Zhou et al. EURASIP Journal on Wireless Communications and Networking (2018) 2018:80
https://doi.org/10.1186/s13638-018-1090-9

EURASIP Journal on Wireless Communications and Networking

CORRECTION Open Access

Correction to: Improving cellular downlink throughput by multi-hop relay-assisted outband D2D communications

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1 Correction

The original publication [1] misses four algorithms. The missing ones can be found in this Erratum.

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Published online: 17 April 2018

Reference

1. Improving cellular downlink throughput by multi-hop relay-assisted outband D2D communications. EURASIP J Wireless Commun Netw **2017**, 209 (2017) https://doi.org/10.1186/s13638-017-0998-9

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Algorithm 1: The first relay preselection for DTO-MROD

Run at *eNB*

Input: T^{i}_{cell}, T^{ji}_{cell}, $V_i \subset I_{i,nei} \subset \Re$, d^{ji}, d_{th}, RIE_{th}, $\forall i,j \in \Re = \{0,1, \ldots, N\}$

Output: α_{ji}, c_{ji}

1. Initialize: $o=0$, $s=0$, $\alpha_{00}=1$, $\alpha_{ji}=0$, $c_{ji}=0$, $\Delta T_{ji}=0$; $D=\varnothing$
2. **For** $i \in \Re$ **do**
3. $T^{i}_{th} = b^{i}_{cell} \cdot \log_2(1+\gamma_{th})$
4. **If** $T^{i}_{cell} < T^{i}_{th}$ **then**
5. **For** $j \in V_i$ **do** $\Delta T_{ji} = T^{ji}_{cell} - T^{i}_{cell}$ **End for**
6. **End if**
7. **End for**
8. **For** i from 1 to N **do**
9. Find $argmax_{(j\setminus i)} \Delta T_{ji}$, $j \in V_i$
10. **If** $\Delta T_{ji} > 0$ **then**
11. **If** $d^{ji} \le d_{th}$ **then**
12. **If** $o == 0$ **then** {$o=j$; $\Delta T_{ji} = 0$; *go to* 9}
13. **Else if** $s == 0$ **then** $s=j$
14. **End if**
15. **Else** $\Delta T_{ji} = 0$ and *go to* 9
16. **End if**
17. **End if**
18. **If** $RIE_i < RIE_{th}$ **then** {$\alpha_{si}=1$, $c_{si}=1+\text{Rand}(9)$, $\alpha_{0s}=1$, and $D=D \cup \{(s,i)\}$}
19. **Else** {$\alpha_{oi}=1$, $c_{oi}=1+\text{Rand}(9)$, $\alpha_{0o}=1$, and $D=D \cup \{(o,i)\}$}
20. **End if**
21. **End for**

Algorithm 2: The second relay preselection for DTO-MROD

Run at *eNB*

Input: T^{j}_{cell}, T^{kj}_{cell}, $V_j \subset I_{j,nei} \subset \Re$, c_{ji}, d^{kji}, d_{th}, e^{k}, e_{th}, $\forall i,j,k \in \Re=\{0,1,\ldots,N\}$

Output: α_{kji}, c_{kj}

1. Initialize: $\alpha_{00}=1$, $\alpha_{kji}=0$, $c_{kj}=0$, $\Delta T_{kj}=0$
2. **For** $\forall(j,i) \in D$ **do**
3. $T^{j}_{th} = b^{j}_{cell} \cdot \log_2(1+\gamma_{th})$
4. **If** $T^{j}_{cell} < T^{j}_{th}$ **then**
5. **For** $k \in V_j$ **do** $\Delta T_{kj} = T^{kj}_{cell} - T^{j}_{cell}$ **End for**
6. **End if**
7. **End for**
8. **For** $\forall(j,i) \in D$ **do**
9. Find $argmax_{(kj)}\, \Delta T_{kj}$, $k \in V_j$
10. **If** $\Delta T_{kj} > 0$ **then**
11. **If** $d^{kji} \le d_{th}$, $e^{k} \ge \min(e^{j}, e_{th})$ **then** $\{\alpha_{kji} = 1$ and $c_{kj} = c_{ji}+5\}$
12. **Else** $\Delta T_{kj} = 0$ and *go to* 29
13. **End if**
14. **End if**
15. **End for**

Algorithm 3: The relay verification for DTO-MROD

Run at *eNB*

Input: $I_{i,nei} \subset \Re$, $I_{j,nei} \subset \Re$, $V_m \subset \Re$, α_{ji}, α_{kji}, c_{ji}, c_{kj}, $\forall i,j,k,m \in \Re = \{0,1, \ldots, N\}$

Output: α_{ji}, α_{kji}

1. Initialize: $T^{kji}_{d2d} = 0$, $T^{ji}_{d2d} = 0$
2. **For** $i \in \Re$ **do**
3. **If** $\alpha_{kji} == 1$ **then**
4. $F_{i,wifi} = 0$; $F_{j,wifi} = 0$
5. **For** $m \in I_{i,nei} \backslash j$ and $l \in V_m$ **do**
6. **If** Abs(c_{ml}-c_{ji})<5 **then**
7. $F_{i,wifi} = F_{i,wifi} + g_{mi} \cdot p_{ml} \cdot (1\text{-}0.2 \cdot \text{Abs}(c_{ml}\text{-}c_{ji}))$
8. **End if**
9. **End for**
10. **For** $m \in I_{j,nei} \backslash k$ and $l \in V_m$ **do**
11. **If** Abs(c_{ml}-c_{kj})<5 **then**
12. $F_{j,wifi} = F_{j,wifi} + g_{mj} \cdot p_{ml} \cdot (1\text{-}0.2 \cdot \text{Abs}(c_{mj}\text{-}c_{kj}))$
13. **End if**
14. **End for**
15. $T^{kji}_{d2d} = \min(T^{ki}_{cell}, T^{kj}_{wifi}, T^{ji}_{wifi})$
16. **If** $T^{j}_{cell} > T^{kji}_{d2d}$ **then** {α_{kji}=0, c_{kj}=0 and c_{ji}=0} **End if**
17. **Else if** $\alpha_{ji} == 1$ **then**
18. $F_{i,wifi} = 0$
19. **For** $m \in I_{i,nei} \backslash j$ and $l \in V_m$ **do**
20. **If** Abs(c_{ml}-c_{ji})<5 **then**
21. $F_{i,wifi} = F_{i,wifi} + g_{mi} \cdot p_{ml} \cdot (1\text{-}0.2 \cdot \text{Abs}(c_{ml}\text{-}c_{ji}))$
22. **End if**
23. **End for**
24. $T^{ji}_{d2d} = \min(T^{ji}_{cell}, T^{ji}_{wifi})$
25. **If** $T^{j}_{cell} > T^{ji}_{d2d}$ **then** {α_{ji}=0 and c_{ji}=0} **End if**
26. **End if**
27. **End for**

Algorithm 4: The method for like-minded D2D Opportunistic Relay with QoS Enforcement (LIKE-DORE)

Run at *eNB*

Input: T^{i}_{cell}, T^{ji}_{cell}, d^{ji}, d^{i}_{th}, $\forall i,j\in\Re=\{0,1,\ldots,N\}$

Output: α_{ji}

Initialize: $\alpha_{00}=1$, $\alpha_{ji}=0$, $c_{ji}=0$, $\Delta T_{ji}=0$, $\forall i,j\in\Re$; $D=\varnothing$
For $i\in\Re$ **do**
  For $j\in\Re\backslash i$ **do**
    $\Delta T_{ji}=T^{ji}_{cell}-T^{i}_{cell}$
  End for
End for
For i from 1 to N **do**
  Find $argmax_{(ji)}\,\Delta T_{ji}, j\in\Re$
  If $\Delta T_{ji}>0$ **then**
    If $d^{ji}\le d^{i}_{th}$ **then** $\{\alpha_{ji}=1, c_{ji}=1+\mathrm{Rand}(9), \alpha_{0j}=1$, and $D=D\cup\{i\}\}$
    Else $\Delta T_{ji}=0$
    End if
  End if
End for
For $i\in\Re$ **do**
  If $\alpha_{ji}==1$ **then**
    $F_{i,wifi}=0$
    For $m\in\Re\backslash j$ and $l\in\Re$ **do**
      If $\mathrm{Abs}(c_{ml}-c_{ji})<=5$ **then**
        $F_{i,wifi}=F_{i,wifi}+g_{mi}\cdot p_{ml}\cdot(1-0.2\cdot\mathrm{Abs}(c_{ml}-c_{ji}))$
      End if
    End for
    $T^{ji}_{d2d}=\min(T^{ji}_{cell},T^{ji}_{wifi})$
    If $T^{i}_{cell}>T^{ji}_{d2d}$ **then** $\alpha_{ji}=0$ and $c_{ji}=0$ **End if**
  End if
End for