

**Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)**

Submission Title: [Performance comparison between proposed SFDs]

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Abstract: [Report performance comparison results between proposed SFDs]

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# Summary

- SFD: 4 SFD plans with length of 16-bits have been proposed for FEC and Non-FEC identification

Plan	SFD Value for FEC mode (a)	SFD value for Non-FEC mode (b)
A (Doc. 10-0112-01-004g)	0xF68D	0x7BC9
B (Doc. 10-0112-01-004g)	0x6F4E	0x904E
C (Doc. 10-0112-01-004g)	0x21F6	0xC9C2
D (Doc. 10-0126-00-004g)	0x632D	0x7A0E

- Performance comparisons regarding peak and rms of side lobe of correlation values have been done by
  - Correlating between a and 15.4g preamble (24 bit) + a, -a, b, or -b
  - Correlating between b and 15.4g preamble (24 bit) + a, -a, b, or -b.
  - Correlating between 15.4d preamble (24 bit) + SFD (8bit) and + a, -a, b, or -b
- **Plan B achieves the best performance** in terms of its correlation properties as well as the co-existence with 802.15.4g

## Summary of correlation values

- From the viewpoint of correlation value, plan B achieves the best performance because it offers the lowest side lobe correlation values
- From the viewpoint of co-existence with 802.15.4g, plan B also achieves the best performance because it offers the lowest correlation values with 802.15.4d

Plan		Maximal Peak and r.m.s. of side lobe by Correlation of 15,4g preamble + a and a	Maximal Peak and r.m.s. of side lobe by correlation of 15,4g preamble - a and a	Maximal Peak and r.m.s. of side lobe by correlation of 15,4g preamble + b and a	Maximal Peak and r.m.s. of side lobe by correlation of 15,4g preamble -b and a	Maximal Peak and r.m.s. of side lobe by correlation of 15,4g preamble + b and b	Maximal Peak and r.m.s. of side lobe by correlation of 15,4g preamble - b and b	Maximal Peak and r.m.s. of side lobe by correlation of 15,4g preamble + a and b	Maximal Peak and r.m.s. of side lobe by correlation of 15,4g preamble - a and b	Maximum peak value of 15.4g preamble+15.4d SFD and a, -a, b, or -b
A	a=0xF68D	4	4	4	4	2	4	6	6	6
	b=0x7BC9	1.6013	2	1.9748	2.0736	1.1094	1.9215	2.4083	2.0976	
B	0x6F4E	4	4	4	4	4	4	4	6	4
	0x904E	1.948	1.8947	1.7029	1.7607	1.948	1.6641	2.0248	2.2583	
C	0x21F6	4	4	4	4	4	4	6	6	6
	0xC9C2	1.7831	1.7246	1.7321	1.7889	2.1721	1.9215	2.3875	2.2583	
D	0x632D	4	8	4	8	6	6	6	6	6
	0x7A0E	1.8947	2.4179	1.8439	2.3664	3.5518	3.6374	3.5777	3.4351	

## Comments from Doc. 10-0126-00-004g

- While DC imbalance of the SFD's is not a selection criterion, the preamble is designed to have 0 DC and smaller DC imbalances are generally preferable
- The value "The DC imbalance" is computed by finding the absolute value of the (sum of the zeros – sum of the ones). Since there are 2 SFD's, the larger DC imbalance is listed
- From these viewpoints, plan D has the best performance because DC balance will be 0

### Resolution

- To have lower DC imbalance is "nice to have" but minor problem from the viewpoint of feasibility
- Because although the DC imbalance value of the 802.15.4d SFD (8-bits) is 2, where five '1' values and three '0' values, the product (chip) has been developed
- In the case of 802.15.4g 16-bit SFD, it would be OK to develop actual chip even if the DC values is 4 or 5 because of the assumption that 16-bit SFD can be supported with smaller imbalance.
- Most important parameters of SFD would be autocorrelation, cross-correlation image-correlation values when the SFD is combined with preamble and correlated with the SFD itself.

# Appendix

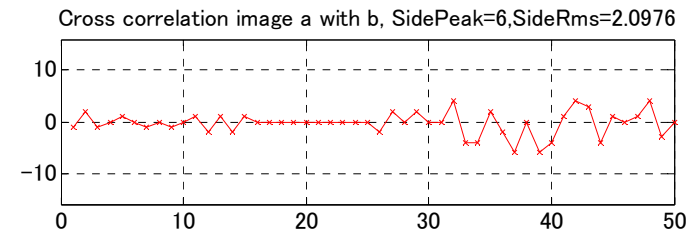
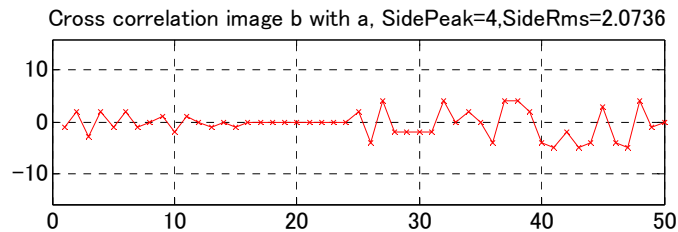
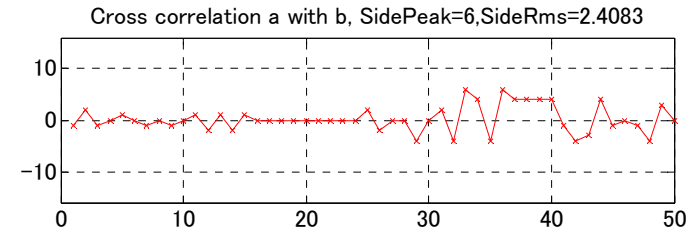
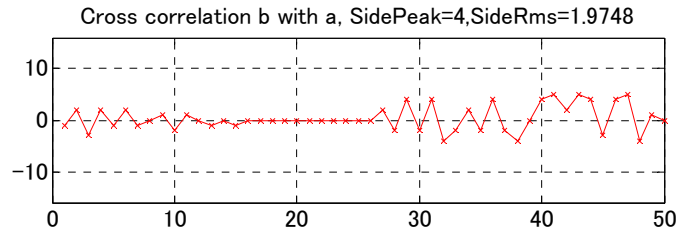
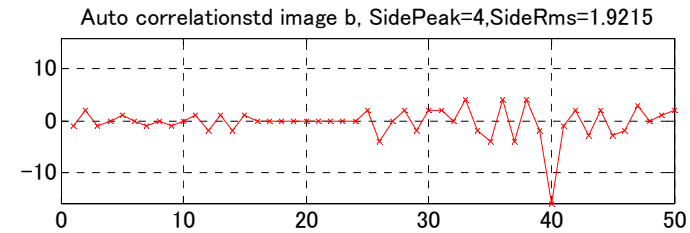
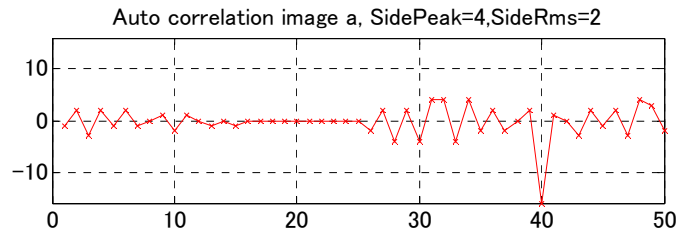
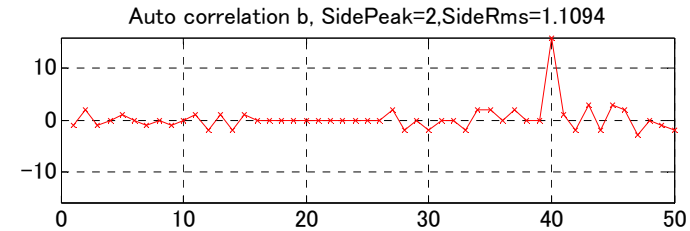
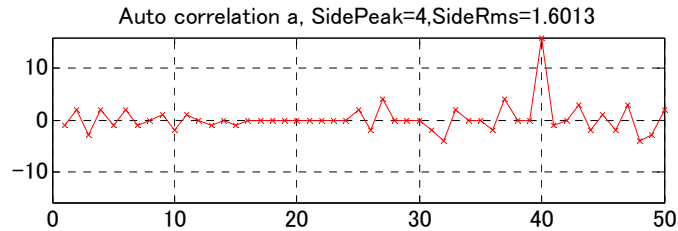
(Partially referred by doc. 10-0112-01)

# Proposal on SFD

Plan	SFD Value for FEC mode	SFD value for Non-FEC mode
A (Doc. 10-0112-01-004g)	0xF68D	0x7BC9
B (Doc. 10-0112-01-004g)	0x6F4E	0x904E
C (Doc. 10-0112-01-004g)	0x21F6	0xC9C2
D (Doc. 10-0126-00-004g)	0x632D	0x7A0E

## Correlation performance of Plan A (a=0xF68D, b=0x7BC9)

- Left figs: Correlation values between a and 15.4g preamble (24 bit) + a, -a, b, or -b
- Right figs: Correlation values between b and 15.4g preamble (24 bit) + a, -a, b, or -b
- **Note: maximal correlation values between 15.4d-preamble+15.4d-SFD and a, -a, b, or -b are 6**



## Correlation performance of Plan B (a=0x6F4E, b=0x904E)

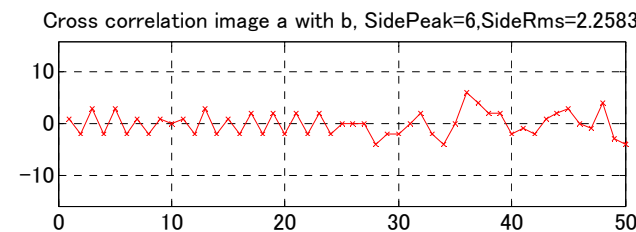
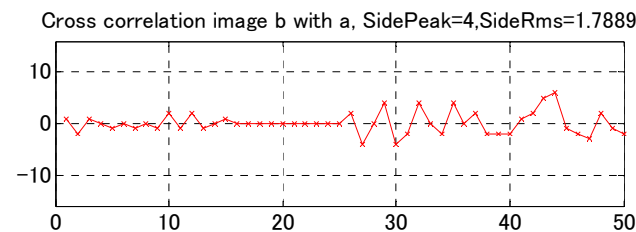
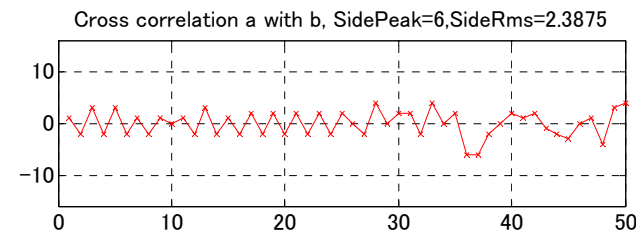
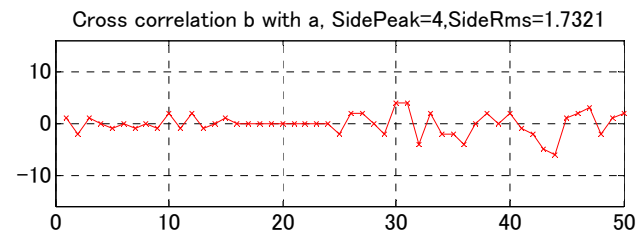
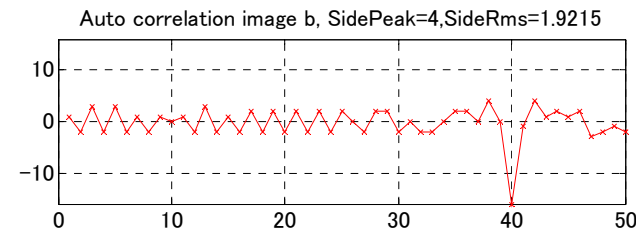
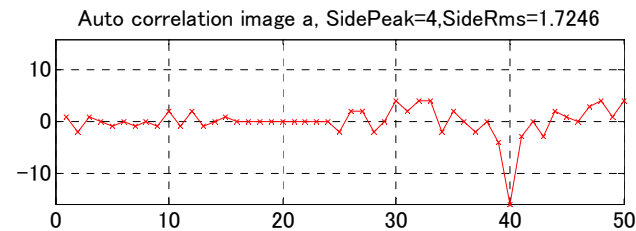
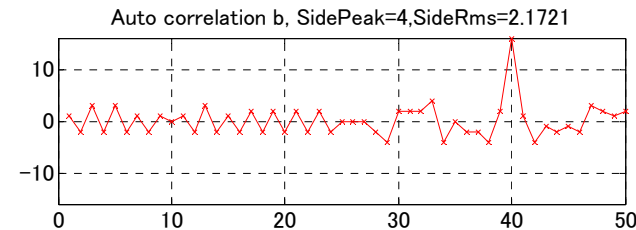
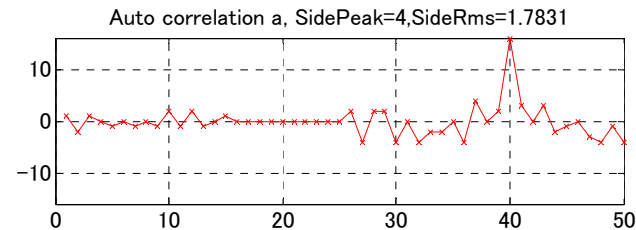
- Left figs: Correlation values between a and 15.4g preamble (24 bit) + a, -a, b, or -b
- Right figs: Correlation values between b and 15.4g preamble (24 bit) + a, -a, b, or -b
- **Note: maximal correlation values between 15.4d-preamble+15.4d-SFD and a, -a, b, or -b are 4**





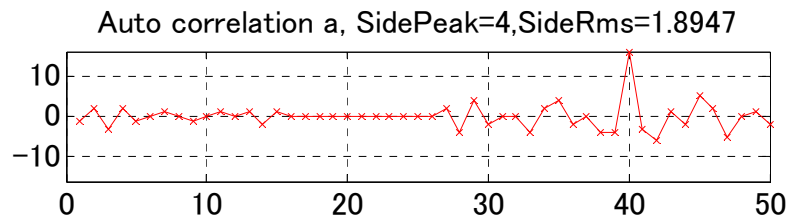
## Correlation performance of Plan C (a=0x21F6, b=0xC9C2)

- Left figs: Correlation values between a and 15.4g preamble (24 bit) + a, -a, b, or -b
- Right figs: Correlation values between b and 15.4g preamble (24 bit) + a, -a, b, or -b
- **Note: maximal correlation values between 15.4d-preamble+15.4d-SFD and a, -a, b, or -b are 6**

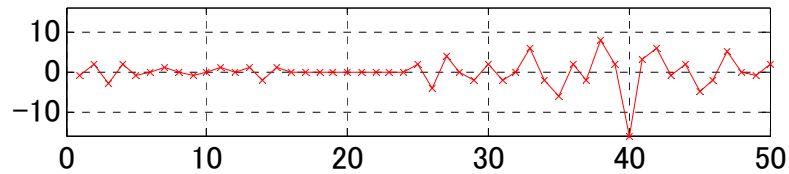


## Correlation performance of Plan D (A=0x632D, b=0x7A0E)

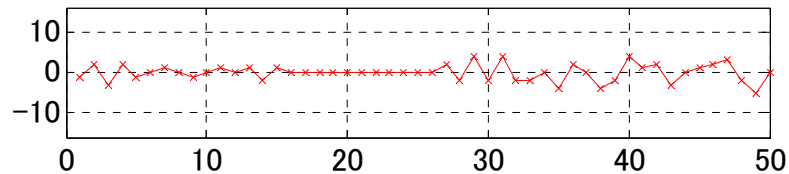
- Left figs: Correlation values between a and 15.4g preamble (24 bit) + a, -a, b, or -b
- Right figs: Correlation values between b and 15.4g preamble (24 bit) + a, -a, b, or -b
- **Note: maximal correlation values between 15.4d-preamble+15.4d-SFD and a, -a, b, or -b are 6**



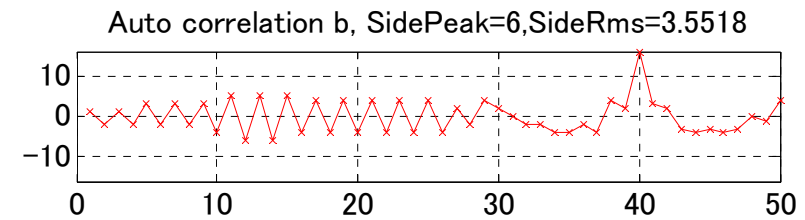
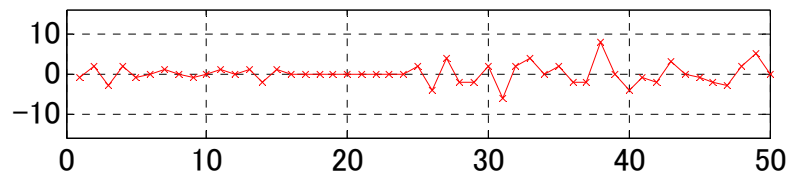
Auto correlation image a, SidePeak=8,SideRms=2.4179



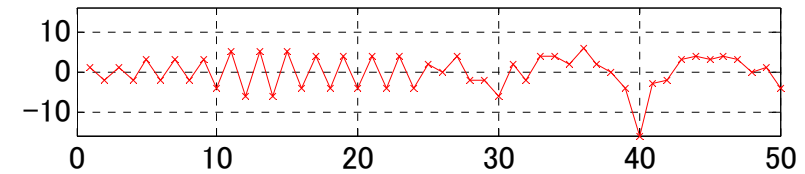
Cross correlation b with a, SidePeak=4,SideRms=1.8439



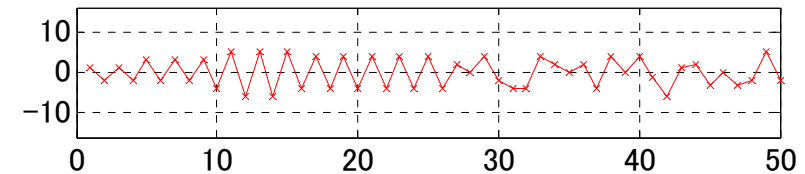
Cross correlation image b with a, SidePeak=8,SideRms=2.3664



Auto correlation image b, SidePeak=6,SideRms=3.6374



Cross correlation a with b, SidePeak=6,SideRms=3.5777



Cross correlation image a with b, SidePeak=6,SideRms=3.4351

