

PhD Application for The PhD Thesis "Decentralized Fog Computing Infrastructure Control"

Ali J. Fahs

Supervised by Professor Guillaume Pierre

Audition, 8th of June, 2017

Outline

- 1 Personal Presentation
- 2 Master Thesis
- 3 State-of-the-Art for Edge Clouding
- 4 PhD Topic
- 5 Project Perspective

- A double diploma student.
 - Engineering diploma in telecommunication and computer science - **Lebanese University, Faculty of engineering (ULFG)**.
 - Master's degree in Informatics Grenoble (MoSIG) Parallel, Distributed Systems Track - **Grenoble INP** (Institut national polytechnique), **Ensimag** (École nationale supérieure d'informatique et de mathématiques appliquées de Grenoble) jointly with **UGA** (université grenoble alpes), **IMAG** (Informatique, mathématiques, mathématiques appliquées de Grenoble).
- Research interest: **Distributed systems, Networking.**
- Master's thesis "Distributed Approach for Cross-Layer Resource Allocation in Wireless Sensor Networks" Jointly between LIG (Laboratoire d'Informatique de Grenoble) and VERIMAG.

Overview

- IEEE802.15.4: Wireless sensor network standard.

Overview

- IEEE802.15.4: Wireless sensor network standard.
- Time-slotted channel hopping (TSCH), The Medium access layer control.

		Time Slot				
		0	1	2	3	4
Channel Offset	0	Shared Slot				B>A
	1		C>A			
	2		B>D		D>B E>C	
	3					

Overview

- IEEE802.15.4: Wireless sensor network standard.
- Time-slotted channel hopping (TSCH), The Medium access layer control.
- 6TiSCH: IPv6 over IEEE802.15.4e TSCH.

		Time Slot				
		0	1	2	3	4
Channel Offset	0	Shared Slot				B>A
	1		C>A			
	2		B>D		D>B E>C	
	3					

Challenges

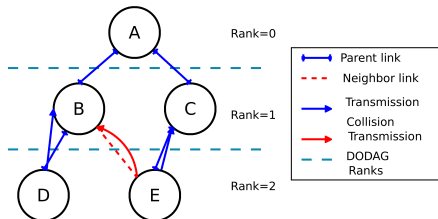
- High collision rates in TSCH dedicated cells.

		Time Slot				
		0	1	2	3	4
Channel Offset	0	Shared Slot				B>A
	1		C>A			
	2		B>D		D>B E>C	
	3					

Challenges

- High collision rates in TSCH dedicated cells.
- Cause: no coordination between nodes.

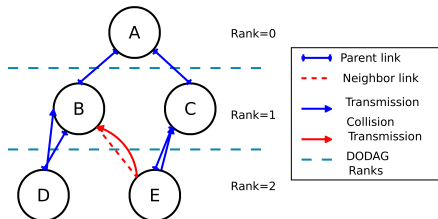
		Time Slot				
		0	1	2	3	4
Channel Offset	0	Shared Slot				B>A
	1		C>A			
	2		B>D		D>B E>C	
	3					



Challenges

- High collision rates in TSCH dedicated cells.
- Cause: no coordination between nodes.
- Lack of central entity.

		Time Slot				
		0	1	2	3	4
Channel Offset	0	Shared Slot				B>A
	1		C>A			
	2		B>D		D>B E>C	
	3					

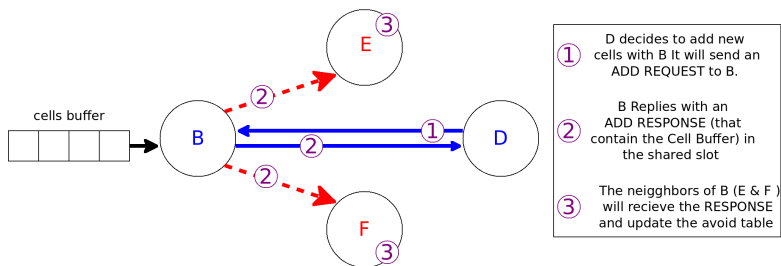


Proposed Mechanism

- Local mutual exclusion: every node passively learn the schedule of their neighbors.

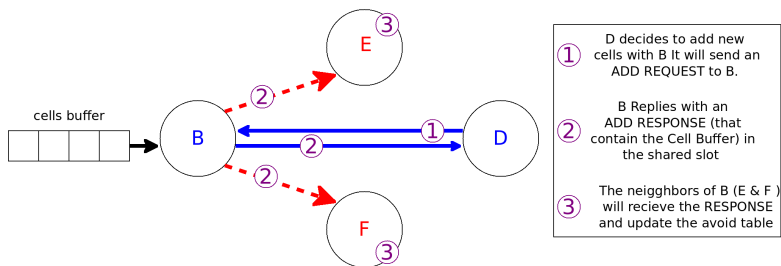
Proposed Mechanism

- Local mutual exclusion: every node passively learn the schedule of their neighbors.
- Entirely local algorithm, no new messages were introduced.

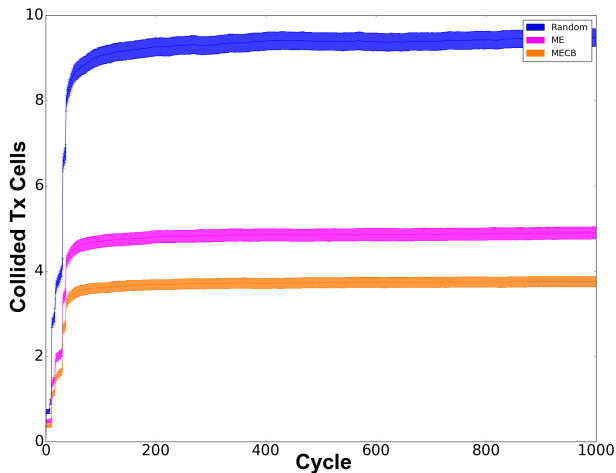


Proposed Mechanism

- Local mutual exclusion: every node passively learn the schedule of their neighbors.
- Entirely local algorithm, no new messages were introduced.
- Result: 70% reduction in the colliding Tx cells.



Master thesis Results



- Paper to be submitted to conference **WiMob 2017**.

Cloud Infrastructure

- Pros: extremely flexible and powerful.

Cloud Infrastructure

- Pros: extremely flexible and powerful.
- Cons: Clouding disadvantages: latency, mobility, *etc...*

State-of-the-Art for Edge Clouding

Cloud Infrastructure

- Pros: extremely flexible and powerful.
- Cons: Clouding disadvantages: latency, mobility, *etc...*

Edge clouds

- Idea: deploying cloud applications in the immediate end user proximity.

*references: 1-Yi, Shanhe, Cheng Li, and Qun Li. "A survey of fog computing: concepts, applications and issues." Proceedings of the 2015 Workshop on Mobile Big Data. ACM, 2015.

2- Van Kempen, Alexandre, et al. "MEC-ConPaaS: An experimental single-board based mobile edge cloud." IEEE Mobile Cloud Conference. 2017.

State-of-the-Art for Edge Clouding

Cloud Infrastructure

- Pros: extremely flexible and powerful.
- Cons: Clouding disadvantages: latency, mobility, *etc...*

Edge clouds

- Idea: deploying cloud applications in the immediate end user proximity.
- Results: better end to end latency and application interactivity, less long-distance traffic.

*references: 1-Yi, Shanhe, Cheng Li, and Qun Li. "A survey of fog computing: concepts, applications and issues." Proceedings of the 2015 Workshop on Mobile Big Data. ACM, 2015.

2- Van Kempen, Alexandre, et al. "MEC-ConPaaS: An experimental single-board based mobile edge cloud." IEEE Mobile Cloud Conference. 2017.

State-of-the-Art for Edge Clouding

Cloud Infrastructure

- Pros: extremely flexible and powerful.
- Cons: Clouding disadvantages: latency, mobility, *etc...*

Edge clouds

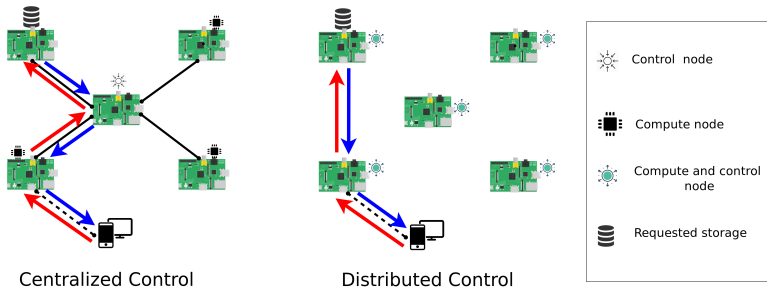
- Idea: deploying cloud applications in the immediate end user proximity.
- Results: better end to end latency and application interactivity, less long-distance traffic.
- Infrastructure based on single-board computers: small, cheap, can be deployed everywhere.

*references: 1-Yi, Shanhe, Cheng Li, and Qun Li. "A survey of fog computing: concepts, applications and issues." Proceedings of the 2015 Workshop on Mobile Big Data. ACM, 2015.

2- Van Kempen, Alexandre, et al. "MEC-ConPaaS: An experimental single-board based mobile edge cloud." IEEE Mobile Cloud Conference. 2017.

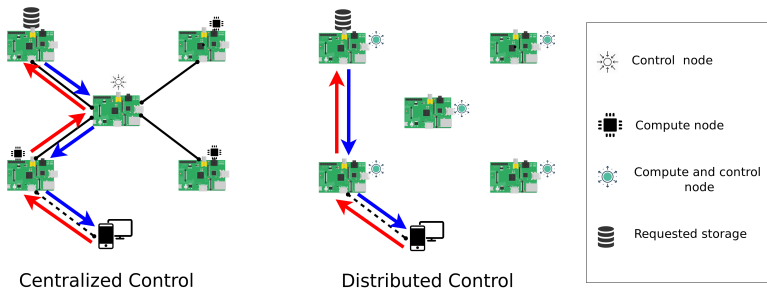
Challenges of Fog Computing

- Infrastructure based on very large numbers of unreliable and distributed servers.



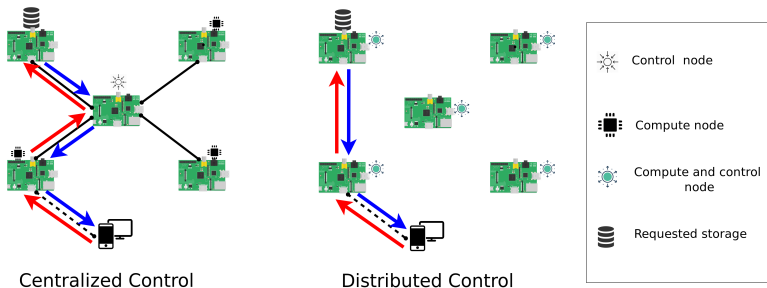
Challenges of Fog Computing

- Infrastructure based on very large numbers of unreliable and distributed servers.
- But the control remains centralized.



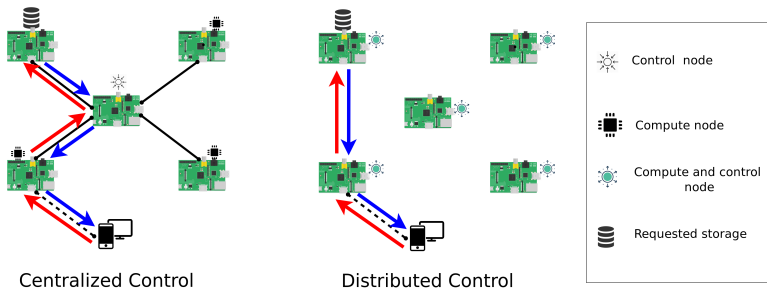
Challenges of Fog Computing

- Infrastructure based on very large numbers of unreliable and distributed servers.
- But the control remains centralized.
- Drawbacks: unnecessary traffic, latency, robustness



Challenges of Fog Computing

- Infrastructure based on very large numbers of unreliable and distributed servers.
- But the control remains centralized.
- Drawbacks: unnecessary traffic, latency, robustness
- Application developers should not handle the complexity of application deployment, fault tolerance, reconfiguration, or elasticity.



Objectives

- Designing fully distributed control mechanisms: every compute node is also a control node.

*references: Jelasity, Mrk, et al. "Gossip-based peer sampling." ACM Transactions on Computer Systems (TOCS) 25.3 (2007).

Objectives

- Designing fully distributed control mechanisms: every compute node is also a control node.
- Compare to centralized alternatives.

*references: Jelasity, Mrk, et al. "Gossip-based peer sampling." ACM Transactions on Computer Systems (TOCS) 25.3 (2007).

Objectives

- Designing fully distributed control mechanisms: every compute node is also a control node.
- Compare to centralized alternatives.
- One interesting direction: gossip-based algorithms for the coordination of multiple schedulers.

*references: Jelasity, Mrk, et al. "Gossip-based peer sampling." ACM Transactions on Computer Systems (TOCS) 25.3 (2007).

Perspective

Project Perspective

- Edge clouds are very new \implies opportunities for impact

Personal Perspective

Project Perspective

- Edge clouds are very new \implies opportunities for impact
- An H2020 project coordinated by Prof. Pierre will start soon on fog computing.

Personal Perspective

Project Perspective

- Edge clouds are very new \implies opportunities for impact
- An H2020 project coordinated by Prof. Pierre will start soon on fog computing.

Personal Perspective

- Spend 3 years of my life with a subject that I'm completely interested in, so I can reach my max potential.

Project Perspective

- Edge clouds are very new \implies opportunities for impact
- An H2020 project coordinated by Prof. Pierre will start soon on fog computing.

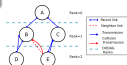
Personal Perspective

- Spend 3 years of my life with a subject that I'm completely interested in, so I can reach my max potential.
- The field of cloud and distributed systems is currently undergoing a revolution, and I want to be a part of this revolution.

Master Thesis

Internship Challenges

- Improvement in the distributed 6TiSCH networks
- Reduction of collision in TSCH Dedicated cells.
- The distributed approach causing the problem.
- Lack of central entity.



Ali J. Fakhri - PhD Application for The PhD Thesis "Decentralized Fog Computing Infrastructure Control" 8 / 12

State-of-the-Art for Edge Clouding

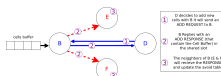
- Cloud infrastructures are extremely flexible and powerful.
- Clouding disadvantages: latency, mobility, etc...
- Application-Network wall.
- Edge Clouds: Deploying Cloudlets in the immediate end user proximity.
- Using single board computers as Cloudlets: cheap, location, size, security.
- Improvement of end to end latency, and application interactivity.

Ali J. Fakhri - PhD Application for The PhD Thesis "Decentralized Fog Computing Infrastructure Control" 8 / 12

Master Thesis

Proposed Mechanism

- Local Mutual exclusion.
- Using already existing transaction.
- No new traffic was induced.
- All the neighbor node will passively learn the schedule of B
- Achieved 70% reduction in the colliding Tx cells.

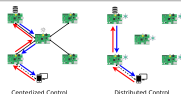


Ali J. Fakhri - PhD Application for The PhD Thesis "Decentralized Fog Computing Infrastructure Control" 8 / 12

PhD Topic

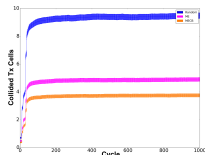
Challenges of Fog Computing

- Centralized control over a distributed compute/storage resources.
- Drawbacks of the centralized: Unnecessary traffic, latency, fragile.
- Implementing very large number of potentially unreliable servers.
- Application developers should not handle the complexity of application deployment, fault tolerance, reconfiguration, or elasticity.



Ali J. Fakhri - PhD Application for The PhD Thesis "Decentralized Fog Computing Infrastructure Control" 8 / 12

Internship Results



Ali J. Fakhri - PhD Application for The PhD Thesis "Decentralized Fog Computing Infrastructure Control" 8 / 12

PhD Topic

Objectives

- Applying a distributed mechanism to manage the resources.
- Comparing the performance of Distributed mechanisms to centralized ones.
- Executing cloud resource scheduling algorithms.
- One interesting direction: gossip-based algorithms for the coordination of multiple schedulers.

Ali J. Fakhri - PhD Application for The PhD Thesis "Decentralized Fog Computing Infrastructure Control" 8 / 12

Thanks for your attention!
Questions?