

Peer -To – Peer Networks

Bluetooth Scatternet Based on
Cube Connected Cycle

H. K. Al-Hasani

Bluetooth Scatternet Based on Cube Connected Cycle

- What is?
 - Piconet
 - Scatternet
- Other approaches :
 - TSF and BlueRings
 - Chains and Loops
 - Stars
 - BlueCubes
- CCC
- CCC and Scatternet
- CCC and iCCC
- What makes CCC different...?
- Conclusion

Bluetooth Scatternet Based on CCC

What is?

Piconet

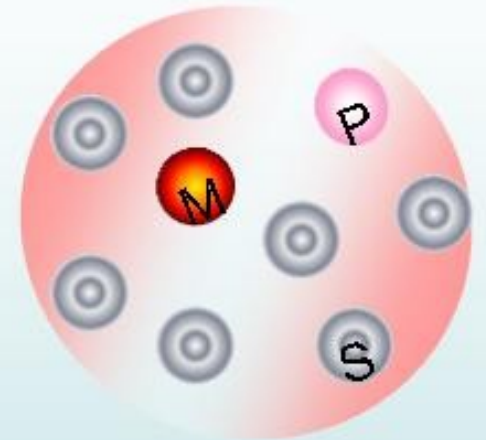
Scatternet



<http://Tux.crystalxp.net>



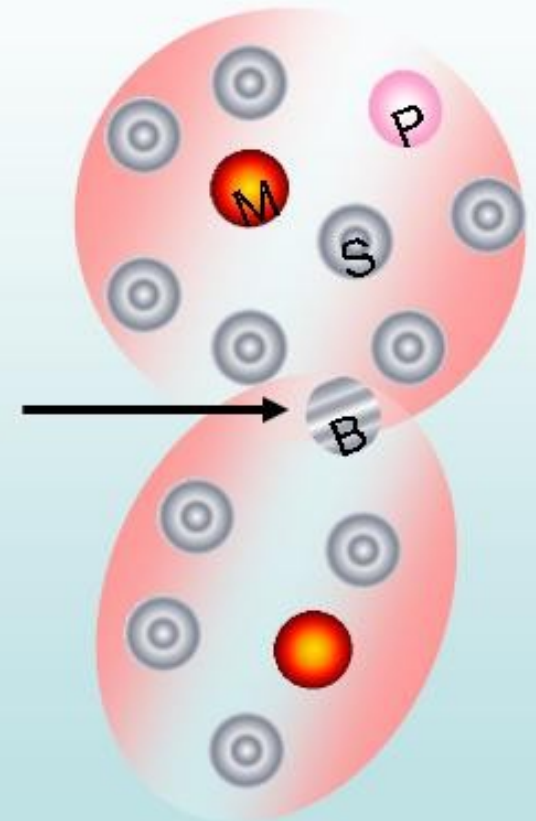
Piconet: One Master, seven Slaves
Master determines Hopping- frequency.
Active Slaves : can communicate.
Parked Slaves : listen





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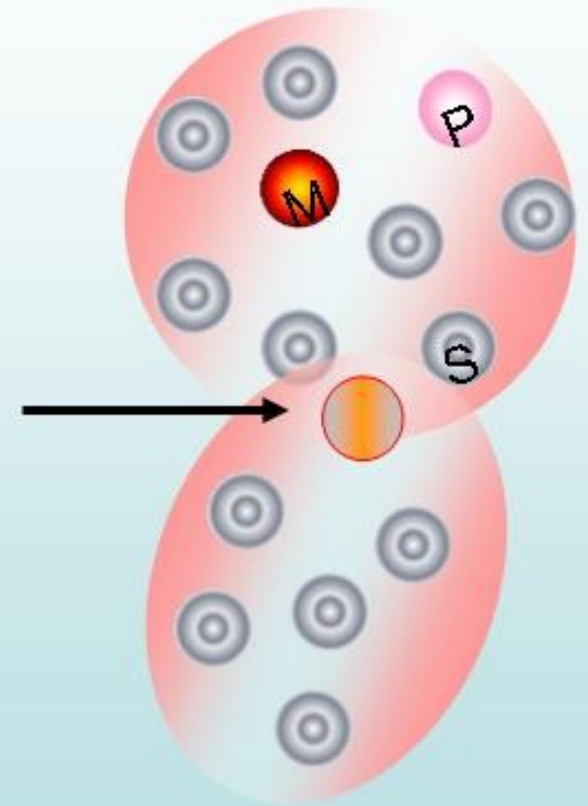
Scatternet: Two or more Piconets are
connected through a bridge.
Slave- Slave bridge





Piconet: One Master, seven Slaves
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Master- Slave bridge

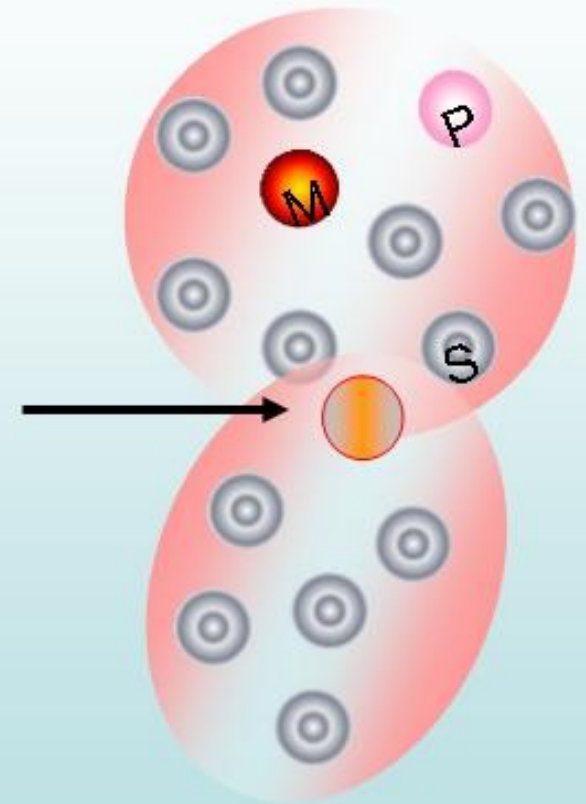




Master-Master bridge is forbidden

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Bluetooth Scatternet Based on CCC

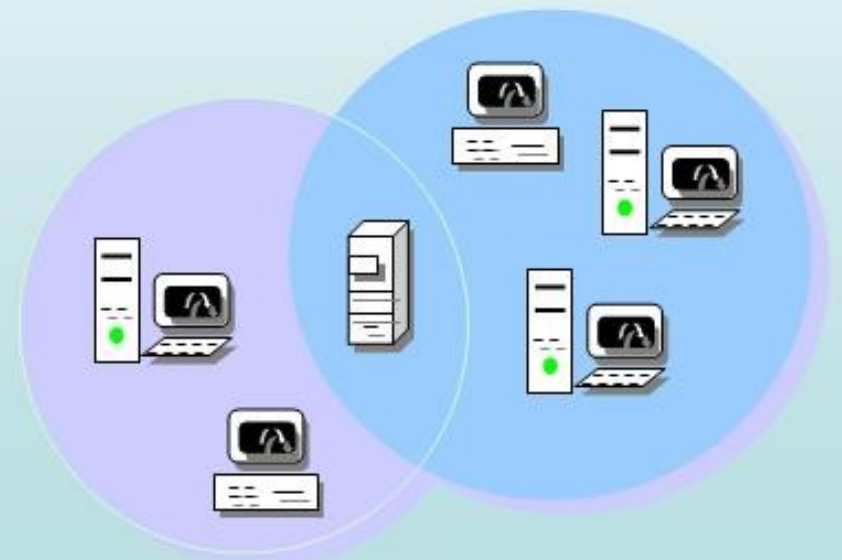
Other approaches :

TSF and BlueRings

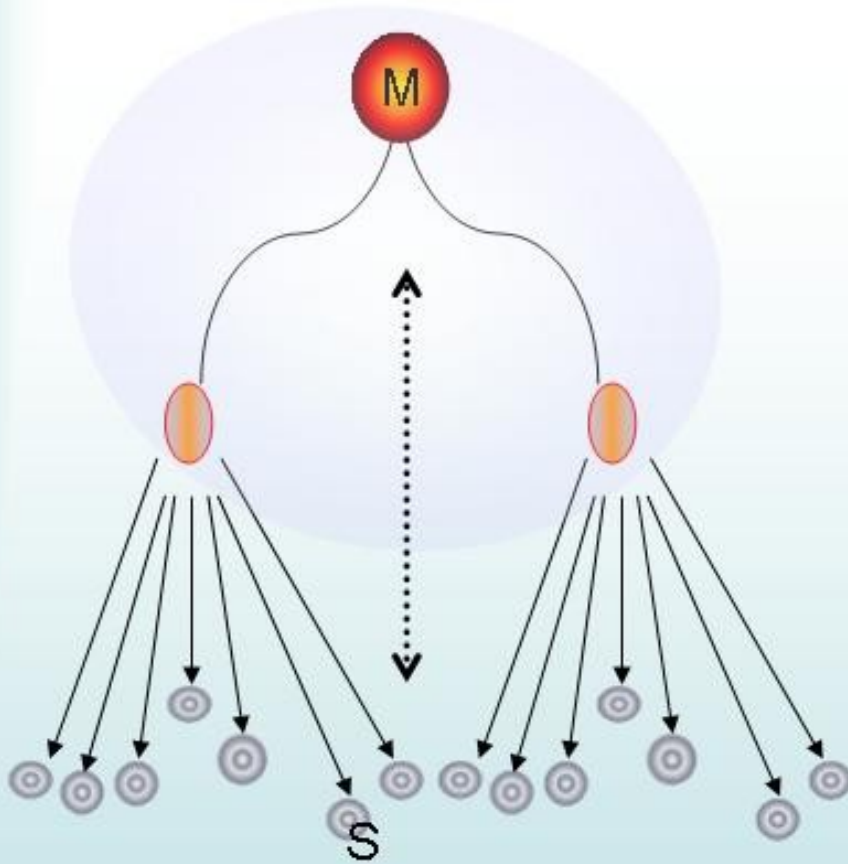
Chains and Loops

Stars

BlueCubes



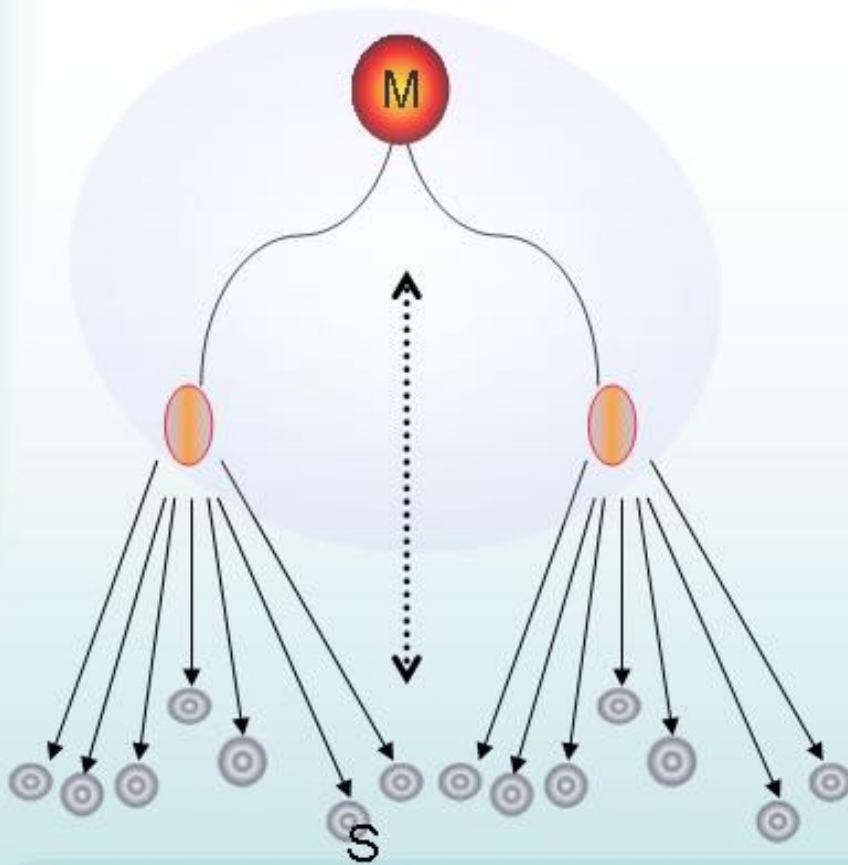
Other approaches :



TSP : Roles assignment;
unique path. Nodes in the middle
are Master-Slave.
Extending the tree = Extending
Routing length

Time complexity: $n-1$

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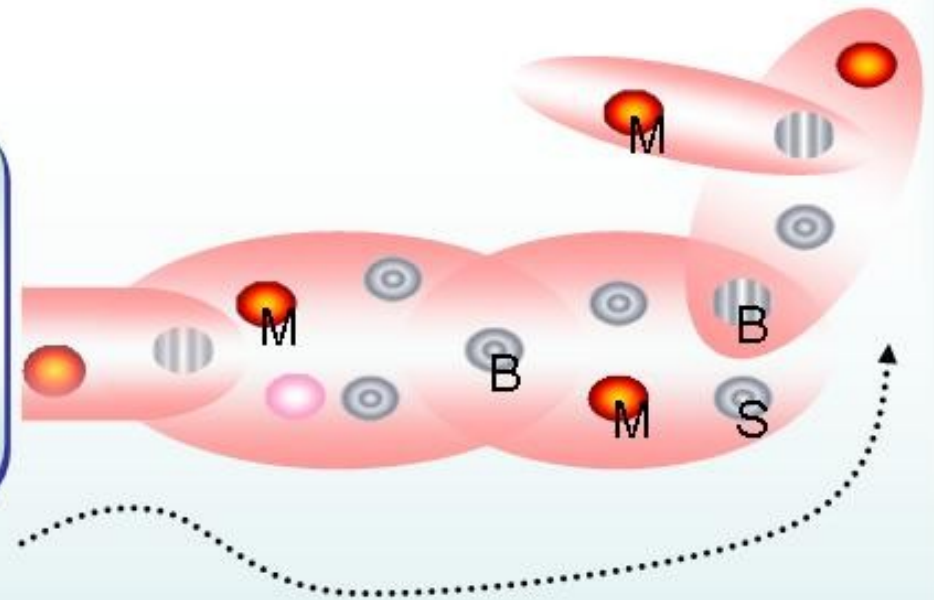
Time complexity: $n-1$

BlueRings : Multi path; fault tolerance; no Roles assignment

Time complexity: n

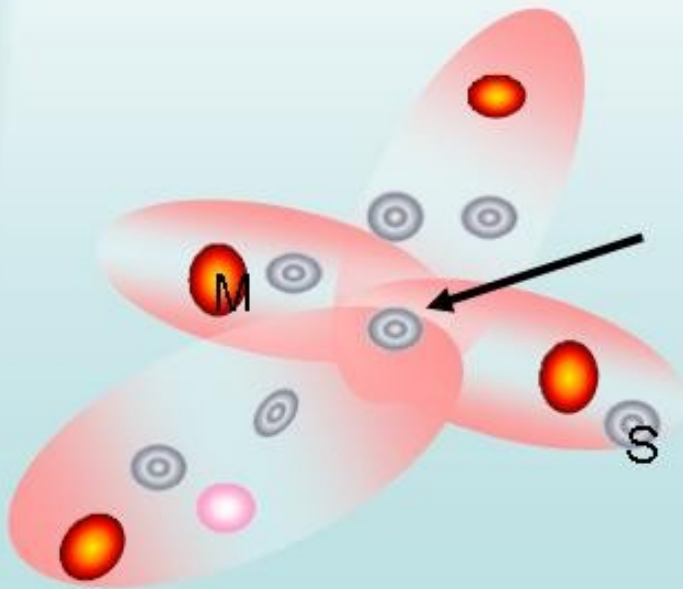
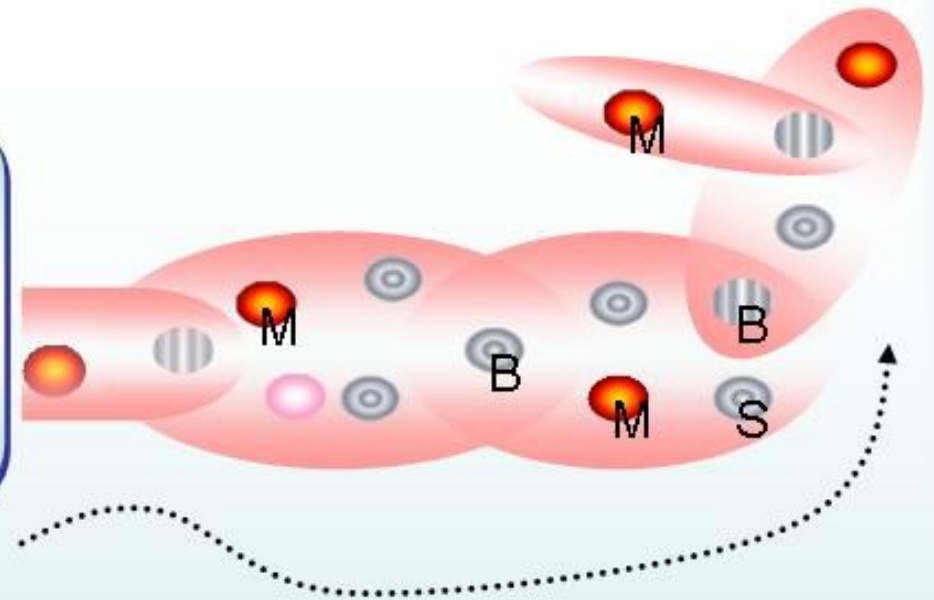
Other approaches :

Chains and Loops: No Master-Slave bridge, Parked in one and active in another; Time delay.



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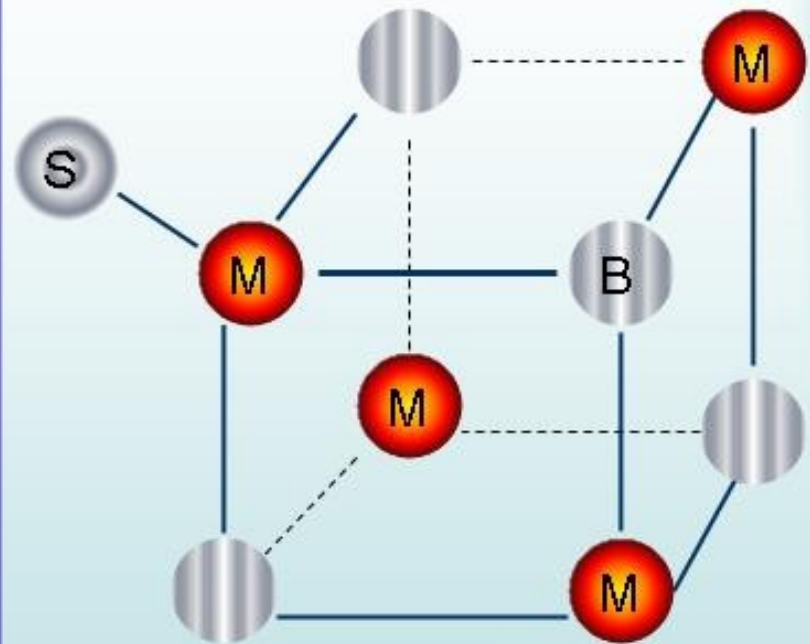
Star: Node in the middle is bottleneck.
Time complexity: $n-1$

Other approaches :

BlueCubes: start with ring and end up with cube

- # Piconets is controlled
- Roles assignment
- No Master- Slave link
- Multi disjoint path
- Scatternet of the same degree (dimension) can connect.

Time complexity: $\log_2 n$



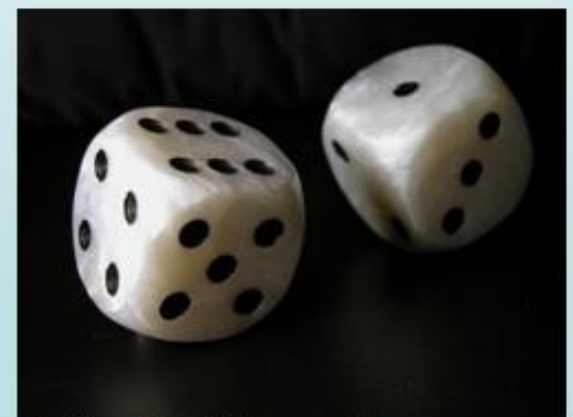
Bluetooth Scatternet Based on Cube Connected Cycle

CCC

CCC and Scatternet

CCC and iCCC

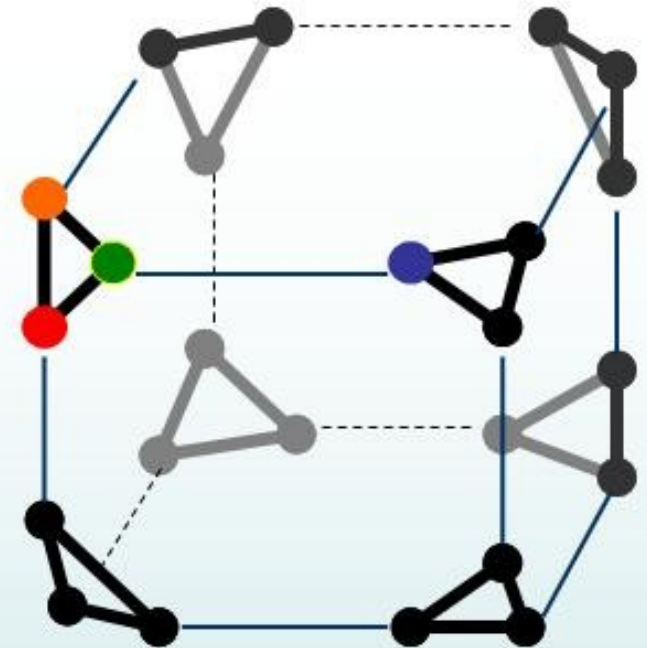
What makes CCC different...?



Cube Connected Cycle

CCC:

- n-dimensional cube
- Vertex are replaced by cycles
- Each cycle has n nodes
- CCC has $n \cdot 2^n$ node
- X is cyclic index
(integer $n-1 \geq X \geq 0$)
- Y is cubic index
(binary $Y \leq 2^n - 1$)



😊 node (x, y)

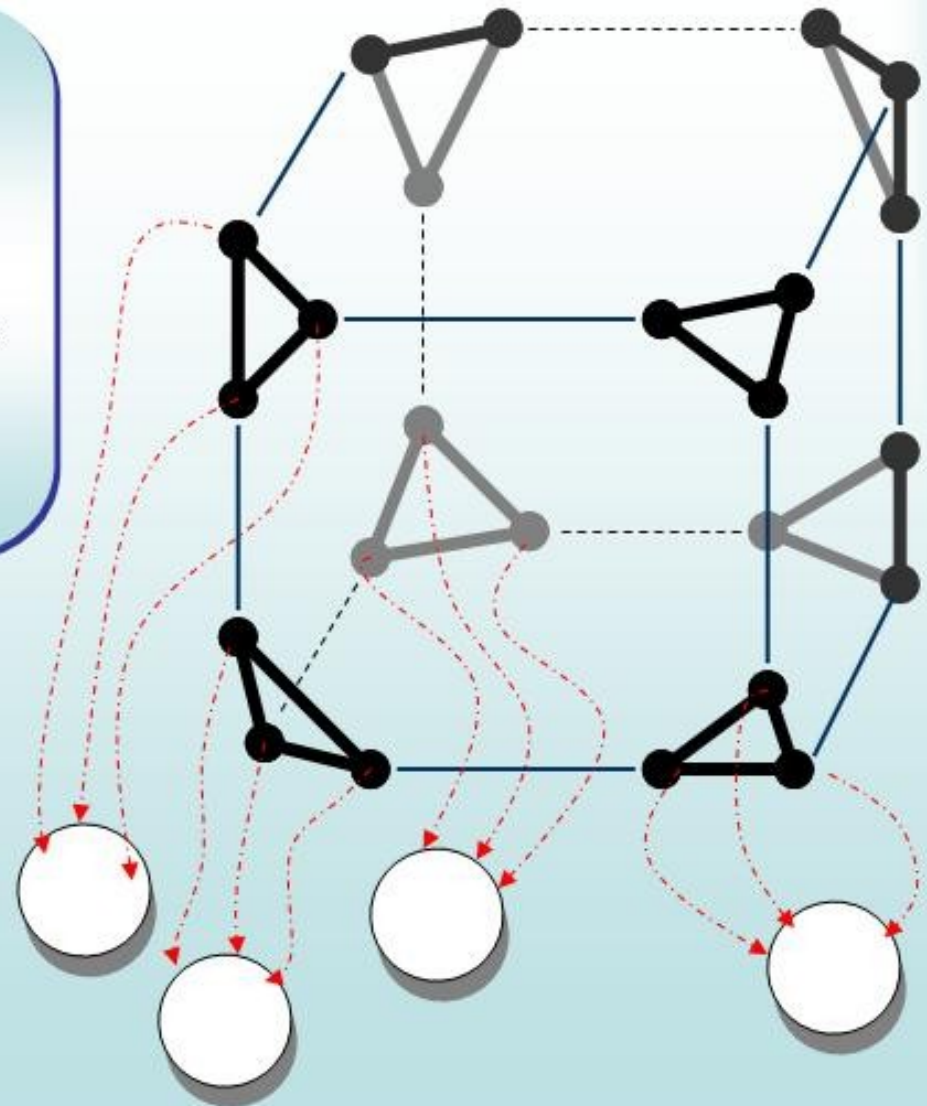
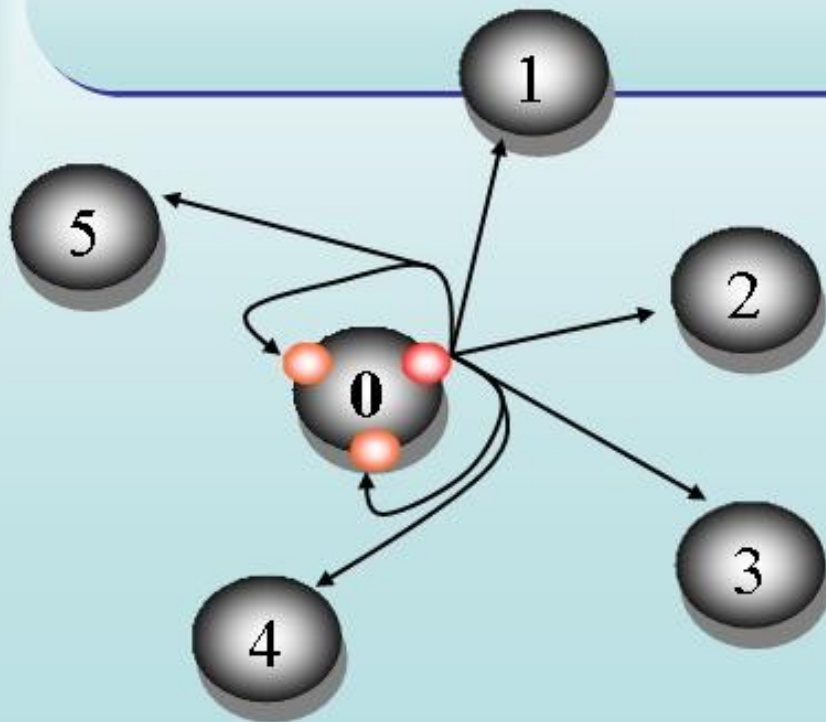
😊 😊 cyclic neighbors $(x \pm 1, y)$

😊 Cubic neighbors $(x, y \oplus 2^x)$

Cube Connected Cycle

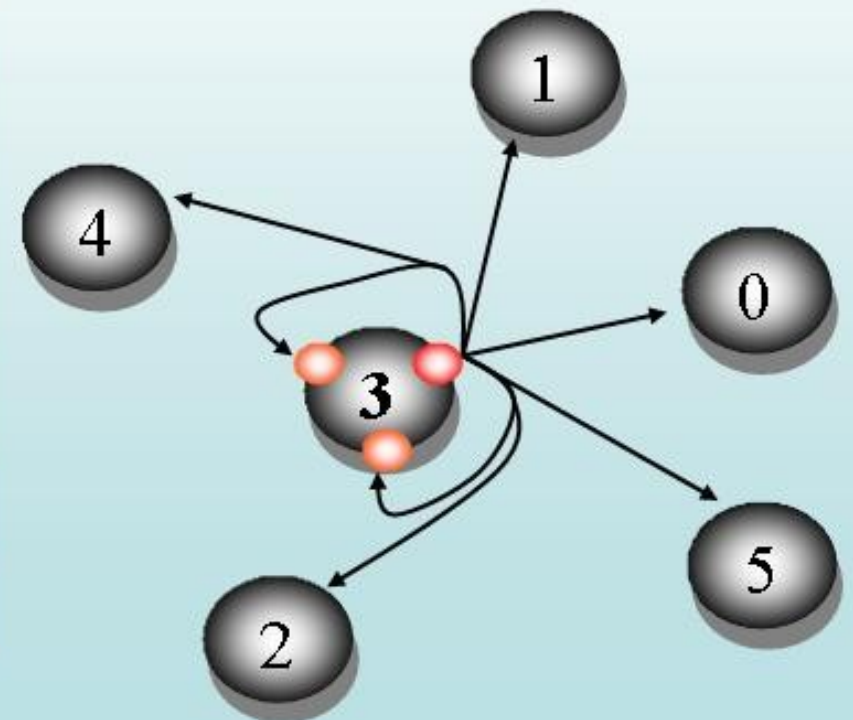
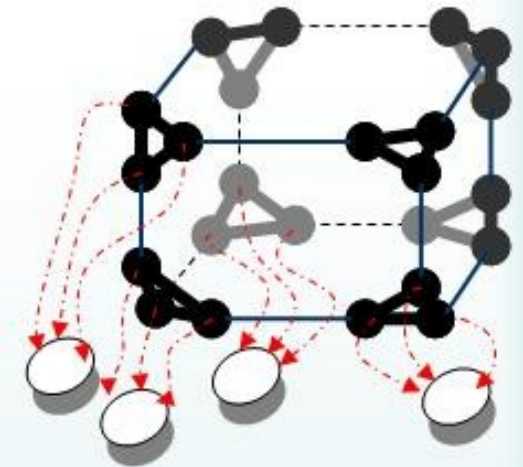
CCC:

- Cyclic index and cubic index
- Local cycles and primary nodes
- Outside and Inside leaf sets



Cube Connected Cycle

Node ID(1,011)	
<i>Routing table</i>	
cubical neighbour: (0,---)	
cyclic neighbour: (0,101)	
cyclic neighbour: (0, 001)	
<i>half smaller, half larger</i>	
<i>Inside Leaf Set</i>	
(0,011)	(2,011)
<i>Outside Leaf Set</i>	
(1,100)	(2,010)

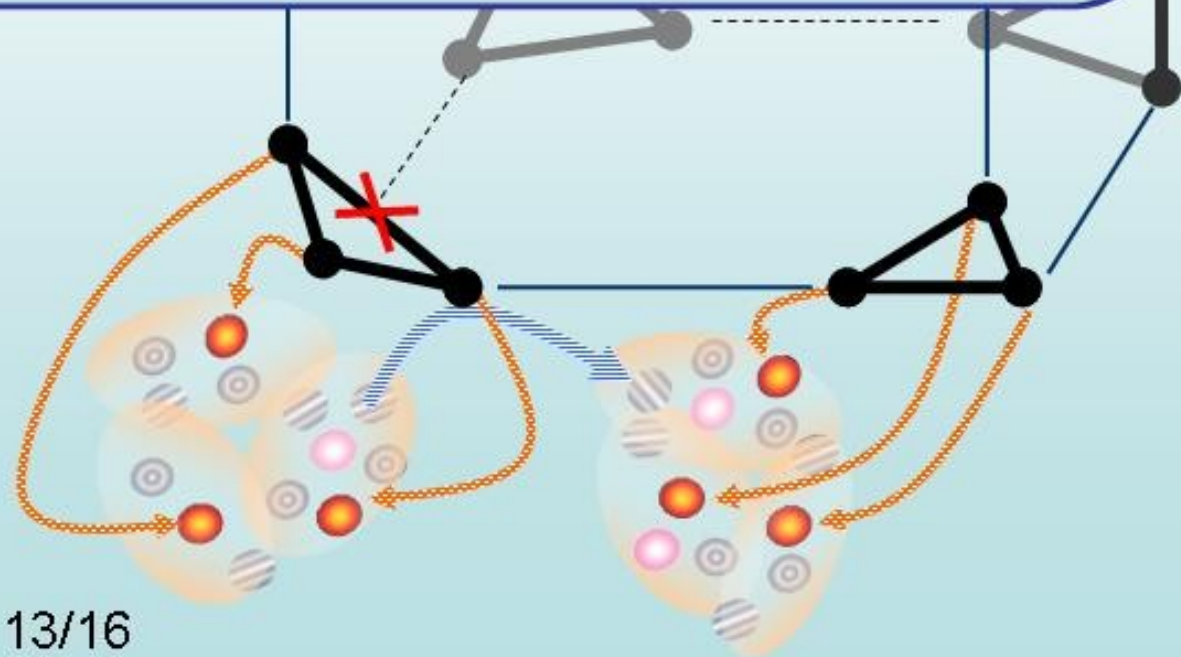


CCC and Scatternet

CCC:

- CCC has $n \cdot 2^n$ Piconets
- Every node is a Master
- Master communicate through bridges

$$\begin{aligned} \text{min CCC} &= 5 \cdot n \cdot 2^{n-1} \quad n \geq 3, \\ \text{max CCC} &= 13 \cdot n \cdot 2^{n-1} \quad n \geq 3 \end{aligned}$$

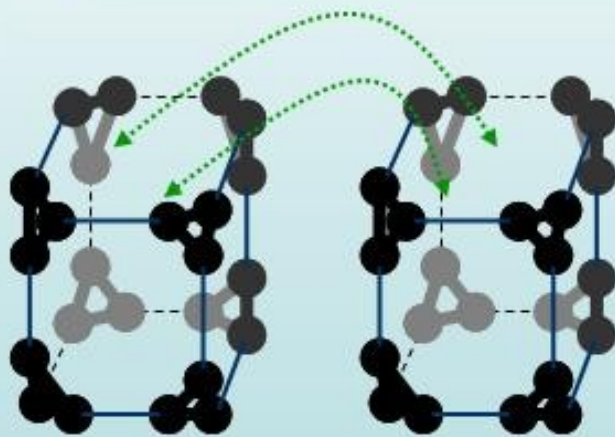


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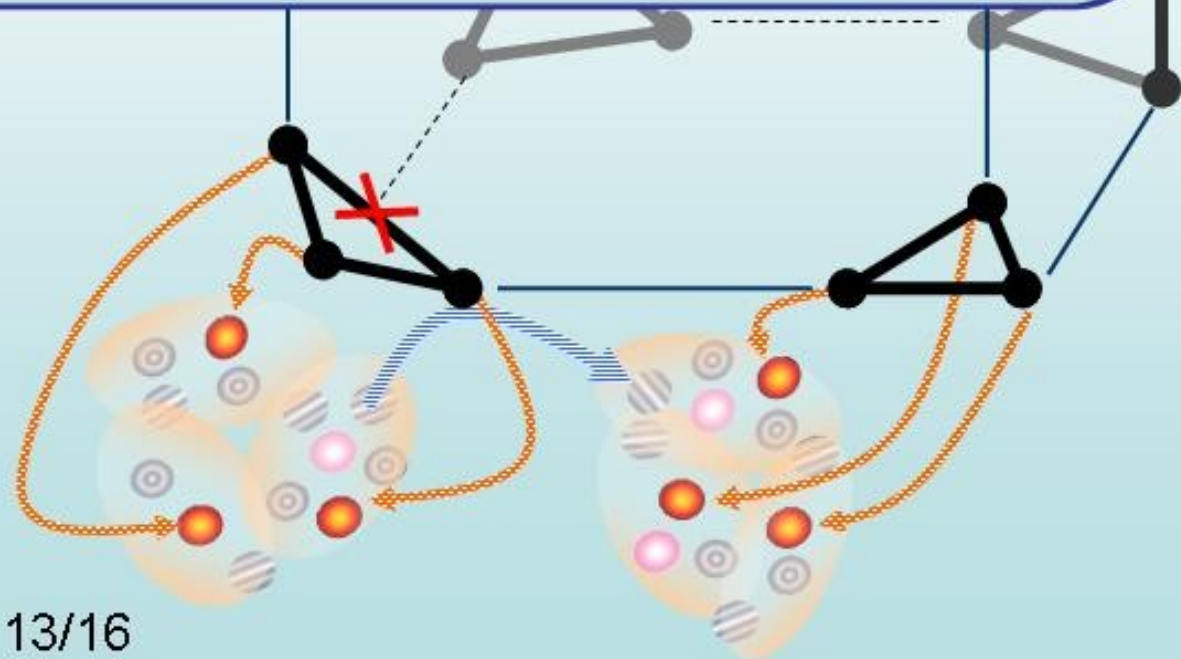
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4-dimentional cube *

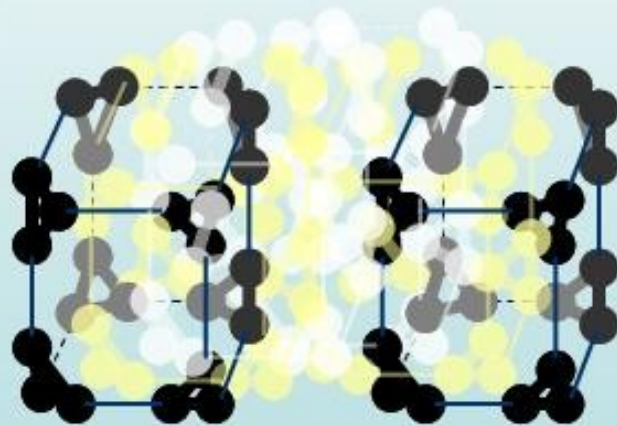


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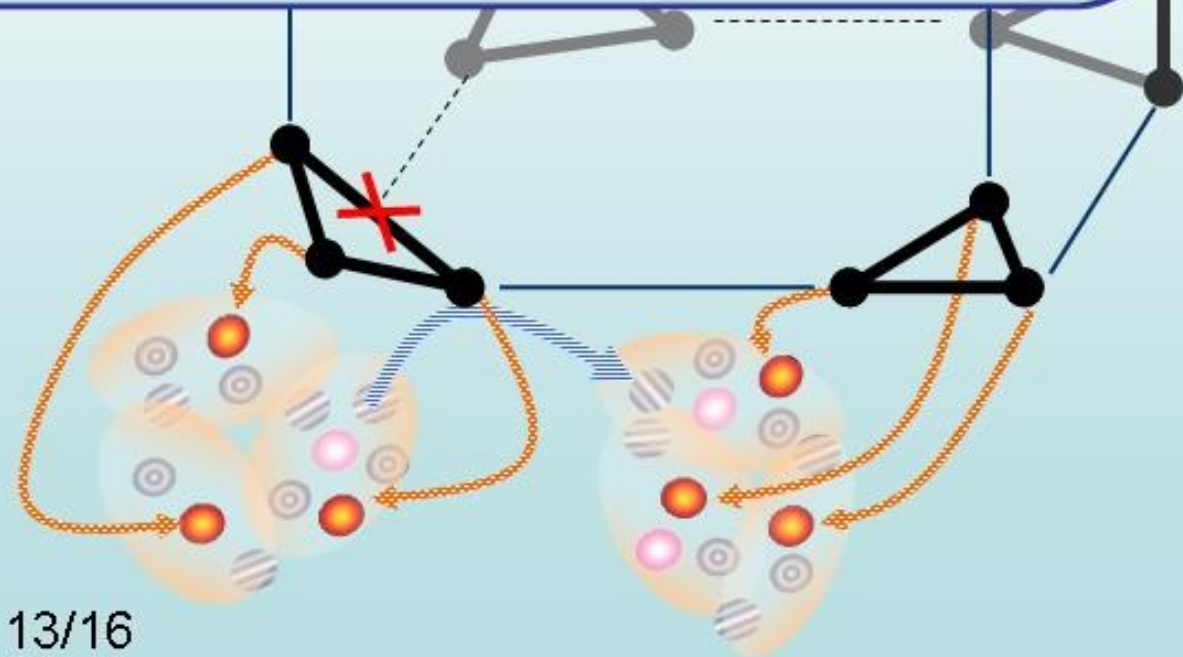
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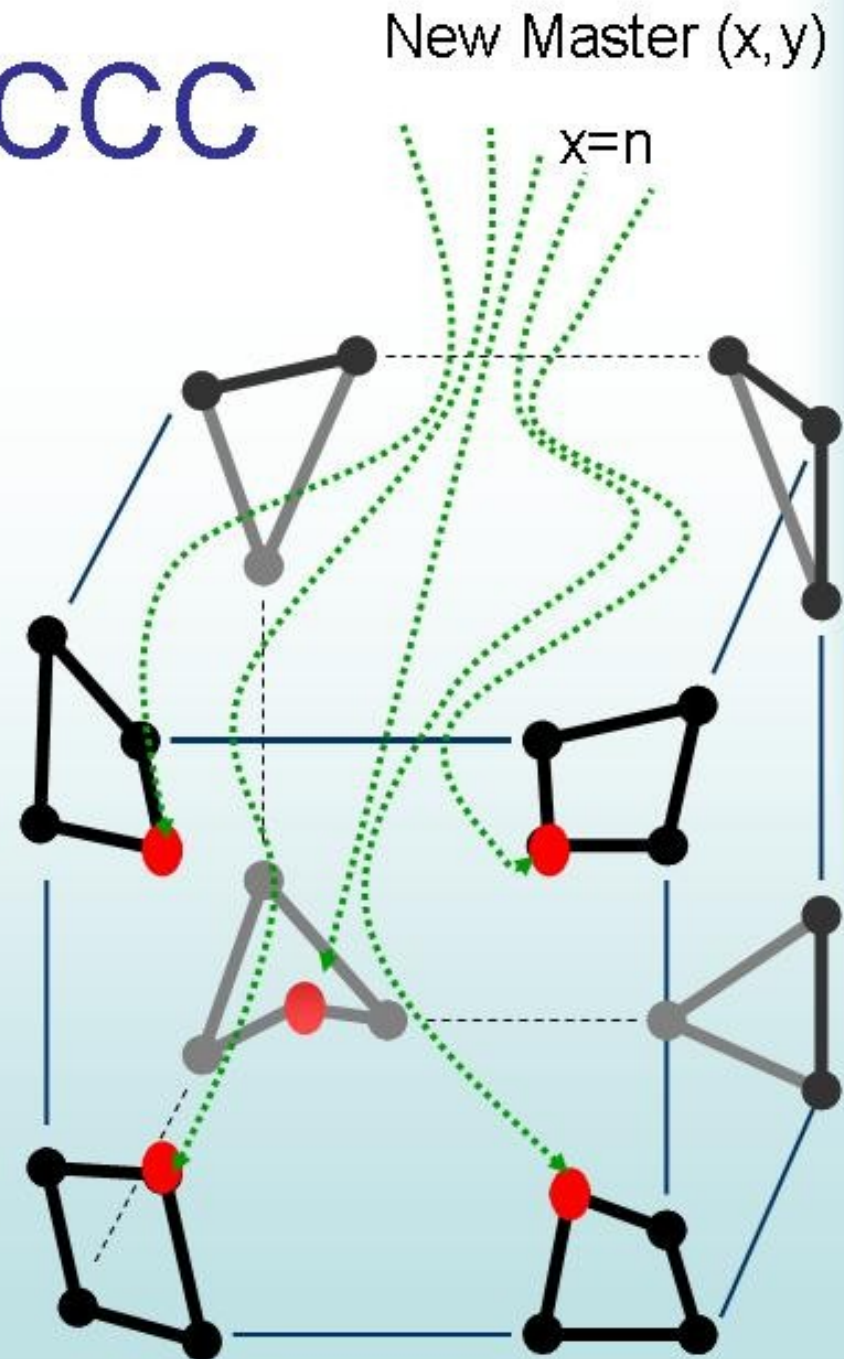


CCC and iCCC

Extending CCC is expensive

iCCC:

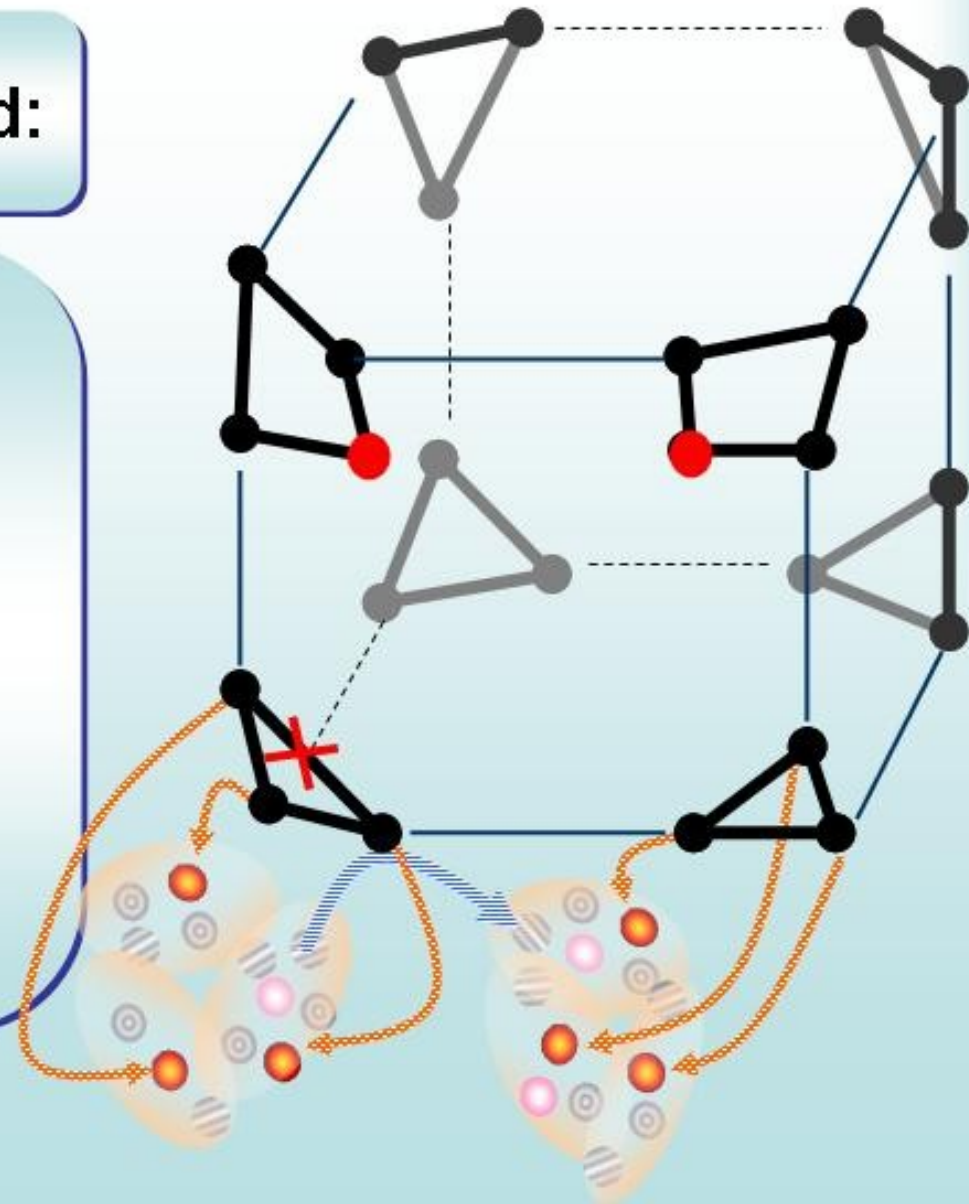
- Intermediate CCC
- Reconstructed CCC has $(n+1) \cdot 2^n$ Piconets instead of $(n+1) \cdot 2^{n+1}$
- Local transmission



What makes CCC different...?

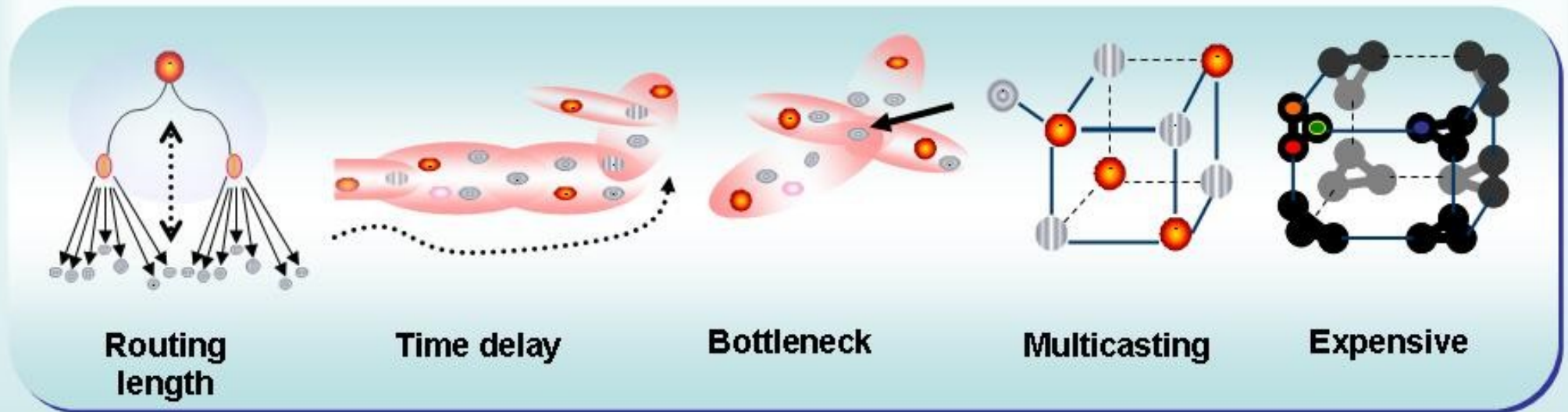
If CCC with iCCC are combined:

- Efficient communication
- Fast lookup $O(n)$
- Broadcast and unicast
- Dynamic system
- Fixed routing table
- Bounded number of reconstruction
- Roles assignment



Bluetooth Scatternet Based on CCC

Conclusion



Expensive and complicated to reality.

Thank you

References



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Søren Debois, IT University of Copenhagen

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Canan PAMUK

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