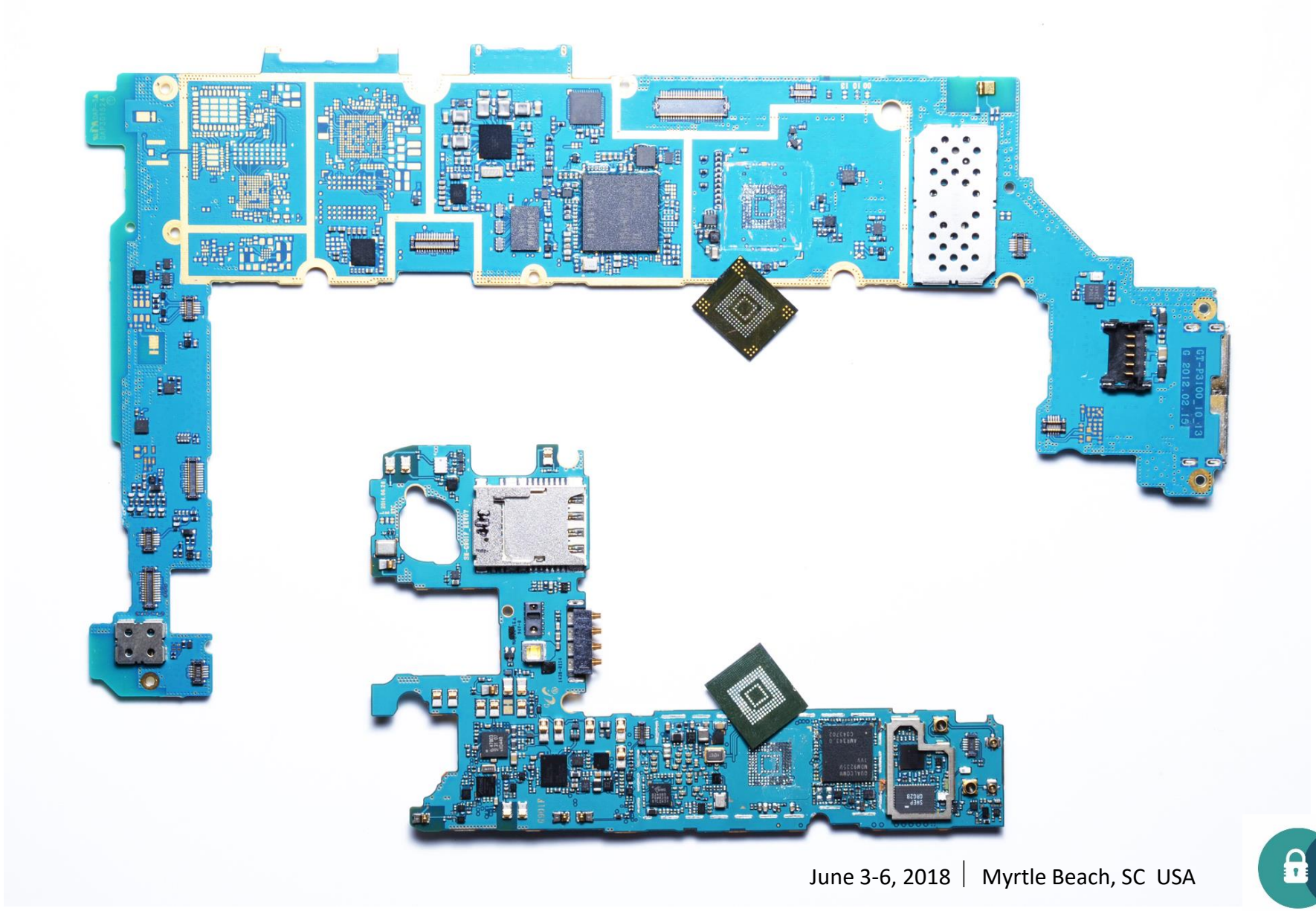
# THE ULTIMATE CHIP-OFF MOBILE FORENSICS: DATA RESURRECTION FROM DEAD EMMC CHIPS

Rusolut

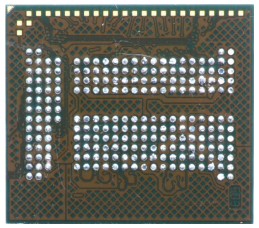
# CHIP-OFF DATA RECOVERY FROM FLASH MEMORY DEVICES



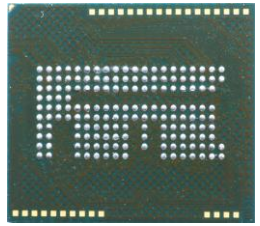
# RAW NAND AND EMMC CHIPS USED IN PHONES AND OTHER DEVICES

## eMMC/eMCP

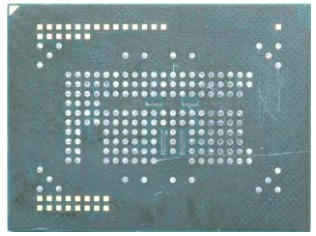
BGA221



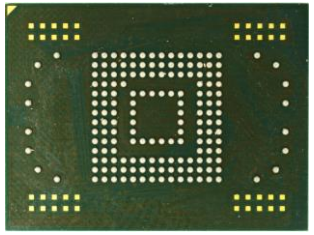
BGA162



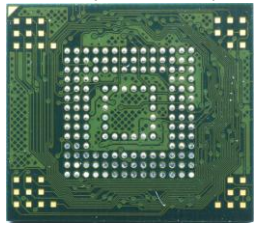
BGA186



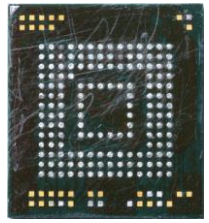
BGA169 12x16



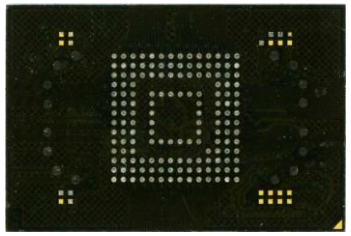
BGA153/169 11,5x13



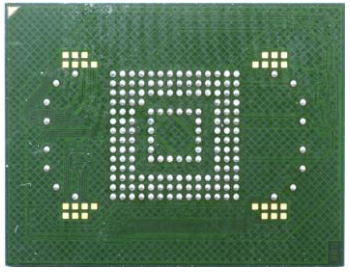
BGA153/169 10x11



BGA169 12x18

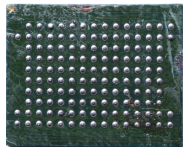


BGA169 14x18

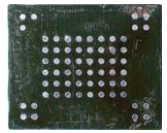


## RAW NAND

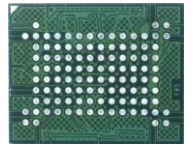
BGA137



BGA63

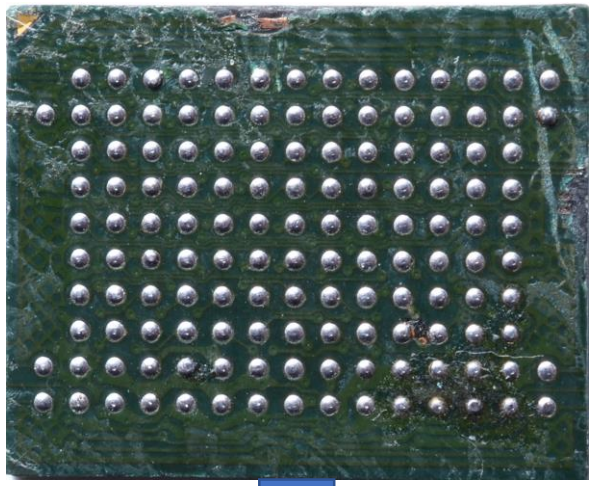


BGA107



# EMMC vs RAW NAND CHIP-OFF DATA RECOVERY

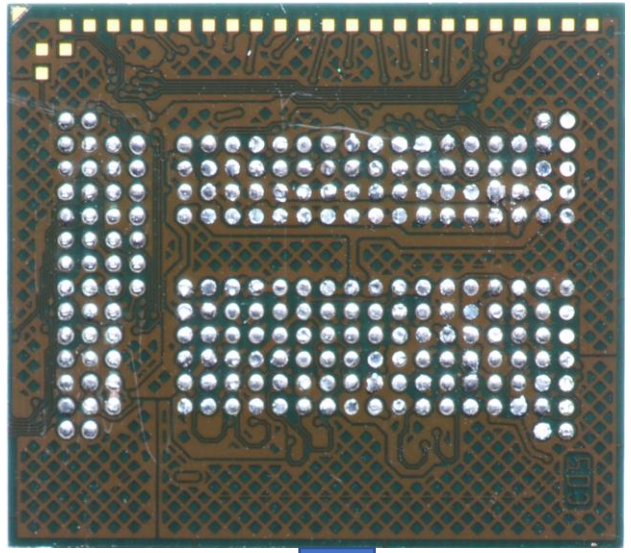
## RAW NAND



READ

NAND protocol

## eMMC/eMCP



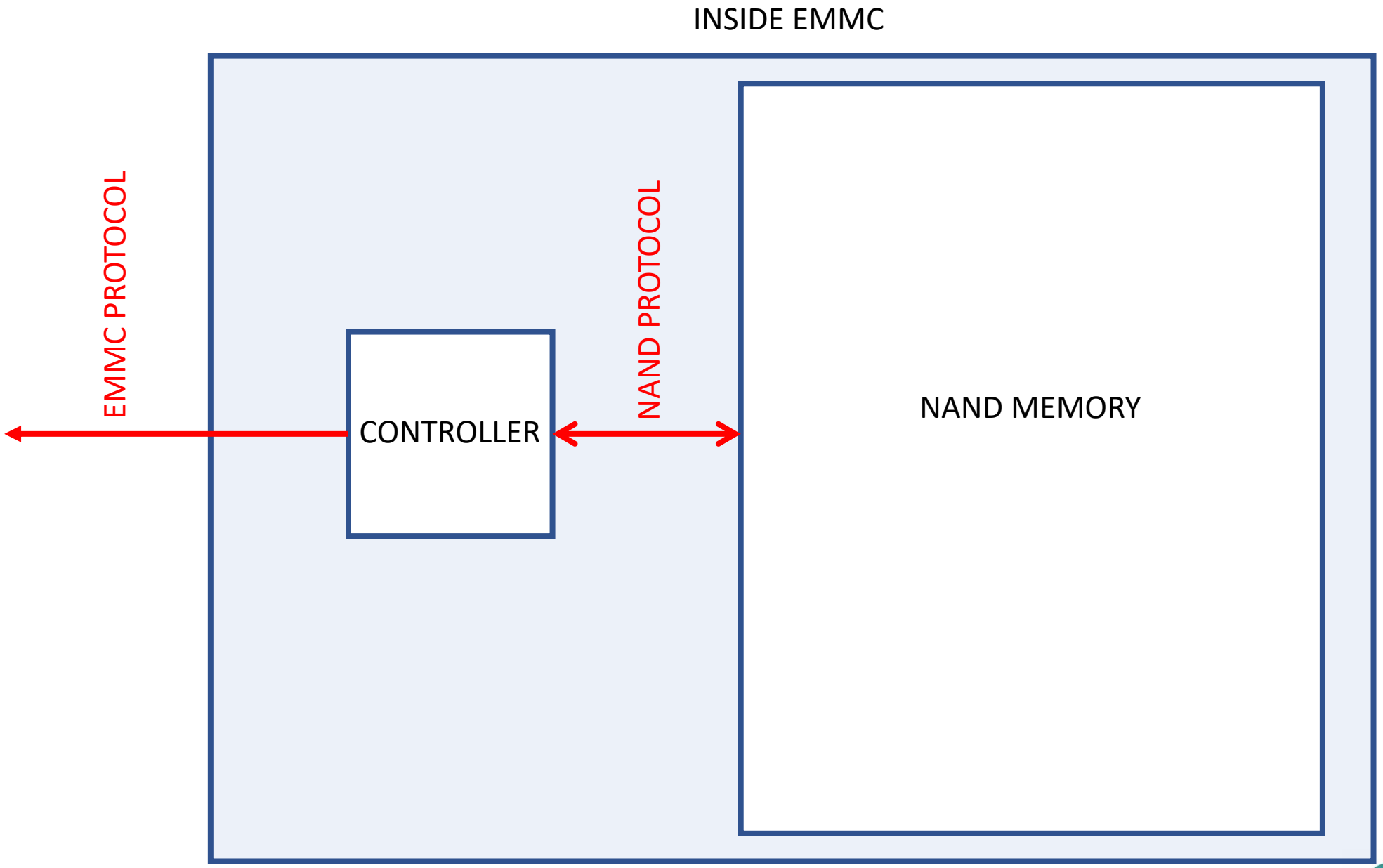
eMMC protocol

READ

# APPLICATIONS OF EMMC CHIPS

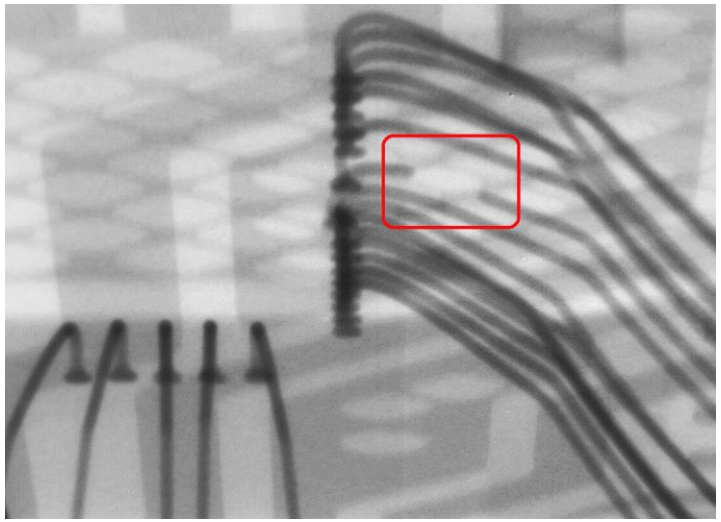
- SMARTPHONES
- TABLETS
- LAPTOPS
- VOICE RECORDERS
- CAMERAS
- MULTIMEDIA PLAYERS
- TV DECODERS
- INTERNET OF THINGS

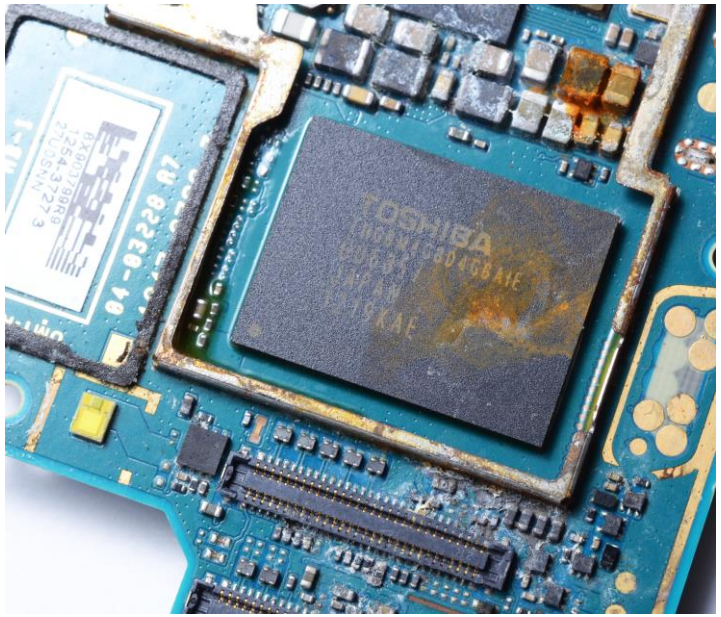
…AND MUCH MORE…


INSIDE EMMC
EMMC PROTOCOL
CONTROLLER
NAND PROTOCOL
NAND MEMORY

# WHEN EMMC CHIP DAMAGE OCCURS

- WATER DAMAGE
- THERMAL DAMAGE
- PHYSICAL DAMAGE
- DAMAGE OF TRACKS/PADS ON CHIP’S PCB
- DAMAGE OF WIRE BONDING INSIDE CHIP
- HUMAN FACTOR DURING DATA RECOVERY



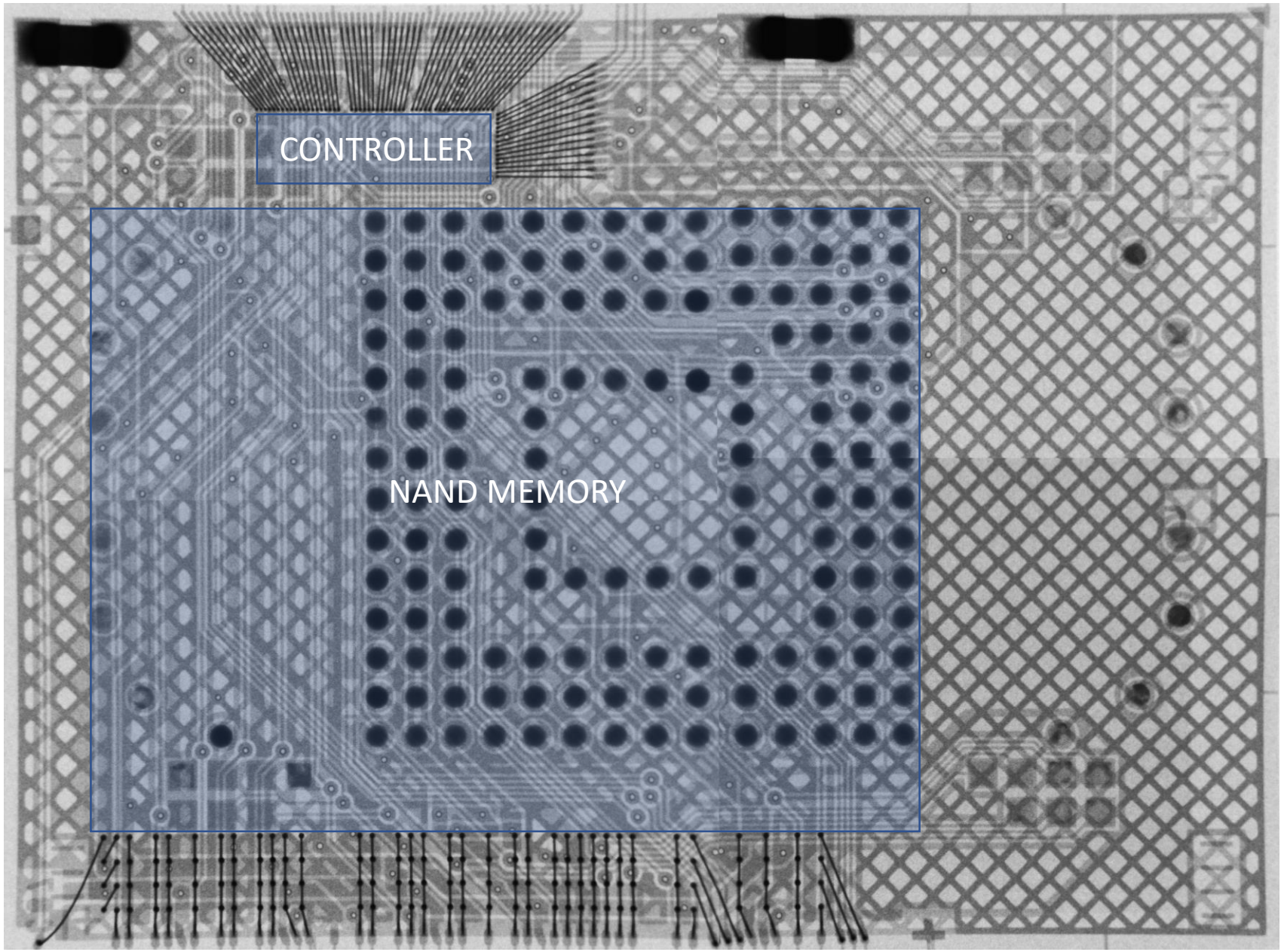


# SYMPTOMS OF DAMAGED EMMC CHIPS

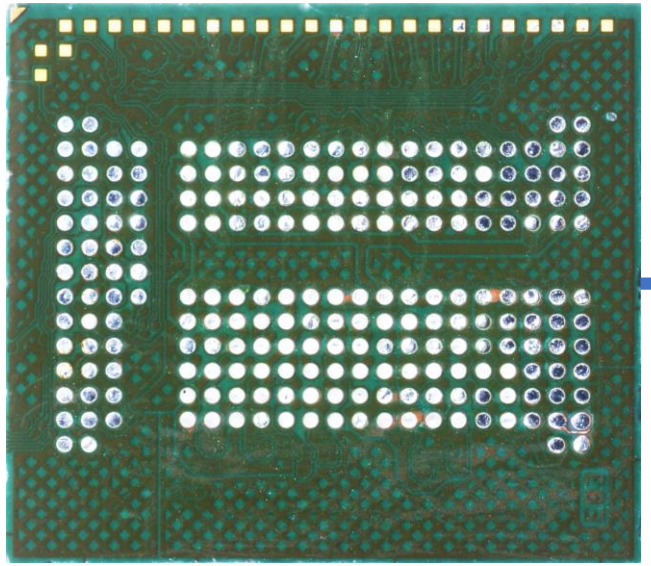
- NOT RECOGNIZED WHEN CONNECTED TO EMMC ADAPTER
- RECOGNIZED BUT SHOWS WEIRD CAPACITY
- RECOGNIZED AND FIRST 32-64MB ACCESSIBLE
- RECOGNIZED BUT READS GARBAGE

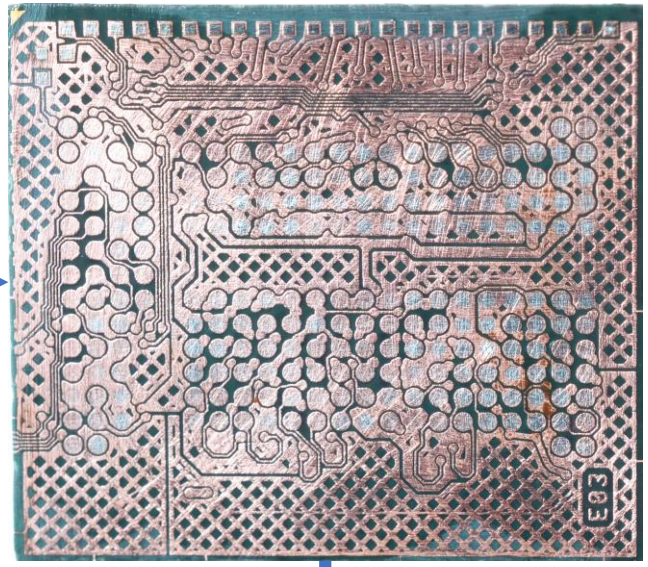
# SO HOW TO EXTRACT THE DATA OUT OF DAMAGED EMMC CHIP?

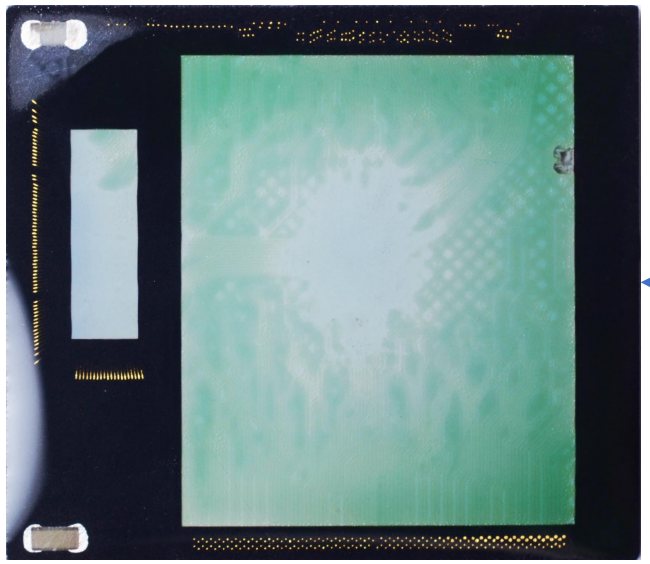
# EMMC THROUGH XRAY

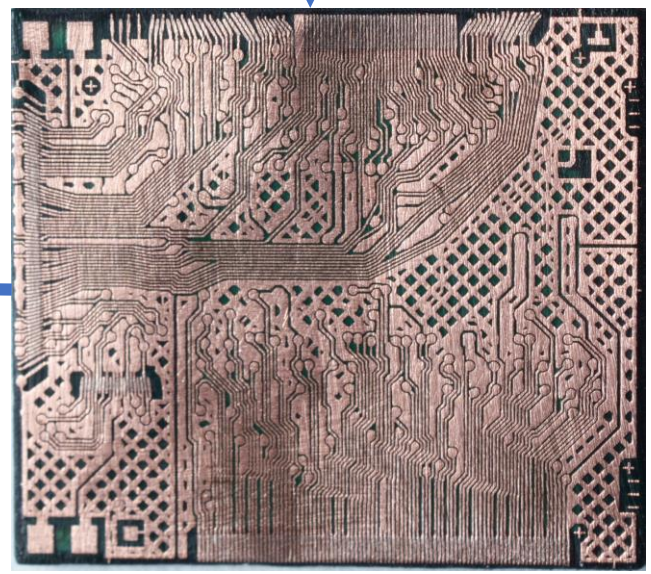


# DELAYERED EMMC CHIP

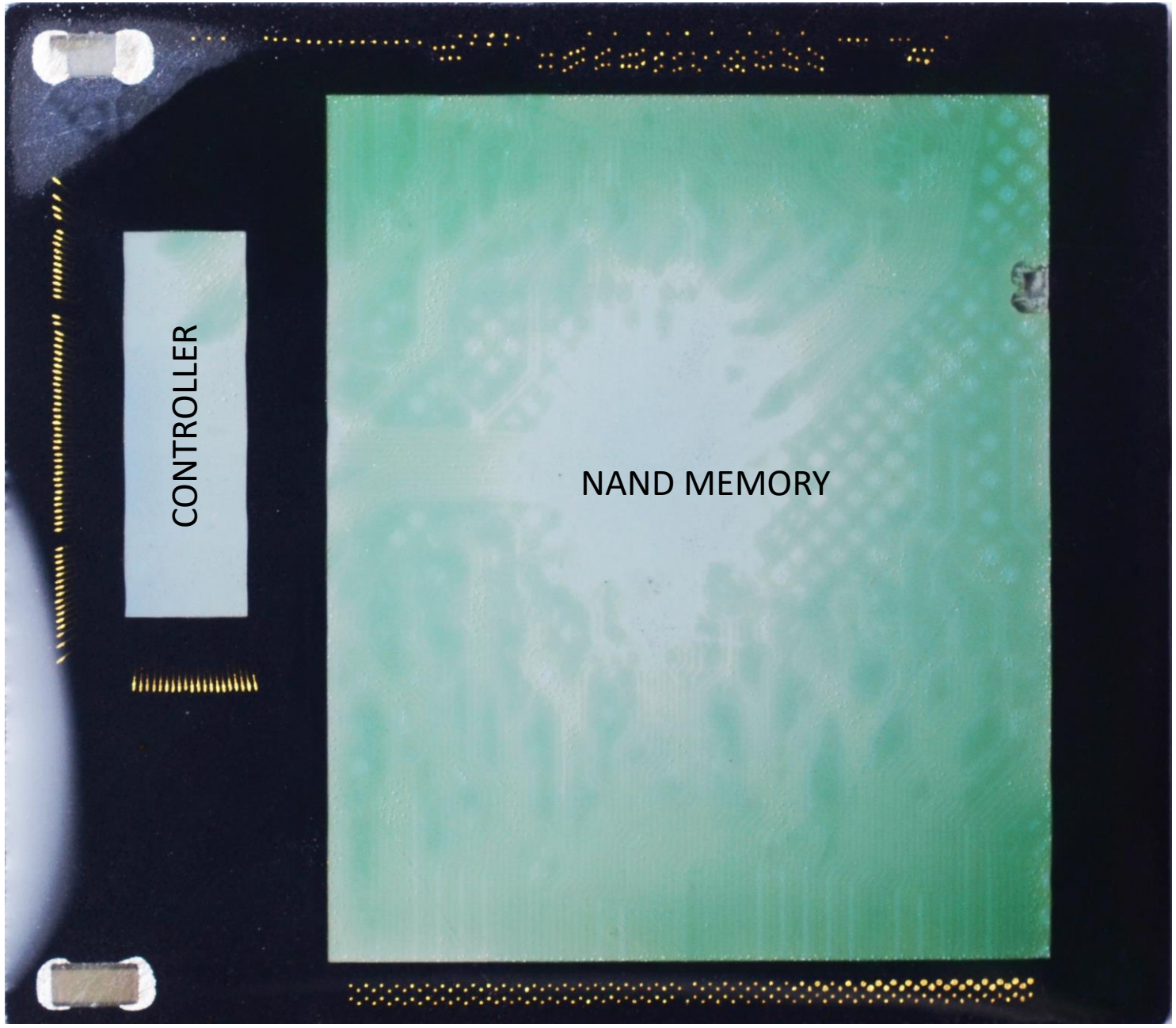




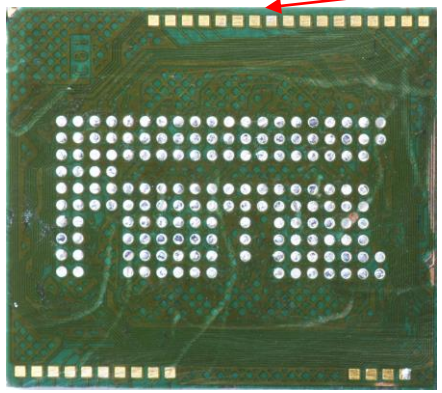
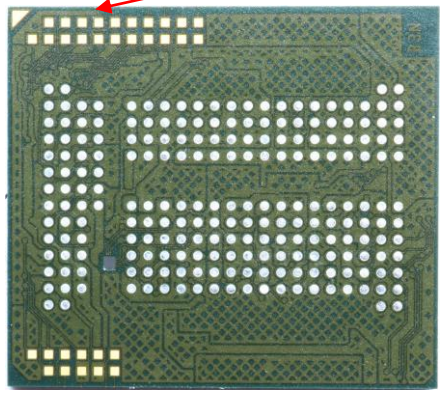
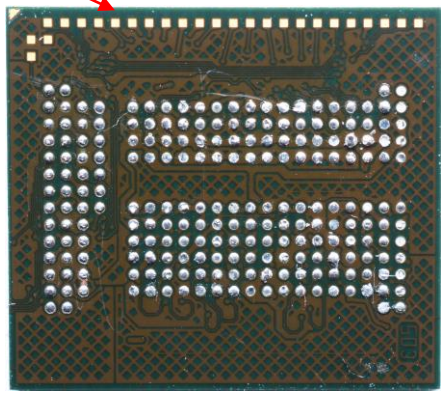
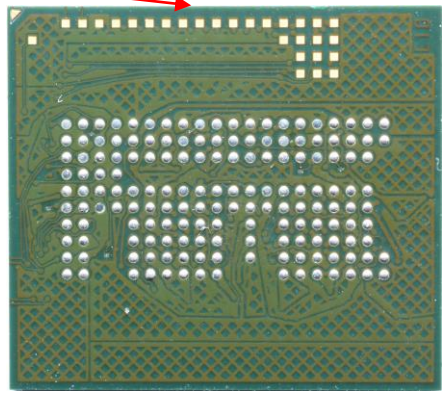
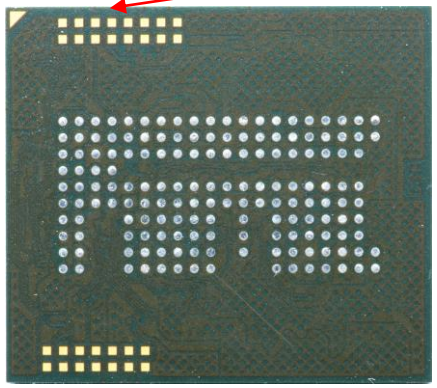
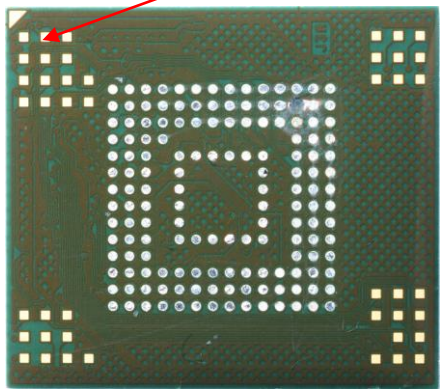
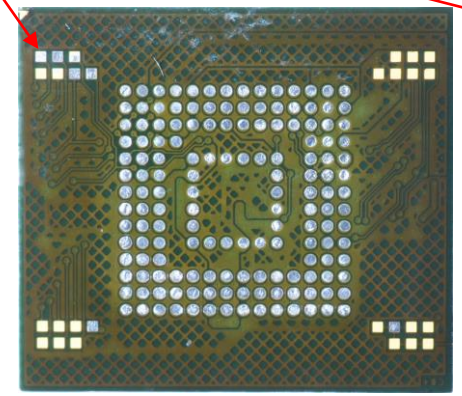
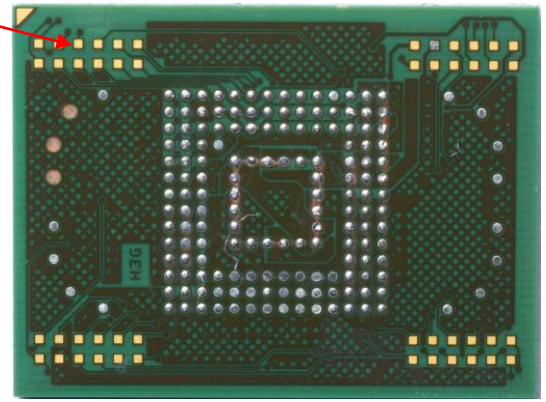




# EMMC CHIP STRUCTURE



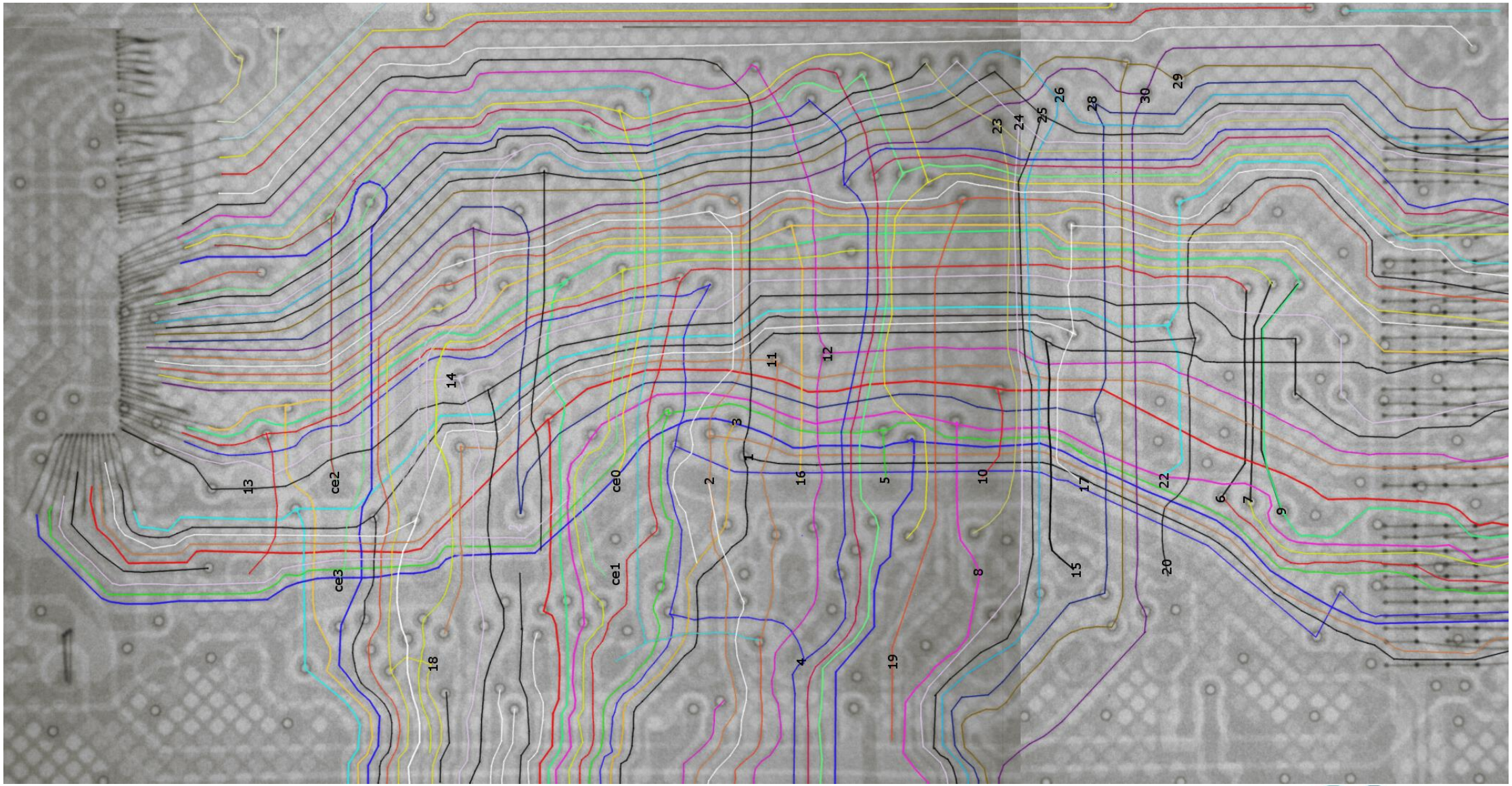
# TECHNOLOGICAL PADS - NAND INTERFACE

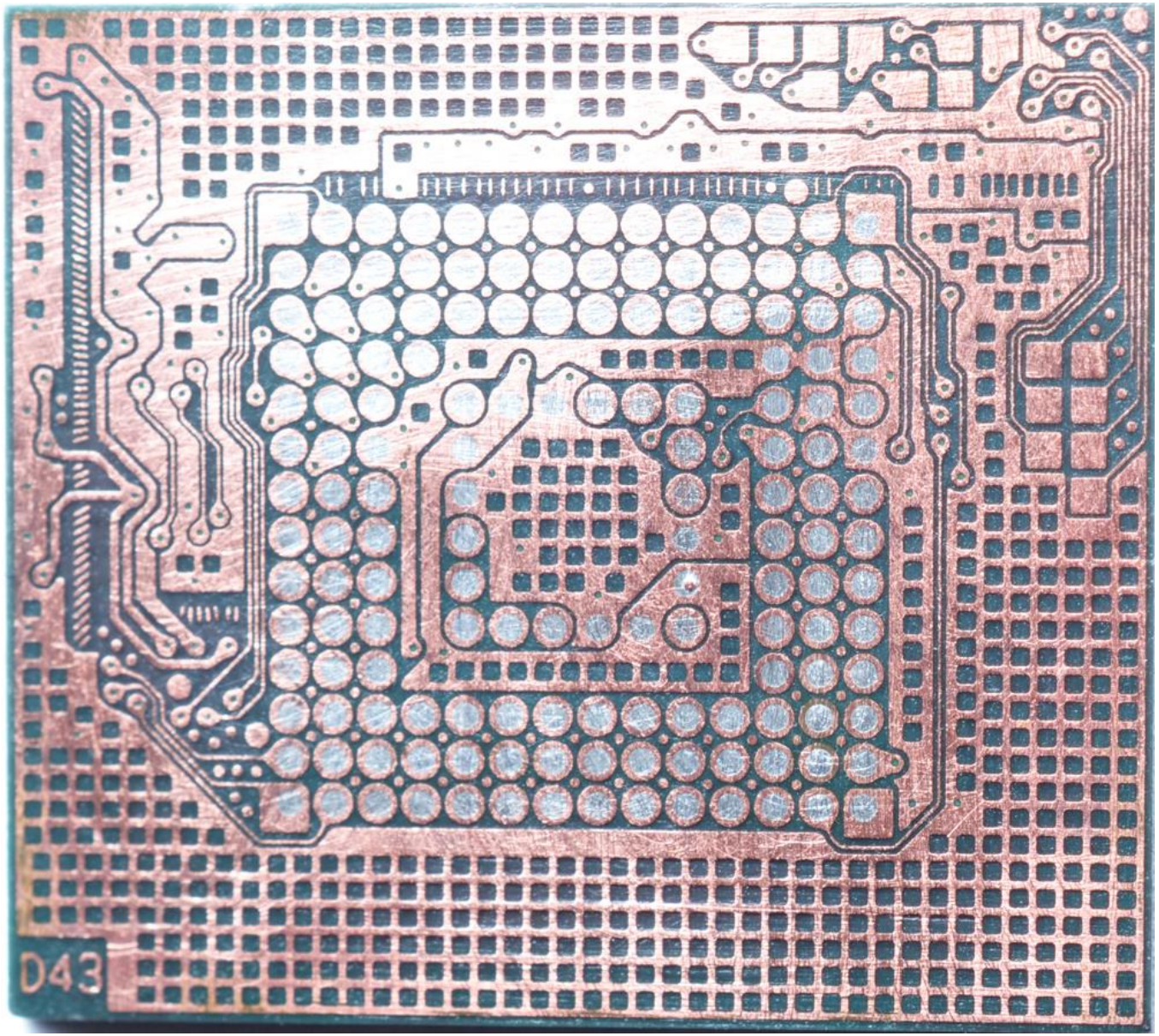
# NAND PINOUT ANALYSIS

- XRAY PCB LAYOUT ANALYSIS WITH FURTHER WIRE BONDING ANALYSIS OF NAND AND CONTROLLER
- NAND AND CONTROLLER PINOUT ANALYSIS THROUGH PCB LAYER REMOVAL
- CLASSIC “MAN IN THE MIDDLE ATTACK” USING LOGIC ANALYZER CONNECTED BETWEEN CONROLLER AND NAND MEMORY

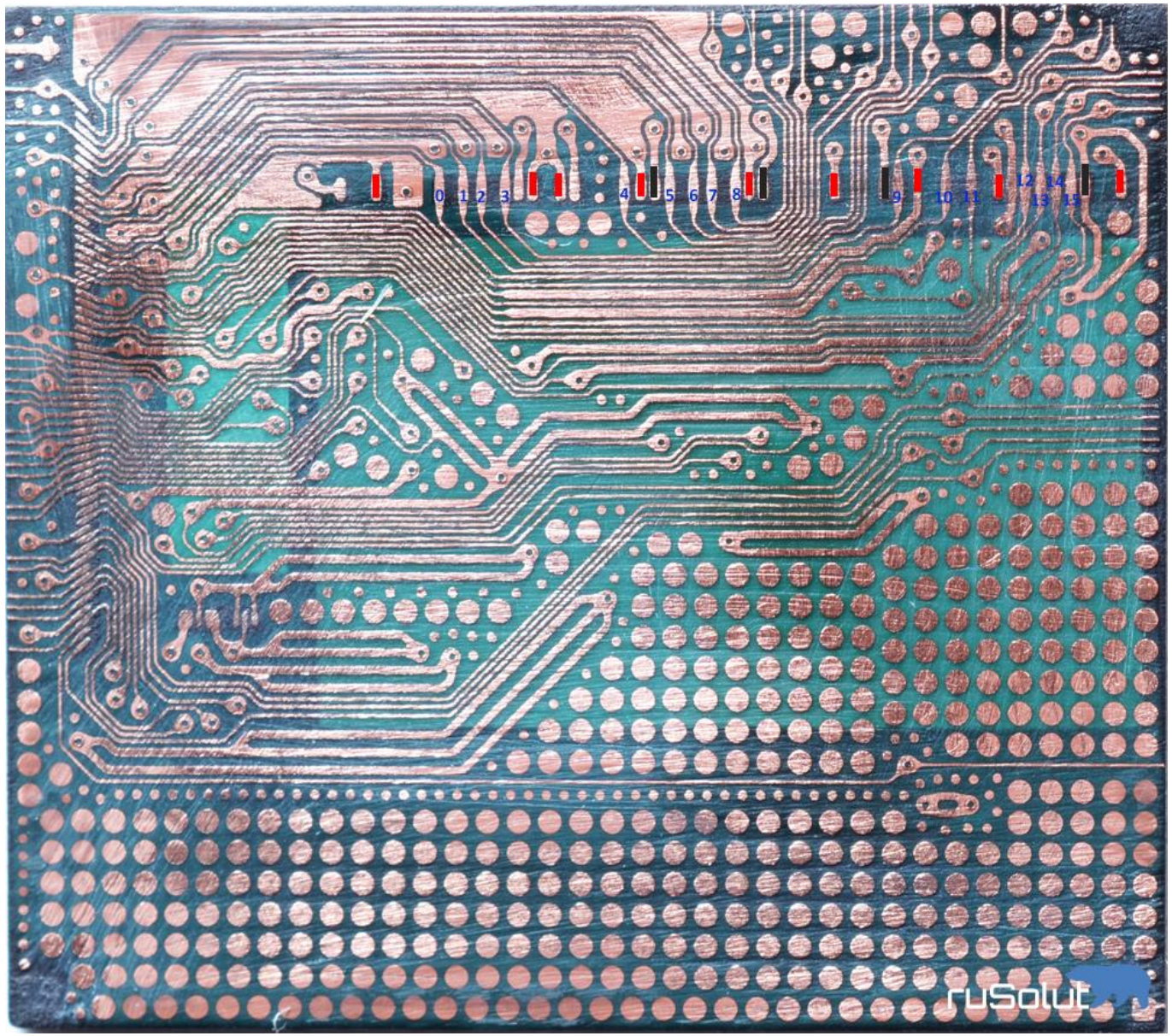
# NAND PINOUT ANALYSIS. XRAY



# NAND PINOUT ANALYSIS. LAYER DISSECTION – LAYER 1 (TOP)



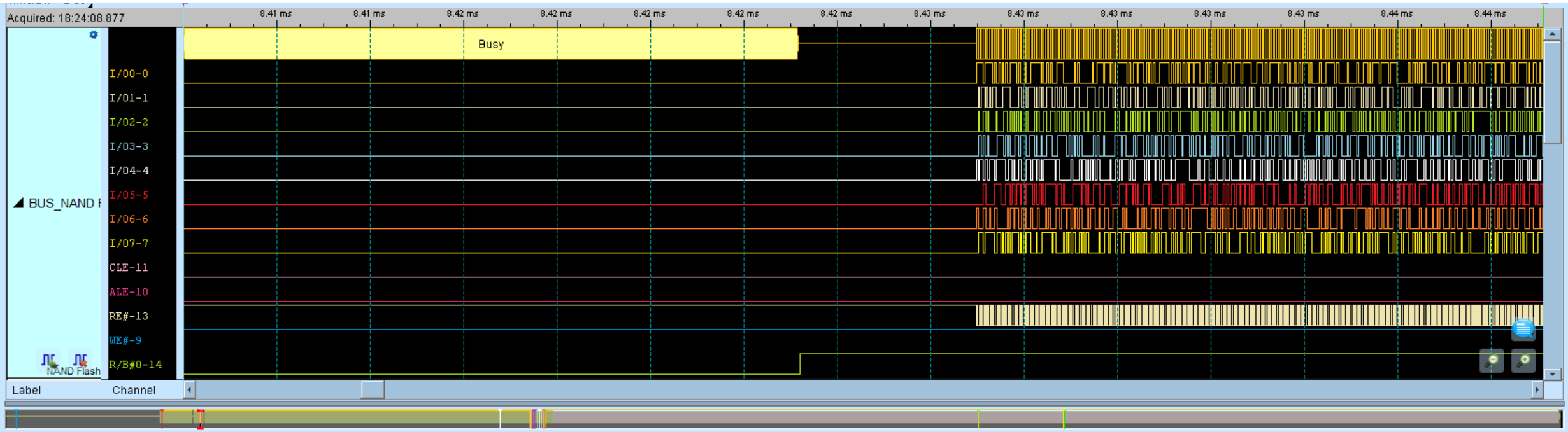
# NAND PINOUT ANALYSIS. LAYER DISSECTION – LAYER 2 (INNER)




ruSolut

Techno Security & Digital Forensics Conference

# NAND PINOUT ANALYSIS. LOGIC ANALYZER



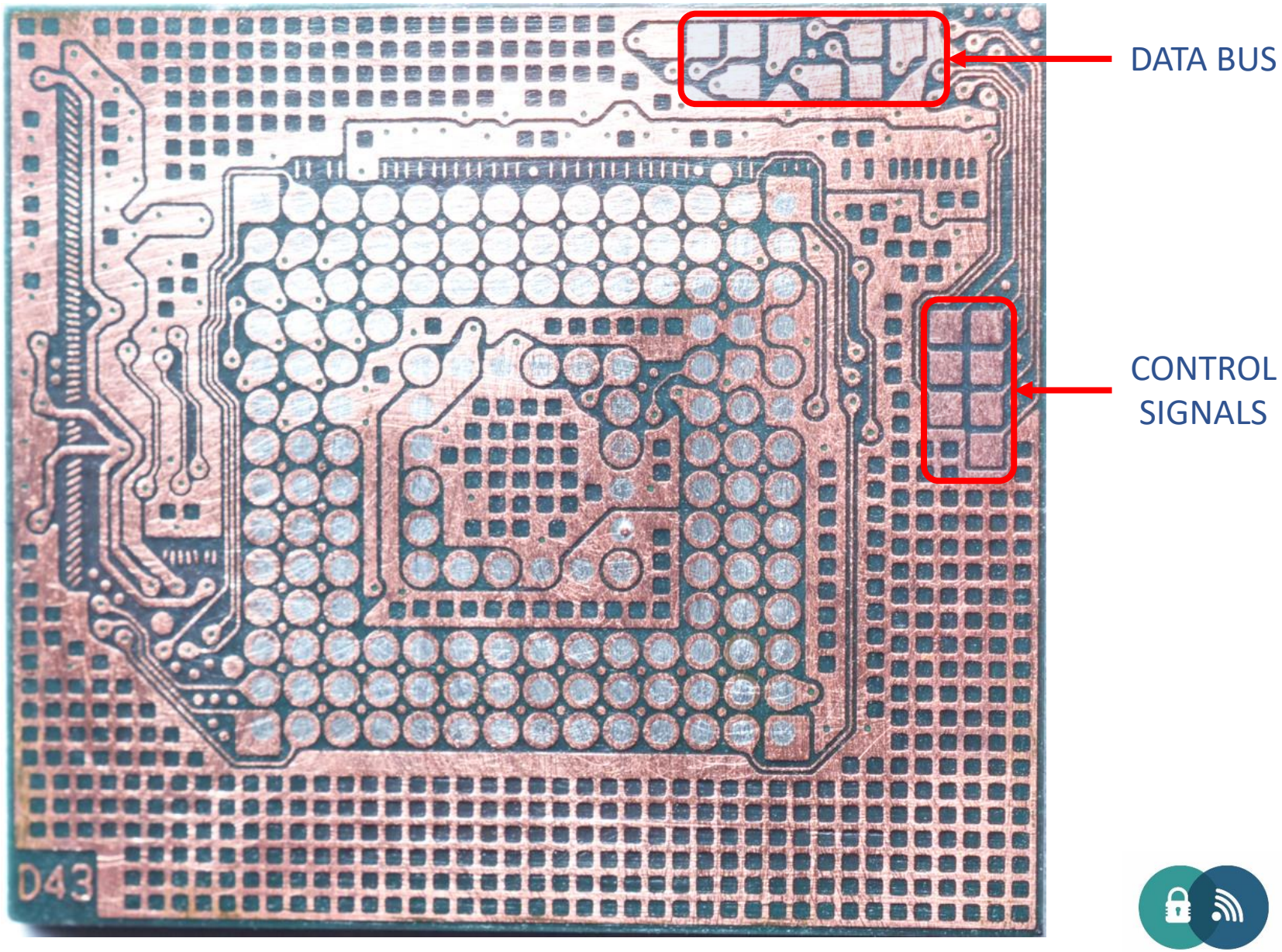

CH-00 CH-01 | Bus BUS_NAND Flash(NAND Flash) | Search All Field

| | Sample | Command | Row Address(h) | Column / Feature Address(h) | D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 | ASCII(D0-D7) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 98 | 8.34249ms | READ #2(30) | 000412 | 0000 | 51 | 8F | 99 | 93 | 6E | F5 | 93 | 8D | Q...n... |
| 99 | 8.81214ms | RESET(FF) | | | | | | | | | | | |
| 100 | 8.82578ms | READ #1(00) | 000600 | 0000 | | | | | | | | | |
| 101 | 8.83052ms | READ #2(30) | 000600 | 0000 | 3B | 0A | F9 | AA | 06 | 43 | AB | 6D | ;....C.m |
| 102 | 9.35098ms | RESET(FF) | | | | | | | | | | | |
| 103 | 9.365925ms | READ #1(00) | 000601 | 0000 | | | | | | | | | |
| 104 | 9.370675ms | READ #2(30) | 000601 | 0000 | 41 | 76 | 9E | C9 | 19 | A9 | 70 | 04 | Av....p. |
| 105 | 9.51533ms | READ #1(00) | 00040A | 0000 | | | | | | | | | |
| 106 | 9.516805ms | READ #2(30) | 00040A | 0000 | 4C | C1 | 0A | 03 | D3 | C4 | D5 | A7 | L..... |
| 107 | 9.965015ms | READ #1(00) | 000412 | 0000 | | | | | | | | | |
| 108 | 9.966495ms | READ #2(30) | 000412 | 0000 | 51 | 8F | 99 | 93 | 6E | F5 | 93 | 8D | Q...n... |
| 109 | 10.4473ms | READ #1(00) | 000413 | 0000 | | | | | | | | | |
| 110 | 10.448715ms | READ #2(30) | 000413 | 0000 | 01 | DF | 7E | 1B | 07 | 8F | 2D | F7 | ..~...-. |
| 111 | 10.92589ms | RESET(FF) | | | | | | | | | | | |
| 112 | 10.940395ms | RESET(FF) | FFFFFF | FFFF | | | | | | | | | |
| 113 | 10.94419ms | RESET(FF) | | | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | ........ |
| 114 | 11.04347ms | RESET(FF) | | | | | | | | | | | |
| 115 | 11.05801ms | RESET(FF) | FFFFFF | FFFF | | | | | | | | | |
| 116 | 11.0618ms | RESET(FF) | | | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | ........ |
| 117 | 11.111551 | RESET(FF) | | | | | | | | | | | |

Techno Security & Digital Forensics Conference

ruSolut

# NAND PINOUT



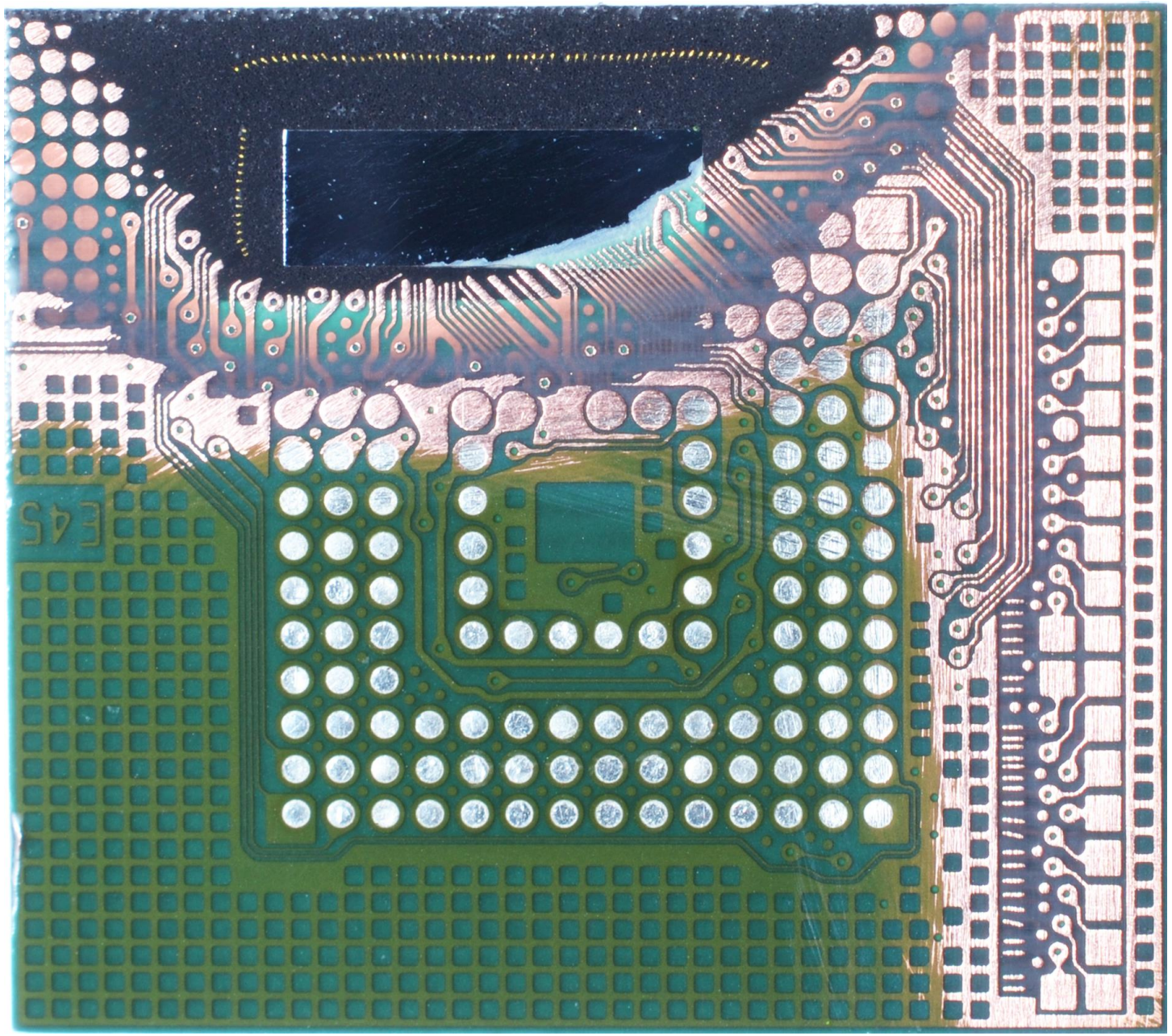
# SCENARIOS OF FAILURE

NO SHORT CIRCUIT ~80-90%

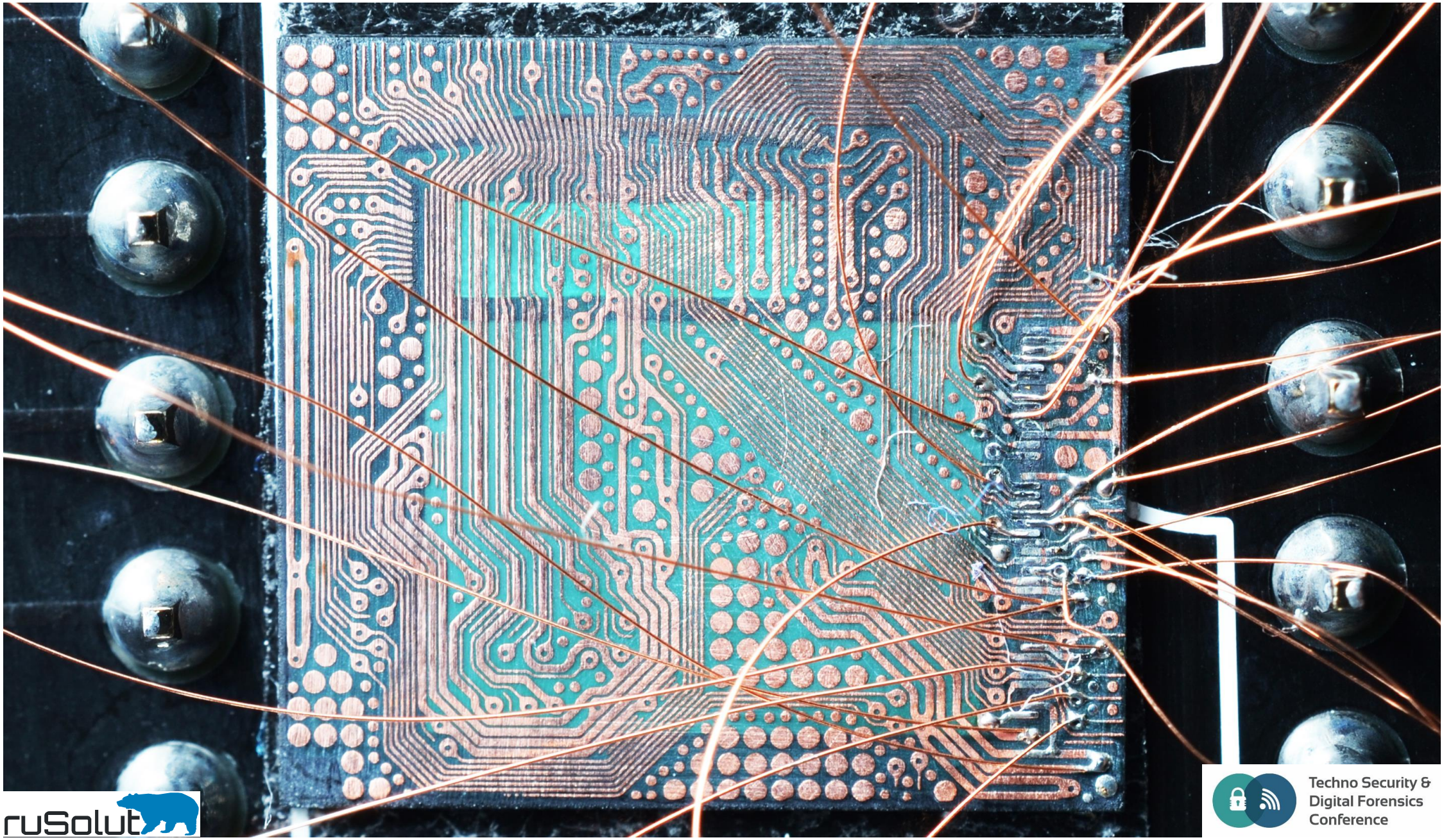
- FW CORRUPTION
- CONTROLLER DAMAGE DUE TO OVERHEAT
- WIRE BONDING DAMAGE
- UNKNOWN COTROLLER DAMAGES

SHORT CIRCUIT ~10-20%

# SHORT CIRCUIT IN CONTROLLER. CONTROLLER DISCONNECTION. EASY CASE

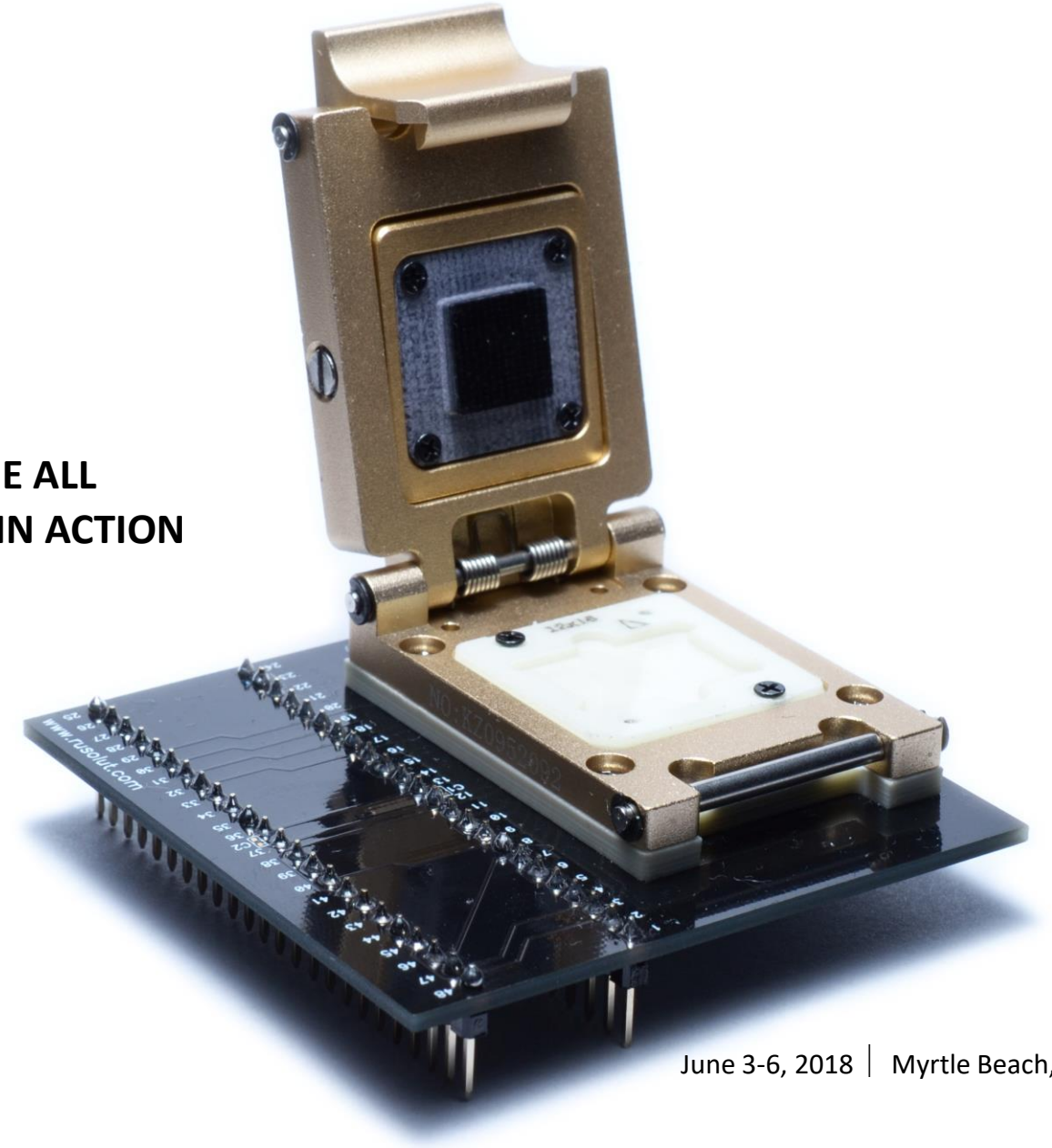


SHORT CIRCUIT IN CONTROLLER. CONNECTING TO SECOND LAYER OF PCB. HARD CASE



# EMMC-NAND ADAPTERS

**VISIT BOOTH 108 TO SEE ALL ADAPTERS AND TECHNOLOGY IN ACTION**



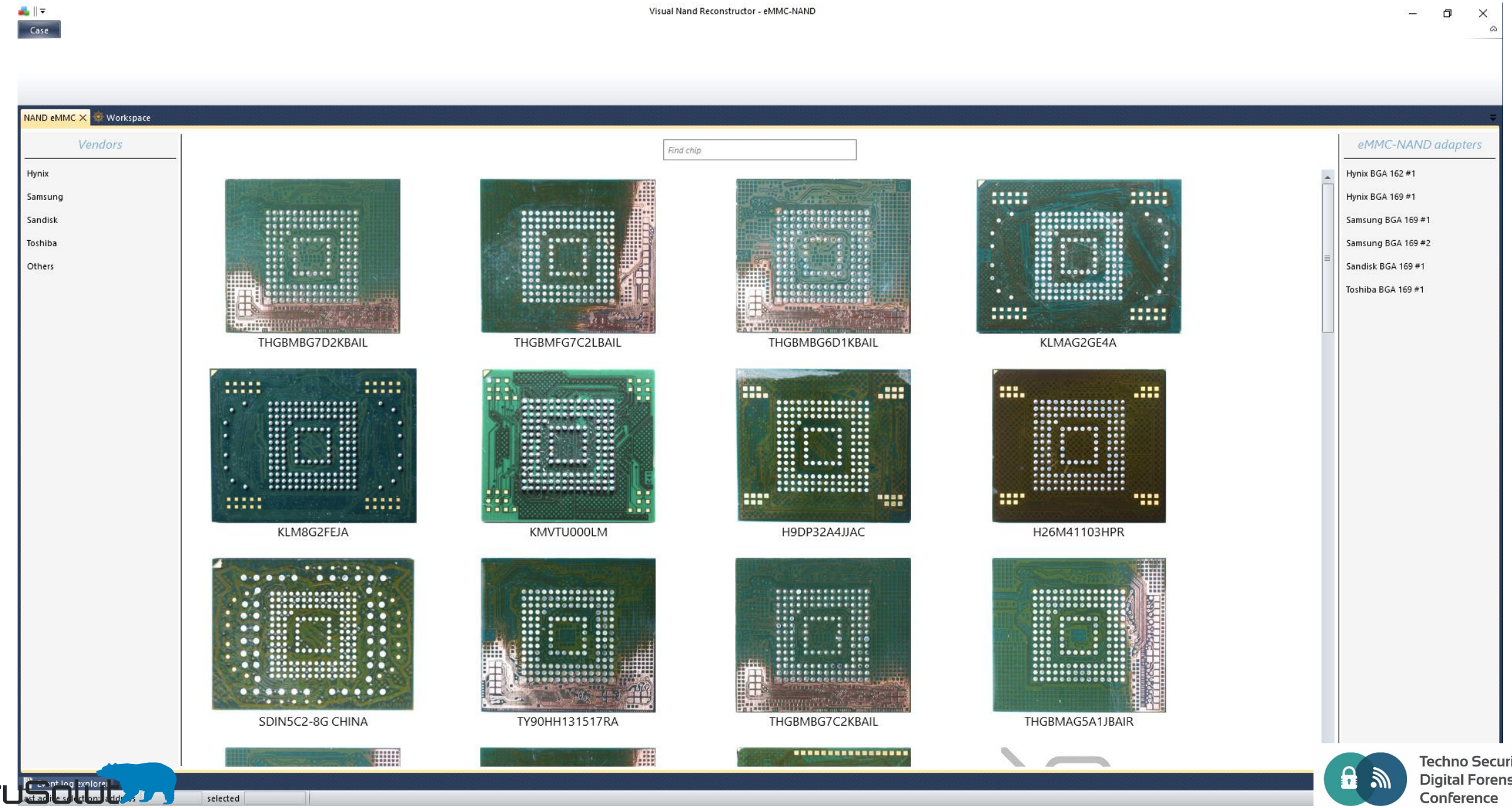

ruSolut

June 3-6, 2018 | Myrtle Beach, SC USA

Techno Security & Digital Forensics Conference

# CONNECT CHIP TO READER

# VISUAL NAND RECONSTRUCOR – THE NEW MODE FOR EMMC-NAND ACCESS



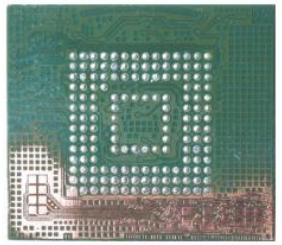
# ADAPTER ASSEMBLY

Visual Nand Reconstructor - eMMC-NAND

Case

NAND eMMC | Workspace

eMMC parameters



Model: THGBMBG7D2KBAIL
Vendor: Toshiba
NAND ID: 98DE949376
Crystals: 2
Capacity: 16 GB

Adapter assembly

PCB

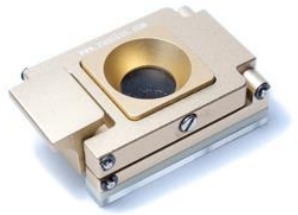
Toshiba BGA 169 #1 (PCB 1)

Frame

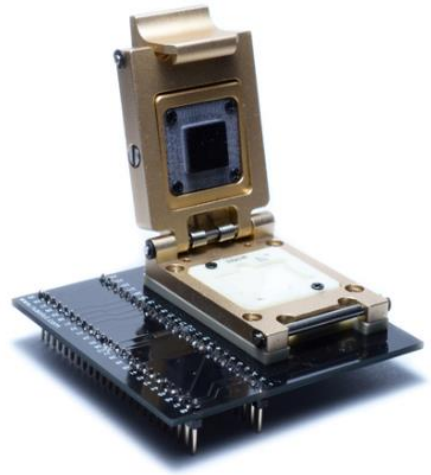
Toshiba BGA 169 #1 (11.5x13)

Socket

Toshiba BGA 169 #1



Assembled adapter

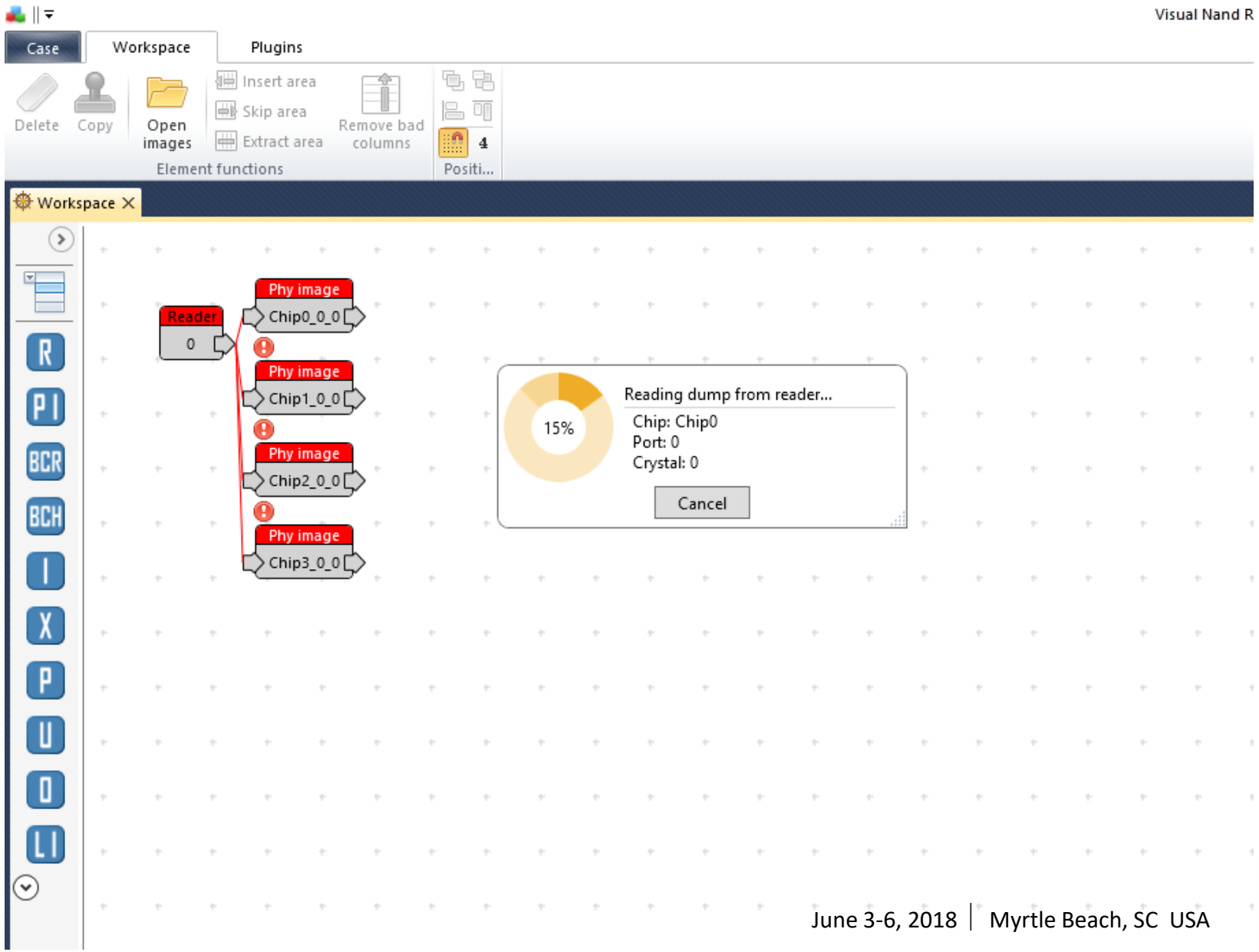


Back | Next

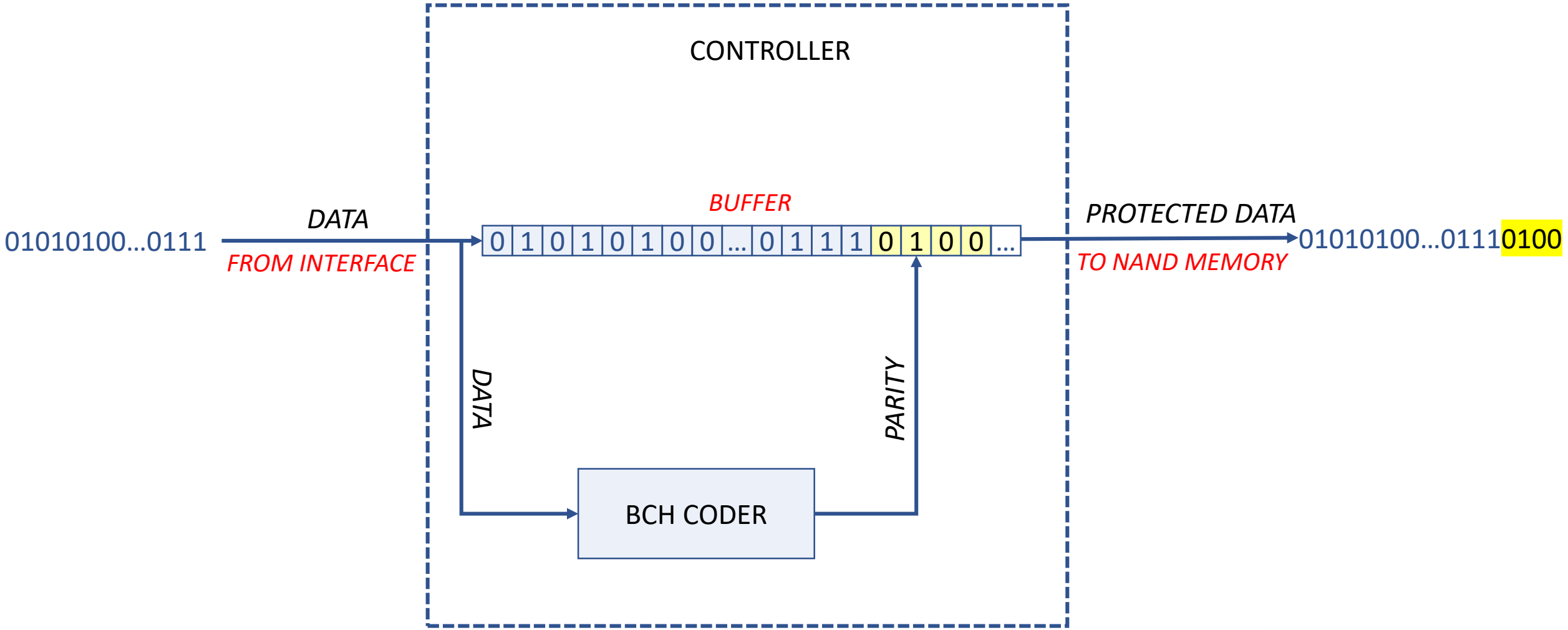
Event log

Last active selection | selected

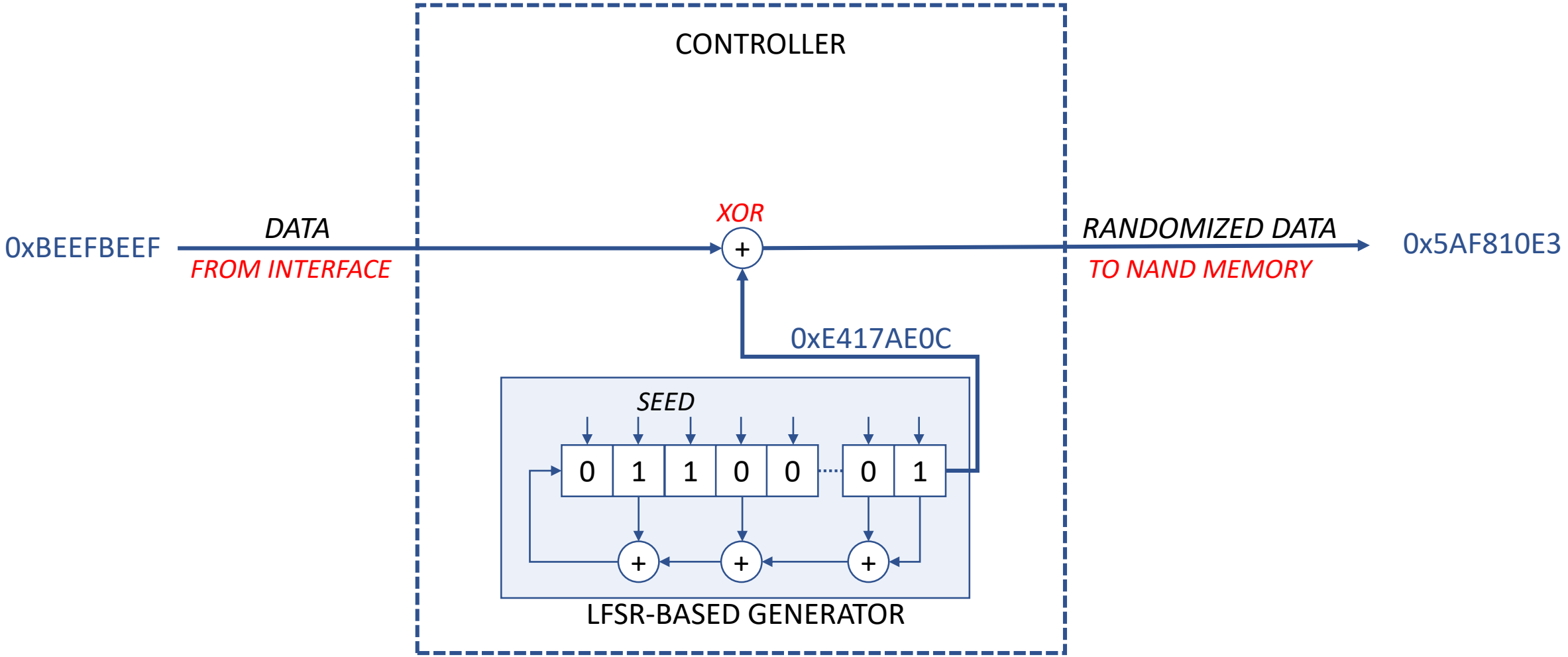
# RAW NAND PHYSICAL IMAGE EXTRACTION



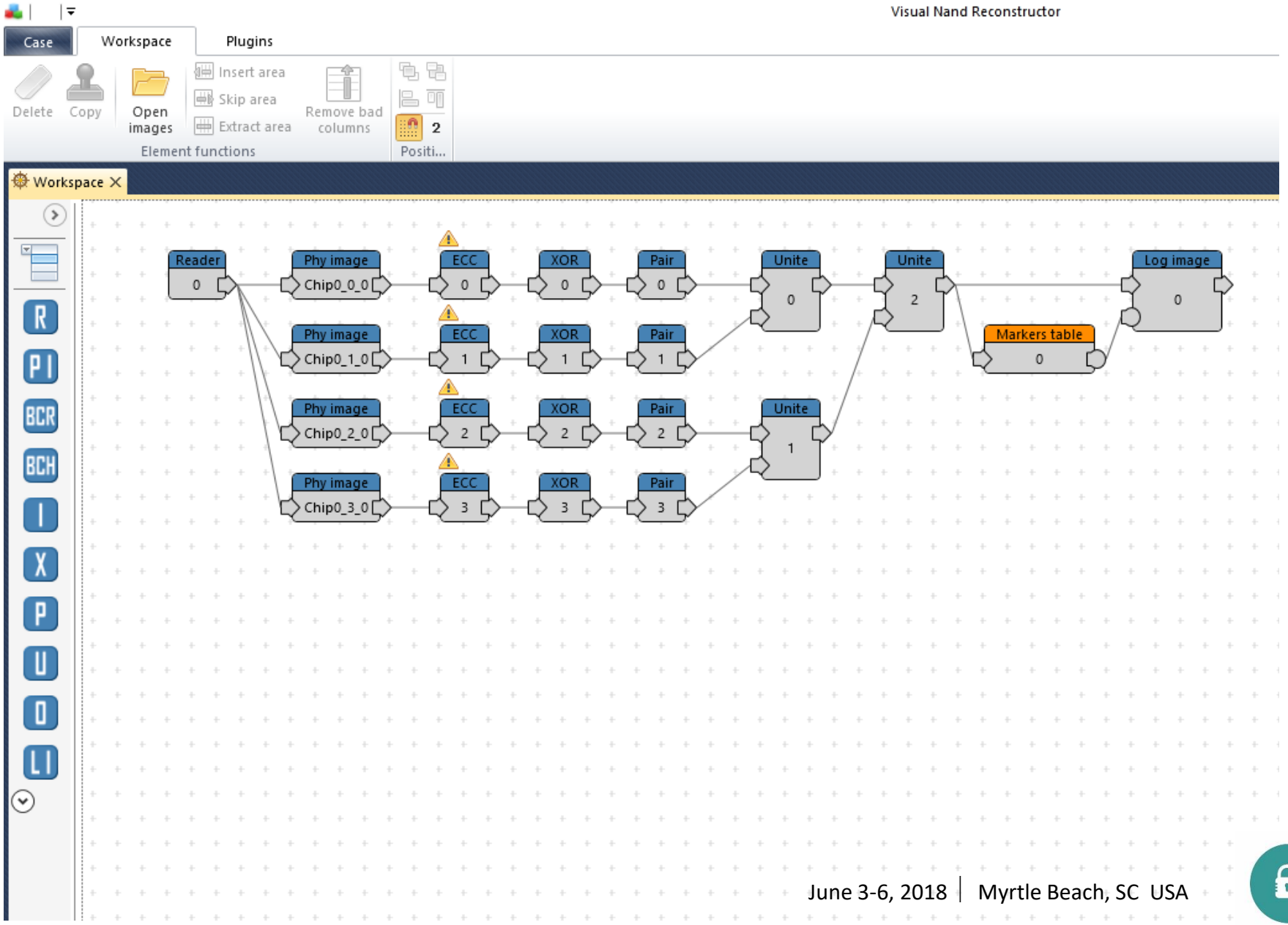
# ERROR CORRECTION CODES IN FLASH MEMORY



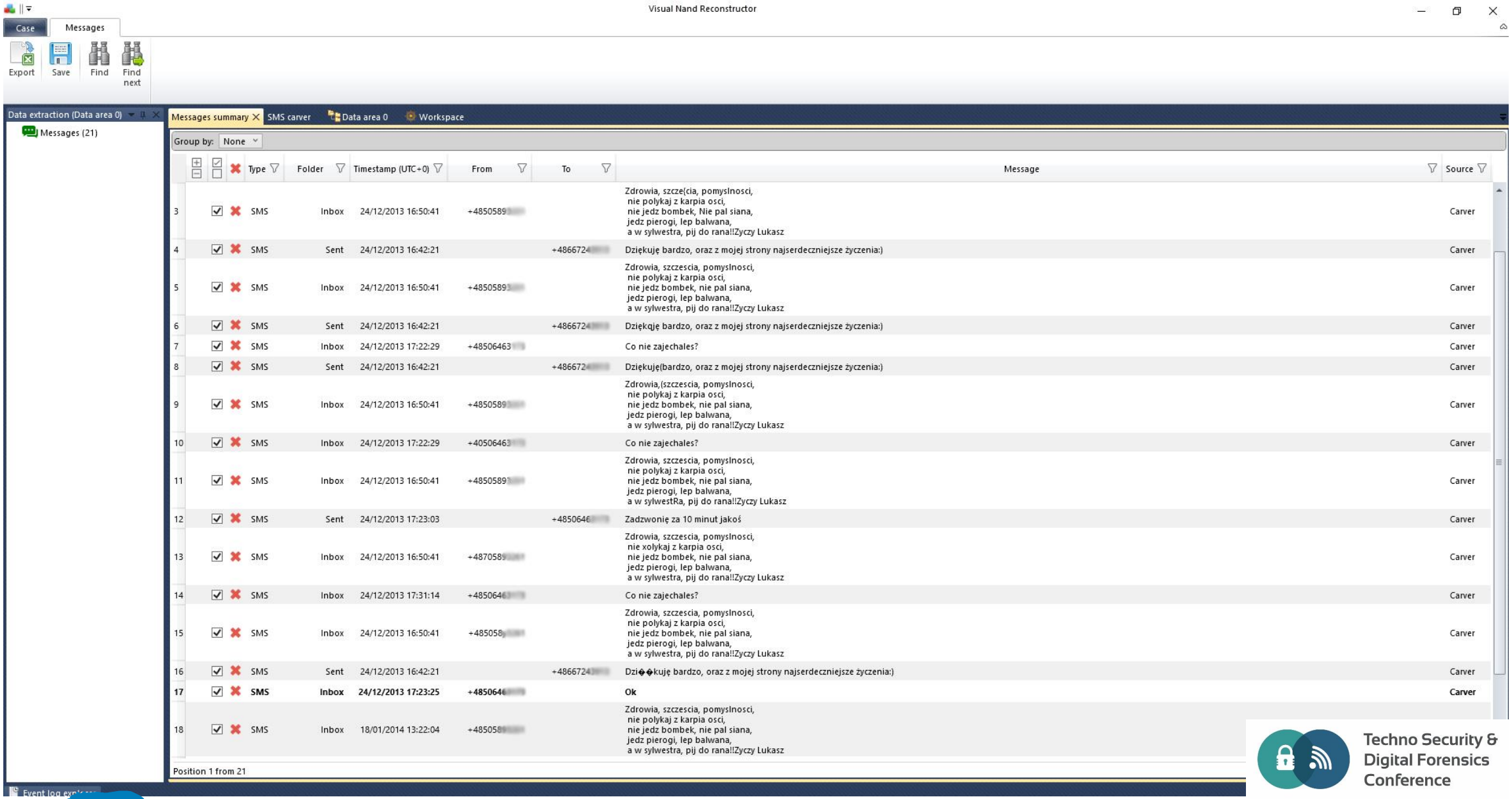
# DATA SCRAMBLERS OF FLASH CONTROLLERS



# LOGICAL IMAGE RECONSTRUCTION



# SQLITE CARVING AND DATA ANALYSIS



# APPLICATIONS OF TECHNOLOGY

- DATA RECOVERY FROM DAMAGED EMMC CHIPS

- RETRIEVAL OF DELETED TEXT MESSAGES, CHATS , ETC. THROUGH NAND PROTOCOL INCLUDING GARBAGE BLOCKS ON DEEPER LEVEL THAT IS NOT ACCESSIBLE FOR CLASSIC MOBILE FORENSIC TOOLS

  More details here:
  https://www.flashmemorysummit.com/English/Collaterals/Proceedings/2017/20170808_S102A_Sheremetov.pdf
  Shortlink: https://goo.gl/g84gkJ

VISIT OUR **BOOTH 108** TO SEE NEW TOOL UNVEIL AND TECHNOLOGY IN WORK

# THANK YOU


ruSolut

www.rusolut.com
Polczynska 10,
Warsaw, Poland
+48 537 202 227
info@rusolut.com




OUR PARTNERS IN USA


CPR TOOLS

www.cprtools.com
2022 Hendry Street
Suite 100
Fort Myers, FL
239.464.DATA (3282)
support@cprtools.com