) in multi-access edge computing (MEC), e.g., [Xu et al., 2021, Du et al., 2018, You?, 2022]. It has generally been assumed that autonomous drones and airships are used for this purpose, sometimes in combination with artificial intelligence [Chen et al., 2021]. A UAV-assisted MEC architecture provides a number of advantages over ground-based MEC, namely a wider coverage and a justification for computer systems researchers to play with drones. To the best of our knowledge, no study has investigated the use of organic UAV with non-artificial intelligence for MEC. Avian carriers already play a major role in today's internet architecture, e.g., [Waitzman, 1990, Waitzman, 1999, Carpenter and Hinden, 2011, Guo et al., 2008] and are much less dystopian than drones, as Figure 1 shows. In this paper, we introduce an architecture for organic UAV-assisted MEC (Section 2), discuss technical challenges of implementing this architecture (Section 3), and then show other concerns and opportunities from non-technical perspectives (Section 4).

2 Organic UAV-Assisted MEC Architecture

We illustrate our proposed architecture for organic UAV-assisted MEC in Figure 2. Clients, such as IoT devices, connected cars, metaverse headsets, or whatever else is in style at the moment, connect to their nearest MEC-enabled organic UAV over the radio network to offload latency-critical tasks. Edge computing research tells us that these tasks are too important for the cloud as they have tight latency constraints that long network paths cannot satisfy [Literally any edge computing paper published in the last ten years]. Cloud computing is thus insufficient,

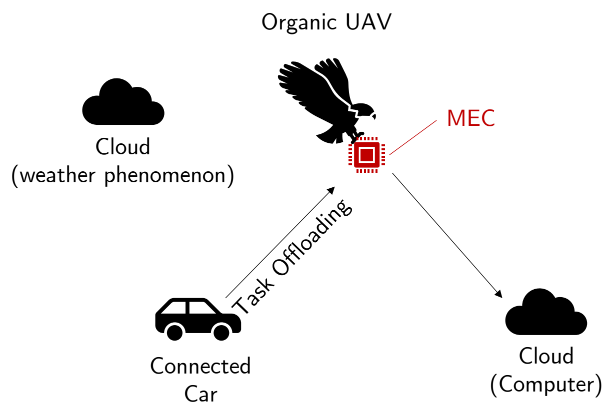

Figure 2: Proposed architecture of organic UAV-assisted MEC: Connected devices offload tasks to MEC-enabled organic UAVs. The cloud is there, too.

and micro-datacenters carried by the UAVs process these tasks close to the edge of the network instead.

The use of organic UAVs can drastically reduce capital expenditure, i.e., birds are literally free when you pick them up from the streets, reduces operational expenditure as organic beings tend to mend themselves, i.e., biology, and they look cuter than drones. Beyond these immediate, obvious benefits, there are a few additional challenges that will need to be addressed in this field.

3 Technical Challenges

While UAV-assisted MEC itself introduces a myriad of research challenges that keep edge systems researchers employed (cf. 1), the use of organic UAVs as described in our reference architecture 2 should help us fund even more technical projects.

Payload Capacity While the architecture of drones can be scaled up to support larger payloads, the payload capacity of an organic UAV is limited. Nevertheless, we can show that it is sufficient to support MEC: Consider the pigeon[1], which has a payload capacity of around 30-50 grams [Pigeonpedia, 2022]. A small, single-board computer such as a *Raspberry Pi Zero 2 W* has a net weight of 10 grams [Adafruit, 2022b], including radio antennas. A battery adapter and 3.7V 1200mAh lithium-ion battery will add an estimated 30 grams of weight [Adafruit, 2022a], staying below the total payload capacity of our pigeon. At an estimated 0.51 Watt draw [Viinikka, 2020], this battery should last $\frac{3.7V*1.2Ah}{0.51W} = \frac{4.44}{0.51}h = 8.7h$, likely longer than our organic UAV will last. Please note that the authors of this paper are computer scientists and any conjecture on basic electrical engineering is likely full of mistakes. We show a possible design of an MEC-enabled organic UAV, i.e., a bird with a Raspberry Pi, in Figure 3.

Unpredictable Trajectories Beyond seasonal changes, organic UAVs exhibit somewhat unpredictable movement. While the airspeed velocity of an *unladen* swallow depends on its exact subspecies [The Old Man From Scene 24 et al., 5th Century], we conjecture that the velocity of birds carrying a payload, e.g., an MEC device, is somewhat constant and may thus be used to make a more informed trajectory prediction. Nevertheless, this presents novel research challenges in ad-hoc networking and task scheduling. This is a good thing because it (a) gives us reasons to apply for further funding and (b) researchers now have a reason to cite this (ours) nominal work [Wallow et al., 2022].

[1] Other species are available.

Figure 3: A picture of a bird with a raspberry was not readily available. We thus present a squirrel holding a walnut.

Figure 4: Organic UAVs are able to self-organize to achieve a common goal. Unlike synthetic UAVs, which require artificial intelligence, organic UAVs use real intelligence.

Distributed Coordination A major challenge in the implementation of swarms of synthetic UAVs is distributed coordination. One possible technology that may be applied here is artificial intelligence. Fortunately, organic UAVs inherently solve this issue through the novel concept of *real intelligence*. With their capability to self-organize, swarms of organic UAVs should be able to coordinate their movements without external influence. This is illustrated in Figure 4. Nevertheless, we plan to conduct Turing tests with different kinds of organic and synthetic UAVs in future work.

4 Other Concerns & Opportunities

Beyond technical challenges, we share other perspectives on the use of organic UAV-enabled MEC in this section.

Increased Cost of Termination Unlike drones, which can be dismantled and recycled at the end of their lifespan, birds get more useless with age. When an organic UAV is no longer useful, it must still be supported until its life is terminated naturally, i.e., through old age. The authors of this paper refuse to hear of any alternative solutions.

United States Mass Ornicide of 1953-1961 As undoubtedly proven by Bohrer and Chau [Bohrer and Chau, 2021], birds as a species do not exist within the continental United States as a result of the CIA's well-known eradication of the species in the years 1953 to 1961. As the authors show, all aviods in the US have since been replaced by drones in order to fill the conceptual void left by this ornicide. This has serious implications on the use of organic UAVs within the US in both industry and research contexts, as any presumed *organic* UAVs are in fact *synthetic* UAVs controlled by the United States government. Nevertheless, we posit that from an MEC perspective, there is little difference as aviod drones are closely modelled after their organic counterparts. In fact, the resulting aviod control interfaces as described in the US GSA's *Methods of Bird Control* [U.S. General Services Administration, 2016] should provide additional avenues for the coordination of organic UAV-assisted MEC deployments. The impact of control by three letter agencies on an MEC deployment is negligible compared to the control already exerted through other means such as chem trails. Additionally, we note that Bohrer et al. have yet to prove their claims that comparable ornicides have occurred outside the US.

Birds are Cool Birds are basically dinosaurs [Hutchinson, 1998]. Dinosaurs are cool. By the transitive property, birds are thus cool. We just thought we should mention that.

UAV-Assisted MEC on Other Planets To the best of our knowledge, research on the use of organic UAVs on planets other than Earth lacks behind that on synthetic UAVs. We identify this as a major research gap.

Ethical Concerns The authors are not aware of any ethical concerns regarding the use of organic UAVs.

5 Conclusion & Future Work

In this paper, we have presented the concept of organic UAV-assisted MEC. Organic UAVs promise a number of advantages compared to synthetic UAVs, albeit their implementation will require overcoming a number of technical challenges, as we have presented. In future work, we plan to leave our basement and look at real birds. We hear they can be observed in parks in spring and summer.

Acknowledgements

Please rest assured that no birds were hurt in the research of this manuscript. However, one PhD student was seriously injured by a seagull on their lunch break.

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