# CFexpress 4.0 and its applications in the industrial market

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FMS the Future of Memory and Storage

CFA CompactFlash Association

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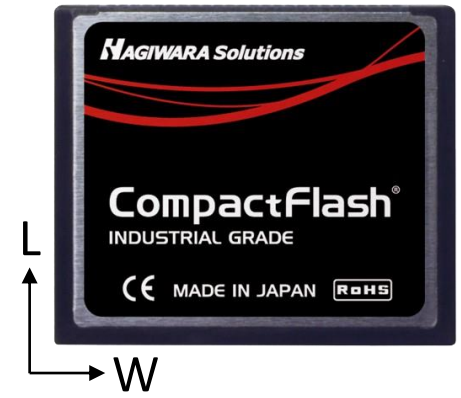
# Agenda

- What is CFexpress?
  - Real footprints
  - Comparison between CFexpress 2.0 and 4.0
  - Key features of CFexpress 4.0
- CFexpress in the industrial market
  - Today's main market for CFexpress cards
  - Why are CFexpress cards suitable for industrial use?
  - Application examples

# Storage Form Factors defined by CompactFlash Association (CFA)

| | CompactFlash (CF) | CFast | CFexpress |
|---|---|---|---|
| Appearance (not to scale) |  |  |  |
| Outline (L x W x T [mm]) | 36.4 x 42.8 x 3.3 (Type I) | 36.4 x 42.8 x 3.6 (Type I) | 38.5 x 29.6 x 3.8 (Type B) |
| Physical | Parallel ATA | Serial ATA | PCIe |
| Logical | ATA | ATA | NVMe |

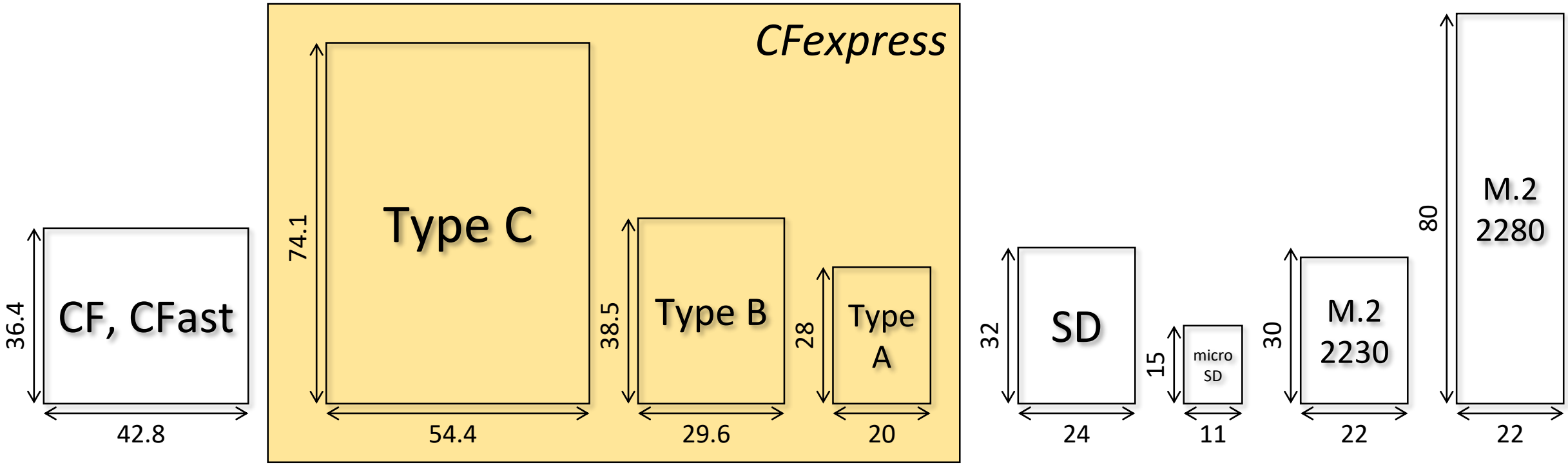
# What is CFexpress?

- The most popular removable card with PCIe and NVMe today

- Three form factors
  - Type A: PCIe 1 lane, smallest
  - Type B: PCIe 2 lanes
  - Type C: PCIe 4 lanes, biggest


*Fig. CFexpress Type B Card*

# CFexpress – Footprint




unit: mm

# CFexpress 2.0 and 4.0 – At a glance

| CFexpress Version | 2.0 | 4.0 |
|---|---|---|
| Form Factor | Type A / B / C | |
| Physical (PCIe) | 3.0 | 4.0 |
| Logical (NVMe) | Revision 1.3 | Revision 1.4c |
| | | HCTM* support is mandatory<br>PS1** support is mandatory |
| Supply Voltage | 3.3 V | |
| Maximum Current | 1.5 A (Type A), 2.5 (B), 7.5 (C)<br>@ PCIe 3.0 | 2.5 A (Type A), 3.0 (B), 3.5 (C)<br>@ PCIe 4.0 |
| Operating Temperature (in Celsius) | Tc = -10 to 70 (Type A / C)<br>Ta = -10 to 70 (Type B) | Tc = -12 to 72 (Type A / B / C) |

*Host Controlled Thermal Throttling, **Power State 1 (lower power state)

Note: Version number “3.0” is intentionally missing.

# CFexpress 4.0 – Key Features

- Doubles its bandwidth with PCIe 4.0
  - Physical bandwidth: about 2.0 GB/s (Type A), 4.0 GB/s (B), 8.0 GB/s (C)
- Adds care for heat and power
  - Supporting Host Controlled Thermal Management (HCTM) is required
  - “Gentle” boot sequence is introduced
- Definition of operating temperature is unified among all card types
  - Defined with surface temperature of card (Tc)
- Size and pinout are not changed
  - Fully utilize its existing ecosystem

# Today’s Main Market of CFexpress

- Still cameras and camcorders
- Other professional and high-end equipment for digital content creators
- It’s capacity and bandwidth are suitable for long-time videos and burst shooting within the camera’s body

# CFexpress in the industrial market

- CF and CFast have been used in the industrial market for a long time.
- Demand for storage with higher performance and/or larger capacity is increasing.
- CFexpress can be a good solution.

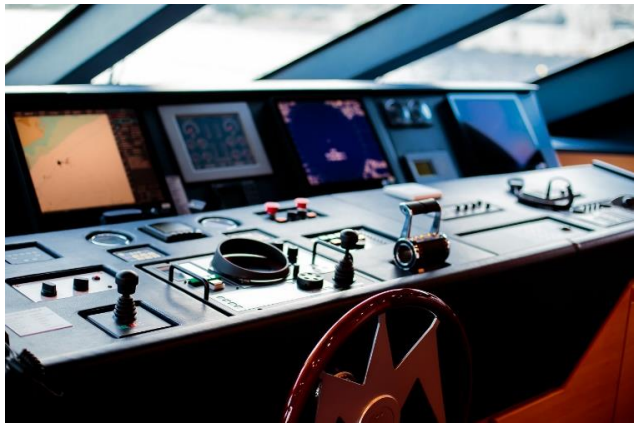


*Fig. Application examples of CF and CFast*

# CFexpress is suitable for industrial use

- Removable
  - Easy to replace, exchange and/or transfer data
- High performance with large capacity
  - Superior to other card-type media, and competitive to SSDs
- Covered with a case
  - Easy and safe for handling
- Offers three types (sizes)
  - Suitable for embedding
- Ecosystem
  - PCIe + NVMe is the most successful interfaces in storage today

# Application (1/2) Long-time recording

- Storing telemetry data, high resolution pictures and video in vehicles, drones, etc.
- Large data won't be transferred via network in real-time manner; buffering is needed for later post-process.
- CFexpress card is suitable for its higher performance, large capacity and removability

# Application (2/2) Edge computing

- Processing large data in near real-time manner at the edge is required for better responsiveness.
- Functions and features vary according to domain-specific requirements.
- CFexpress card is easy to install, reclaim, and re-deploy from/to the field.

# Other topics

- Design notes
  - Operating temperature and power consumption need to be checked.
  - Considerations for high-performance SSDs are also needed.

- Future works
  - Security features (e.g., TCG)

# Summary

- CFA has released new CFexpress specification (4.0) that doubles bandwidth with maintaining its main features.
- It is widely adopted in the digital content creation market today, but the industrial market is also a potential one.
- Its higher performance, larger capacity, and smaller footprint with removability can meet requirements for storage media in the industrial market.

# Thank you!

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