

## The Impact of Crosstalk on 56G+ Serdes Signal

*Li Jinlong, Wei Zhongmin, Bi Yu*

[Li.jinlong15@zte.com.cn](mailto:Li.jinlong15@zte.com.cn) [Wei.zhongmin@zte.com.cn](mailto:Wei.zhongmin@zte.com.cn) [Bi.yu@zte.com.cn](mailto:Bi.yu@zte.com.cn)

Virtual Asian IBIS Summit (China), November 19, 2021



# Agenda

- **Introduction**
- The Optimized Design For Passive Component Crosstalk In System
- The Impact Of System Crosstalk On COM

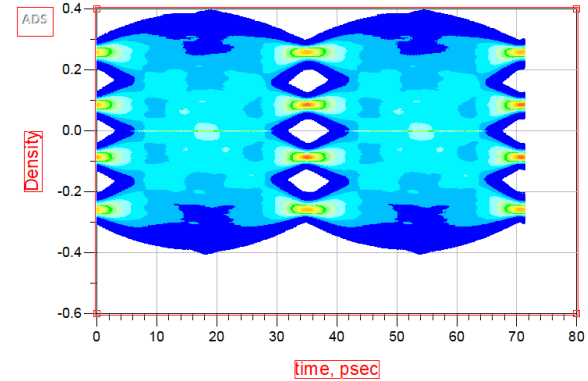


# Why Is Crosstalk So Important?

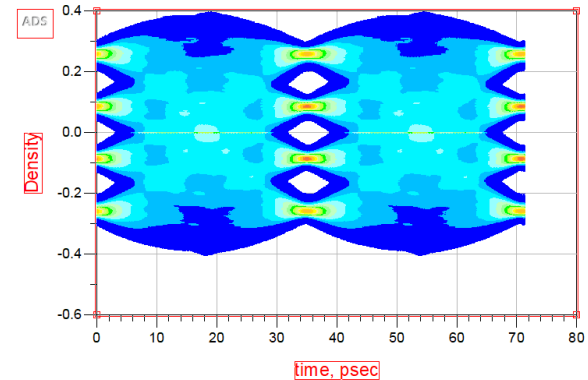
- The crosstalk noise of PAM4 has a greater impact on eye opening .
- With the same crosstalk S-parameter, the ICN(Integrated Crosstalk Noise) value increases with the increase of baud rate fb.

Case1: the system ICN is 0.71mv  
height at BER(1E-5) (69mv 72mv 66mv)  
width at BER(1E-5) (5.9ps 6.1ps 5.9ps)

Case2: the system ICN is 1.61mv  
height at BER(1E-5) (56mv 57mv 57mv)  
width at BER(1E-5) (5.2ps 5.2ps 5.2ps)



56G PAM4 ICN is 0.71mv



56G PAM4 ICN is 1.6mv

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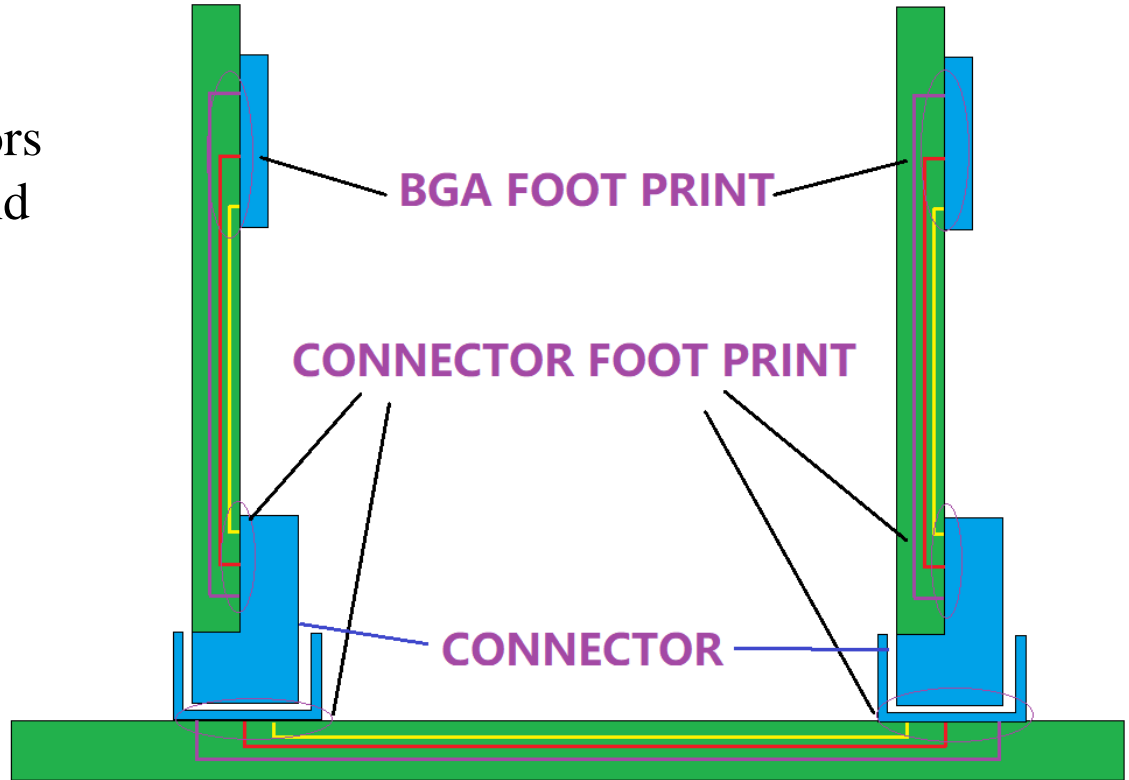
# Major Crosstalk Contributors in Channel

## ■ Connector

- Crosstalk within connectors is controlled by vendor and is out of the scope of this presentation

## ■ Footprint

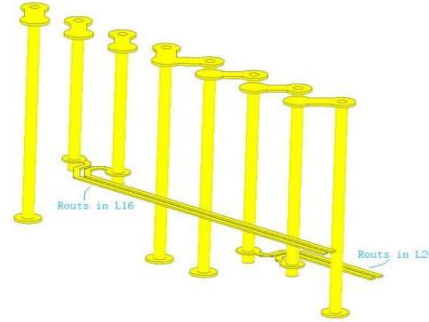
- BGA footprint
- Connector footprint



# Coupling of Footprint Area

## ■ L2V

- Line to via crosstalk



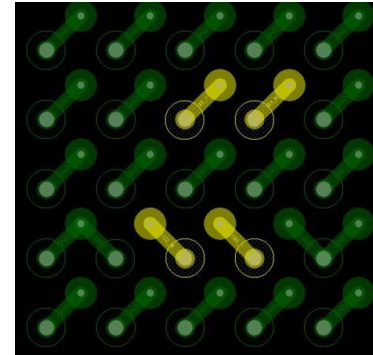
L2V



L2P

## ■ L2P

- Line to pad crosstalk



V2V

## ■ V2V

- Via to via crosstalk

# L2P Crosstalk Analysis

## Varied parameters:

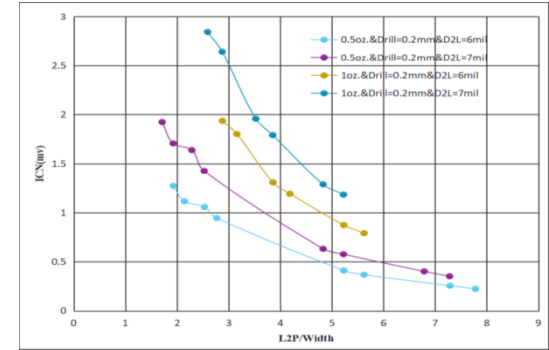
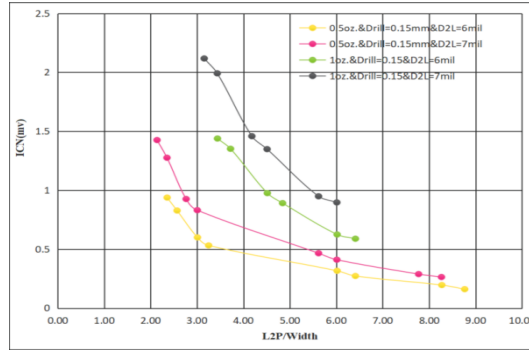
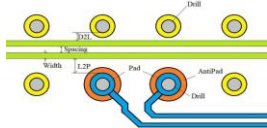
- copper thickness
- distance between trace to ground via

## Observation:

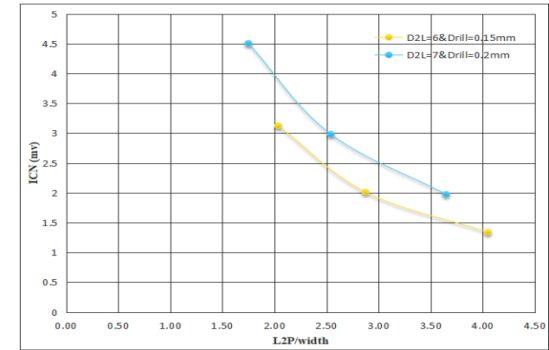
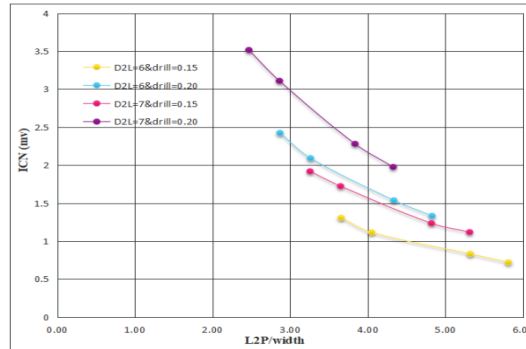
- the ICN of L2P is very sensitive to L2P/width.

## Problem

- As traces go narrower, the insertion loss and impedance will go higher



## 1.0mm BGA



## 0.85mm BGA

# Proposed Method for Reducing L2P/L2V Crosstalk

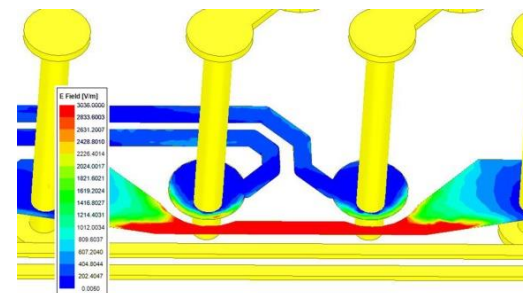
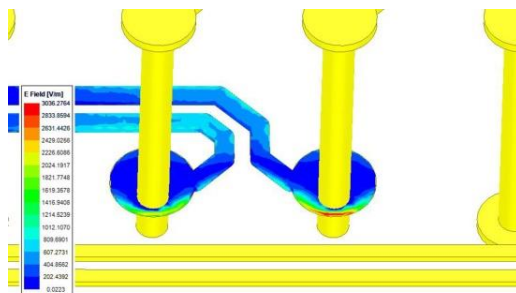
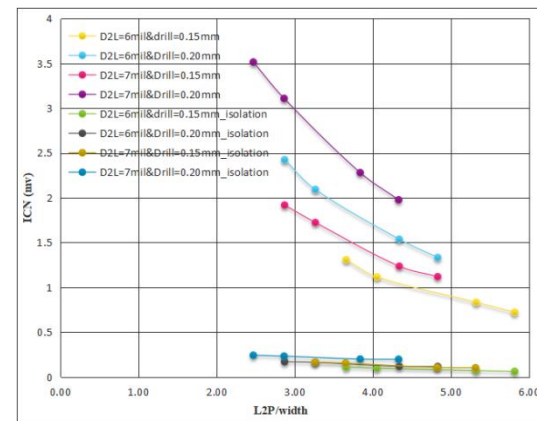
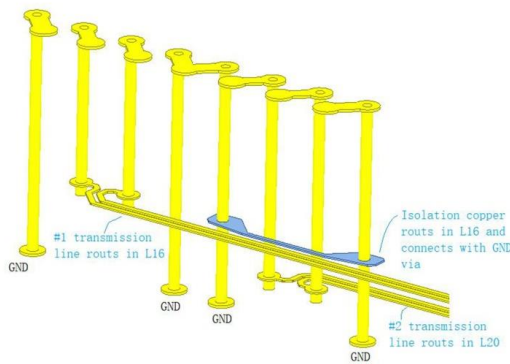
## ■ 1mm BGA

- The biggest ICN improvement is dropping from 3.515mV to 0.241mV, which is a 93% improvement

## ■ 0.85mm BGA

- The biggest ICN improvement is dropping from 1.974mV to 0.195mV, which is a 90% improvement

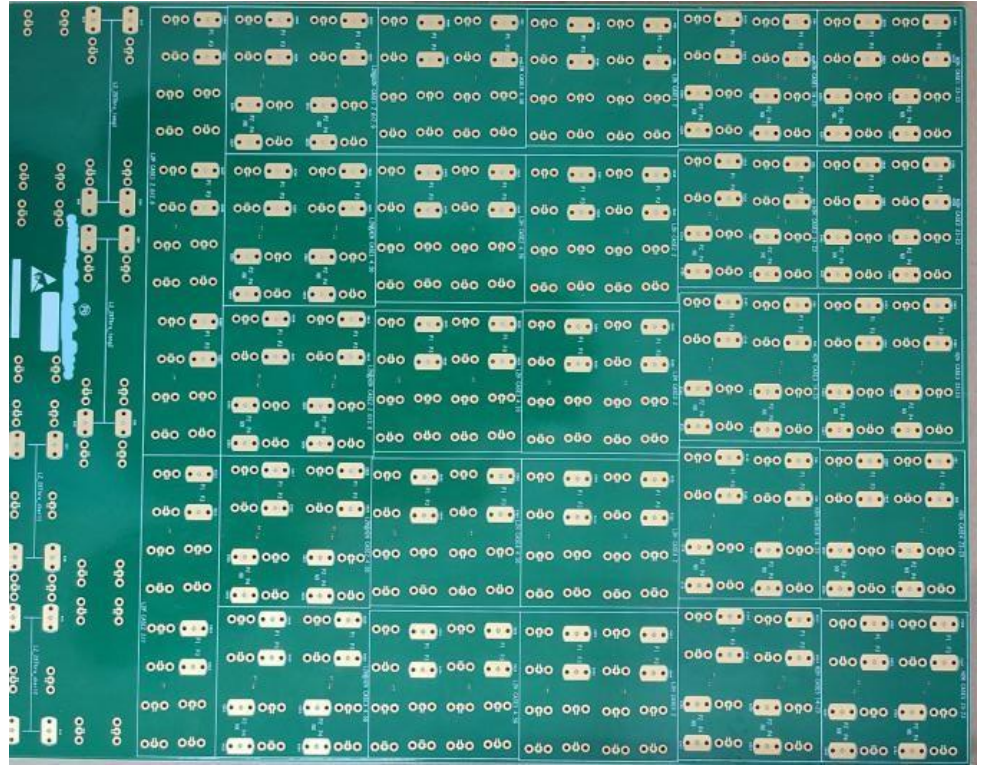
This design can obtain almost the same benefit when used in the footprint of the connector





# Test Board for L2P Optimization

■ Crosstalk of L2P in the BGA area is verified by measurement data.



# Test Result for L2P Optimization

## ■ Conditions

- Condition 1, 2-2-2 trace, 0.5oz copper
- Condition 2, 2.5-2.5-2.5 trace, 0.5oz copper
- Condition 3, 3.3-2-3.3 trace, 0.5oz copper
- Condition 4, 3.8-2.5-3.8 trace, 0.5oz copper
- Condition 5, 3-3-3 trace, 1oz copper

## ■ Conclusion

- After using the new method, ICN is dropping about 80%

## The ICN(0.5oz.) results

		112G-PAM4-ICN (mV)
Without isolation copper	condition 1	0.724
With isolation copper		0.123
Without isolation copper	condition 2	1.029
With isolation copper		0.127
Without isolation copper	condition 3	1.322
With isolation copper		0.177
Without isolation copper	condition 4	2.19
With isolation copper		0.294

## The ICN(1.0 oz.) results

		112G-PAM4-ICN (mV)
Without isolation copper	condition 5	2.283
With isolation copper		0.515

# V2V Crosstalk Analysis

## ■ V2V: via to via crosstalk

- Case 2 has the best crosstalk

Case1-FEXT	L07	L11	L15	L19	L23
L23	0.39	0.64	0.88	1.19	1.41

Case1-NEXT	L07	L11	L15	L19	L23
L23	0.38	0.54	0.64	0.81	0.95

Case2-FEXT	L07	L11	L15	L19	L23
L23	0.12	0.13	0.14	0.15	0.17

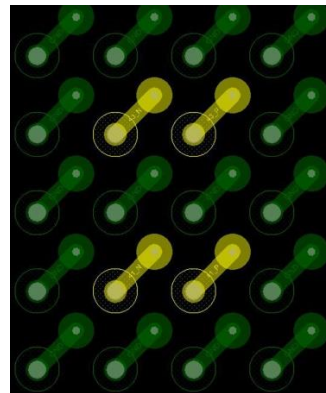
Case2-NEXT	L07	L11	L15	L19	L23
L23	0.09	0.10	0.10	0.11	0.16

Case3-FEXT	L07	L11	L15	L19	L23
L23	0.75	1.24	1.63	2.11	2.47

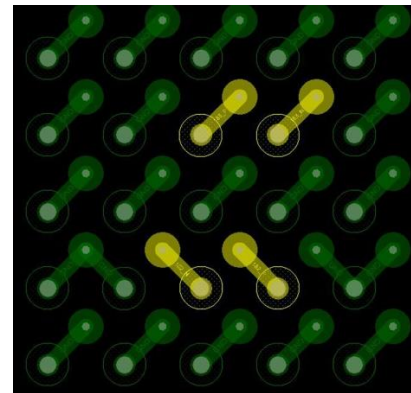
Case3-NEXT	L07	L11	L15	L19	L23
L23	0.62	0.85	0.80	0.86	1.28

Case4-FEXT	L07	L11	L15	L19	L23
L23	0.393	0.642	0.871	1.091	1.345

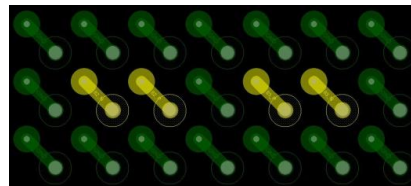
Case4-NEXT	L07	L11	L15	L19	L23
L23	0.395	0.540	0.538	0.538	0.723



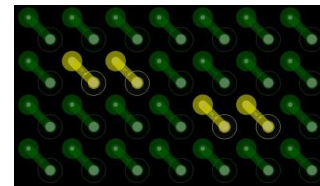
Case1



Case2

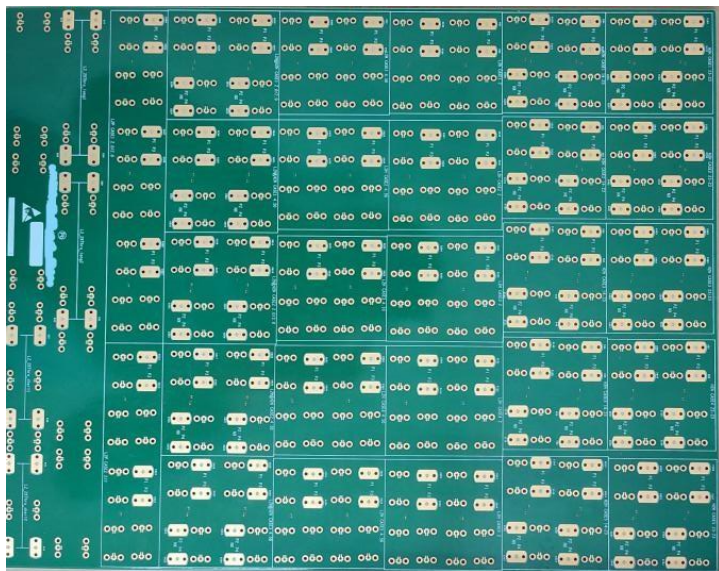


Case3



Case4

# Test Result for V2V Optimization



## The FEXT ICN of V2V\_Case

	112G PAM4 (mV)	224G PAM6 (mV)
V2V_Case1	2.543	3.134
V2V_Case2	0.448	0.714
V2V_Case3	2.866	3.686
V2V_Case4	1.573	2.049

## The NEXT ICN of V2V\_Case

	112G PAM4 (mV)	224G PAM6 (mV)
V2V_Case1	1.576	2.577
V2V_Case2	0.327	0.696
V2V_Case3	1.807	3.241
V2V_Case4	1.031	1.839

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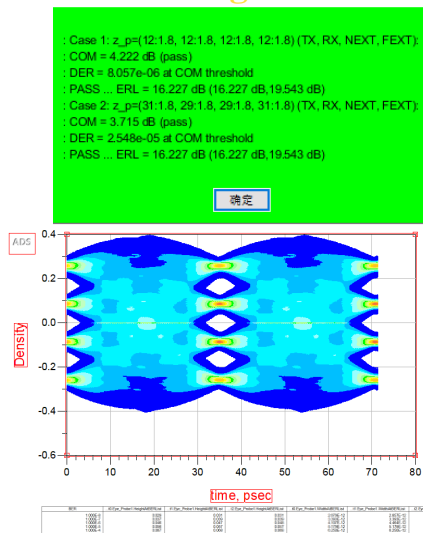
# The Impact of Crosstalk on COM

## ■ Two channels are studied

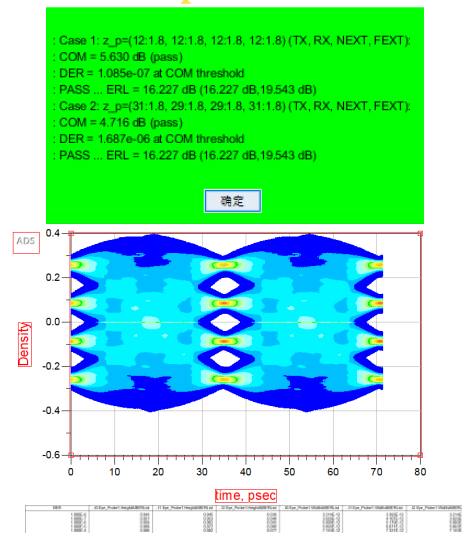
- Original channel
  - Without isolation copper between L2V or L2P
  - Case1 V2V fanout pattern
- Optimized channel
  - With isolation copper between L2V or L2P
  - Case2 V2V fanout pattern

112G PAM4 ICN			
NEXT ICN (mV)		FEXT ICN (mV)	
Original	Optimized	Original	Optimized
1.23	0.50	1.07	0.54

Original



Optimized



# Thank you



Leading 5G Innovations

