A newly published paper called *"What changes from Ubiquitous computing to the Internet of Things in Interaction evaluation"* motivates open ended suggestion on what fields should be further developed to ensure qualities of human interaction with devices in an IoT environment.

It is well presented and does contain numerous amount of references that back this papers arguments with information. This gives the impression that the author has already studied and read these references which gives him a strong understanding and background on the topic. For the average reader it takes a few times to get the concrete idea, especially if you want to verify his facts by going through all the citations. It took my 3 to 4 readings to fully understand the context and purpose of this paper but that might be because of my inexperience of reading scientific papers. It's maybe because of my inexperience that I thought the format of some references confusing, often he referenced facts by writing "then as we saw in [5], we know that…" when in my opinion it would be clearer if he wrote "then as we saw in 'Experiment of IoT Devices' [5], we know that…". This format made the paper a little bit longer to read since you always had to click on the reference, go to the bottom of the paper and then up again.

It builds up nicely by first giving the reader a definition of what Ubiquitous computing is all about and how such systems can be classified and measured. The paper introduces 5 out of 27 important and focused aspects of Ubiquitous computing called HCI evaluation namely context-awareness, mobility, transparency, attention, and calmness. These aspects are then used to construct a software measurement functions where the author demonstrates for example a measurement for one of those aspects, calmness. I would suggest that the author would also add Security and Trust to the major definitions since I feel like systems that are designed for human interaction requires secure communication.

After doing so the attention is turned to a new emerging field, IoT, and how such software and technology can also be classified by its own criteria namely Identification, Sensing, Communication, Computing, Services and Semantics. The paper then takes an example about how these IoT characteristics function together in healthcare monitoring and how all of these small devices communicate together through the internet but not physically in real life. This is a crucial part of the paper since the reader is introduced to the fundamental operation of IoT devices and how they are built on combinations of interactions between things to things on the internet, rather than interaction between human and things. With that said, the focus of the paper is shifted towards using the same quality measurements used in Ubiquitous computing for human interaction for IoT as well to see if they can provide an insightful result.

The author presents three Ubiquitous and two IoT research software developed in the next chapter where he uses his calmness function to measure human to thing interaction on all projects. The arguments provided to measure quality of the calmness for human interaction of such systems is agreeable but I would argue that the measures should also include more of the 27 aspects. The projects varied between functionality like finding printers, controlling context based on available hardware and automating control inside a meeting rooms. After reading through their application measurement and comparison results, the paper is extended into four main questions on their findings which they propose their answers to.

What are the commonalities of HCI UbiComp evaluation that can be also used in IoT applications?
This questions answer simply suggest that when evaluating human to thing interaction most of the same measurements can be used for UbiqComputing and IoT to hint further improvements. To make long story short, these measurements work for the IoT projects but do not score as well as the Ubiquitous ones. Even though his measures are informative, I would have liked to see an example of the other 27 aspects of Ubiquitous computing. This would give me a better reason to understand why

he mostly focused on measuring calmness and why that measure was the most informative for the human to thing interaction.

What interaction problems were not identified in the IoT applications by the UbiComp measures?
The main take from this question was that it's harder for IoT to manage conflict and connections as the number of nodes within the system are increased. Even though I fully agree with managing more nodes in a system makes things harder I'm not fully sold that this is always the case.

What quickly comes to mind my experience in developing and debugging distributed systems. Since all of them are running individually with different clock rate, drift time and asynchronous connections I know how hard it is to predict a correct linearizable output unless using advanced algorithms like Paxos to keep nodes synchronized and fault tolerant. I guess as the devices get smaller they have less computational power and message transfer rate. So in my opinion, I think this statement varies a lot between relative computational powers of the devices used within the IoT environment.

He also talked about the system being inconsistent if an user wanted to turn a light on remotely but the system wanted to keep it off since no one was inside the room. I don't know how I feel about this point since I don't really agree on it. After few years of coding I don't see what's so hard about keeping the system in a state where it knows when it should act on its own and when it should obey external commands on certain matters. Using rules or state machines could have solved this problem so the system would know why it is acting the way it does and wouldn't have any conflicts. Maybe it was a fault in the code or they didn't think this action through. Their software for controlling the room could have had an extra option called hybrid mode which would follow instructions on selected controls, like the light in this case but act automatically by itself on the air condition since the user hadn't given the system any command on that.
Finally, the statement ended with a great sentence saying

> *"In short, the main interaction problems that arise from IoT applications are related to the Thing-Thing interaction, which impact on the Human-Thing interaction."*

Not only was this sentence simple and clear, but this made my mind wander a bit because the problem seems so obvious after reading it. Even though we do have basic broadcasting functions that guarantee that message is always eventually delivered, it doesn't help if a user has to wait for multiple seconds for and answer or response. System that are designed as Ubiquitous that blend within the environment will most likely distinct themselves out as simple running computers if its response is late in such a way that the user knows its communicating or waiting for a device. All of this comes down to an important feature of such systems which is a spontaneous interaction of both devices and humans since all objects tend to move in and out of such system. As they do, they should impact the response rate of the system to minimum. So I fully agree with that statement.

What characteristics and measures of Thing-Thing interaction should be evaluated in IoT systems?
This section determined possible characteristics to evaluate thing to thing interaction for both things communicating over the internet and with its hardware. For the internet the three characteristics Synchronicity, Responsiveness and Reliability are proposed. As I mentioned earlier, making systems synchronized will always be a hassle but it is still doable. No system should display information unless all systems agree on displaying it. I would rather propose Synchronicity time as a measurement since I think the timing of systems to synchronize is more important measurement. Responsiveness covers that though so maybe these two characteristics could be combined into one. Finally the Reliability characteristic falls under the same argument as I proposed earlier, that is, we can guarantee that a messages does arrive with broadcasting and other methods. So I think the author might want to rethink these proposed aspects into a narrower context.

In terms of things characteristics I agree mostly on the Battery, Context Awareness, Interoperability and Difficulty of installation. The first two hold hand in hand since the more aware the

system has to be by sensing more dimensions the more battery is required. The less the battery, the worse the awareness will be. My experience in working in IT for the past three years, I know for a fact that connecting devices together and installing new ones is always problematic since not only do we have different network technologies but operating systems and manufactures also greatly impact it. These two could be combined into a measurement that would relate somehow to some IT standard so we could know how much experience you should need before setting them up.

What are the major challenges to the interaction in IoT applications?

The final question suggested what challenges for developing IoT might need to be considered. The suggested topics were Interoperability, Consistency of the Interactions, Verification of Interest Conflicts, and Evaluation. I don't feel like going deeper into these topics since I have already touched on them partly in the questions above. However I think the author is missing out two important topics that I would like to see more focus on. The first one is security standards of IoT devices since today, most smart refrigerators and other devices for the household are not really secure. Last year a lot of such devices were comprised to perform DDOS attacks on multiple websites. It feels like the might be incorporated with the Interoperability or added a special topic. The second thing I would like to add is what qualities we should be focusing most on since leveraging one aspect of a device will sacrifice the quality of another, hinting some kind of tradeoff. Take for an example, we want to keep the system secure and safe using some hashing/crypto algorithm to encode all messages within the network. This would however slow down the response rate of the device since all of them would need a few extra operations to do so. This stacks up quite fast as the number of devices grow so here we would sacrifice latency for security.

The paper then ends with a short summary of what the paper was all about and the human to thing interaction difference between UbiqComputing and IoT and the problems with thing to thing interactions. The evaluation (implies) that as the IoT environment grows, more latency is introduced which tends to slow the spontaneous interaction of human-things. The author doesn't provide any final conclusion of its findings but instead encourages those who are interested to research further development of the paper's findings from the open ended questions for interaction of things to things in IoT systems. I think that is a fine ending to spark interest for the readers. Plus, his suggestions on what should be research further only comes from hypothesis and discussions so it wouldn't make sense to declare what needs to be done.

I think the paper is an interesting read and surely motivates further research in the area. Since the final conclusion of this paper points to which areas should be further researched for further development of IoT quality standard my first initial thought was that the title is a bit misleading. I feel like the title implies what changes in interaction evaluation between IoT and UbiqComputing when it instead should sound more like "Recommendations for interaction quality of things to things for IoT" or "Motivated suggestion for further evaluation of IoT devices". That would give a more precise information about what the reader should be looking for if he wants to find a new research field within IoT.

I think this paper is highly relevant for those who want to study ubiquitous computing. It gives the reader a deeper perspective about the problems that might rise in the design phase as Ubiquitous systems grows with more devices and interactions if they were to be connected within an IoT environment. This is something that I haven't really given too much thought by myself so I'm happy that I read this.