How PDF/R helps transforming image capture for mobile and cloud

ISO 23504-1:2020 (PDF/R)
Document management applications –
Raster image transport and storage

for modern, reliable and secure image transfers

What is PDF/R ?

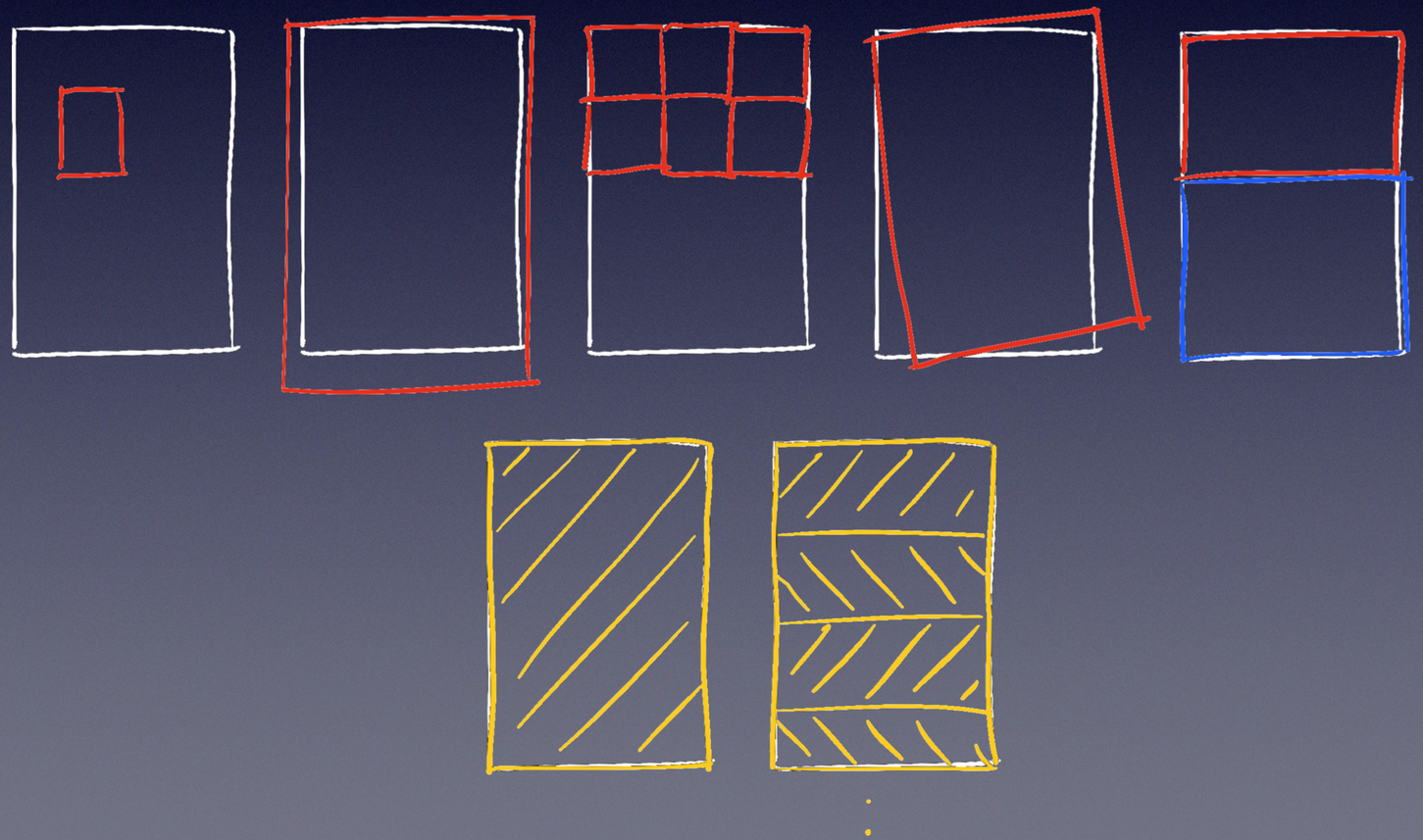
- created ~2016 for TWAIN Direct, a new and modern standard for driver agnostic network / cloud scanning
- making scanning easier and just work
- historically transferred RAW, in-memory data or BMP, TIFF or JPEG
- JPEG does not support multiple pages, or black & white
- also increasing need for encryption and digital signatures

Why a new PDF standard?

- although very versatile and feature rich, for some use cases PDF has too many features: vector graphics, text, forms, 3D, multimedia, ...
- with a thousand pages and even more features PDF support more than image exchange usually needs
- ~2016 TWAIN WG & PDF Association started drafting a PDF subset for image raster data, scans, photos, printing, …

Why a new PDF standard?

- XObject placement with existing PDF images:



Our solution: PDF/R

- 24 pages describing the allowed standard ISO PDF subset
- 100% compatible with existing PDF software
- only images, compressed or uncompressed
- well defined image data placements and alignment
- PDF/A compatible with ICC profiles!
- encryption and signatures

PDF/R features

- multiple pages
- ICC profiles
- no affine transformation (skew, rotation, ...) no cropping
- easy image data access
- no page content stream parsing required
- multiple image strips per page for long images

PDF/R benefits

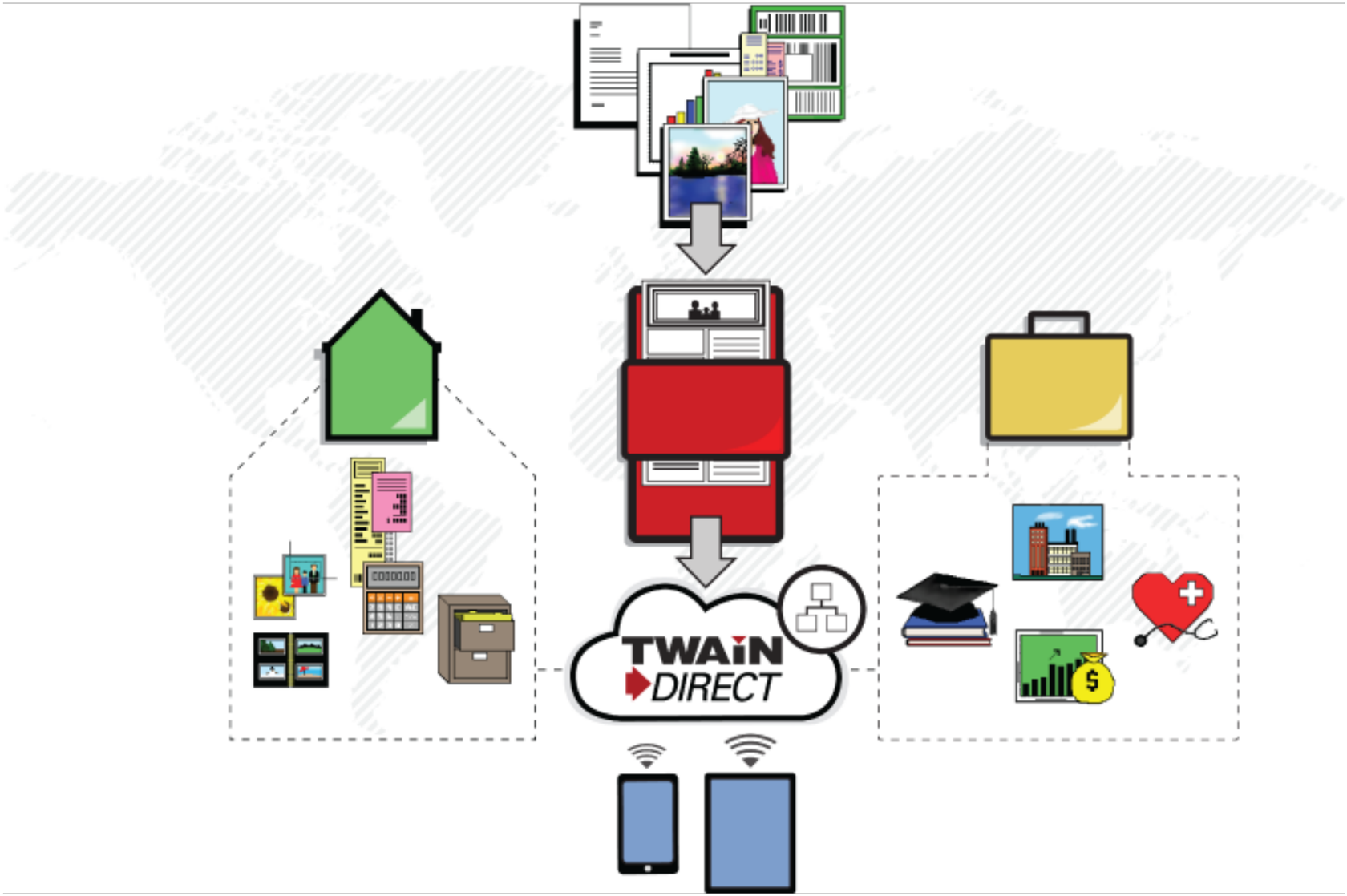
- easily and efficiently extract original raster image pixel data
- guarantee simplicity and compatibility for consumers for mobile devices and cloud applications
- does not require a full PDF processor / rasterization, small for firmware
- can be easier to write than TIFF
- improved security due significant smaller:

Trusted Computing Base (TCB)

PDF/R For who and where?

- can be used everywhere as modern TIFF and JPEG replacement
- scanner, printer, MFP, smartphone, digital camera
- image processing workflows
- mobile & cloud applications
- e-Governance

Use in TWAIN Direct / Cloud



Use in TWAIN Direct / Cloud

- Network scanning protocol / language
- JSON based web API
- emphasis on success
- simplifies application development

TWAIN Direct Example

```
{"actions": [
  {"action": "configure",

  "streams": [

    {"sources": [

      {"source": "any", "pixelFormats": [

        {"pixelFormat": "rgb24", "attributes": [

        {"attribute": "resolution", "exception": “fail", "values": [

          {"value": 300 }, {"value": 200 }

]}  ]}  ]}  ]}  ]}  ]}
```

Use in TWAIN Direct

- receive PDF directly form your scanner or MFP!
- driver-less, especially for mobiles devices
- local LAN or thru the cloud
- application and solution provider can focus on their App

Future PDF/R revisions?

- allow Object Streams, mostly for encryption
- improved / new encryption
- new compression algorithms, like:
- High Efficiency Image Codecs? AV1? JPEG-XL?

Further improvements?

- cellular bandwidth limited: trade shows, countryside, international roaming
- DB / SAN storage for millions of users at scale
- -> We need smaller PDF image files!

Why new image compression?

- JPEG from 1992, Discrete Cosine Transform (DCT) based ~10:1 compression
- 8x8 block bad for non-photographs, synthetic images, sharp edges
- JPEG 2000, Discrete Wavelet Transform (DWT) based mostly improved multi resolution, progressive transmission, but slow, and dated, too

Existing video codec options!

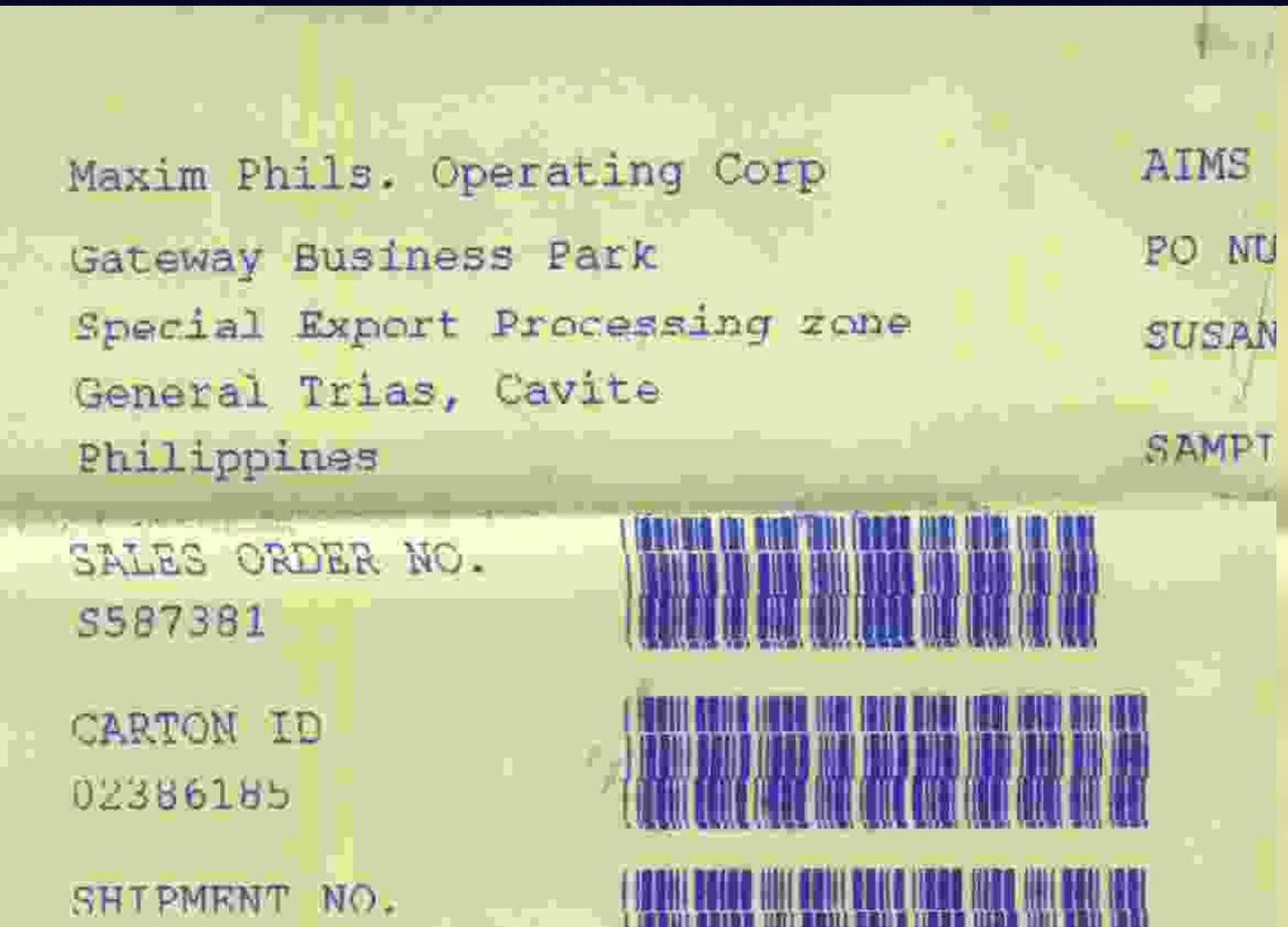
- HEIC, H.265, video compression ~1000:1, heavily patented
- WebP, only 8-bit, obligatory 4:2:0 subsampling
- AVIF, AV1, up to 12 bit, slow
- JPEG-XL, up to 16 bit, supports progressive
- High-Throughput JPEG 2000 (HTJ2K)

JPEG XL very versatile

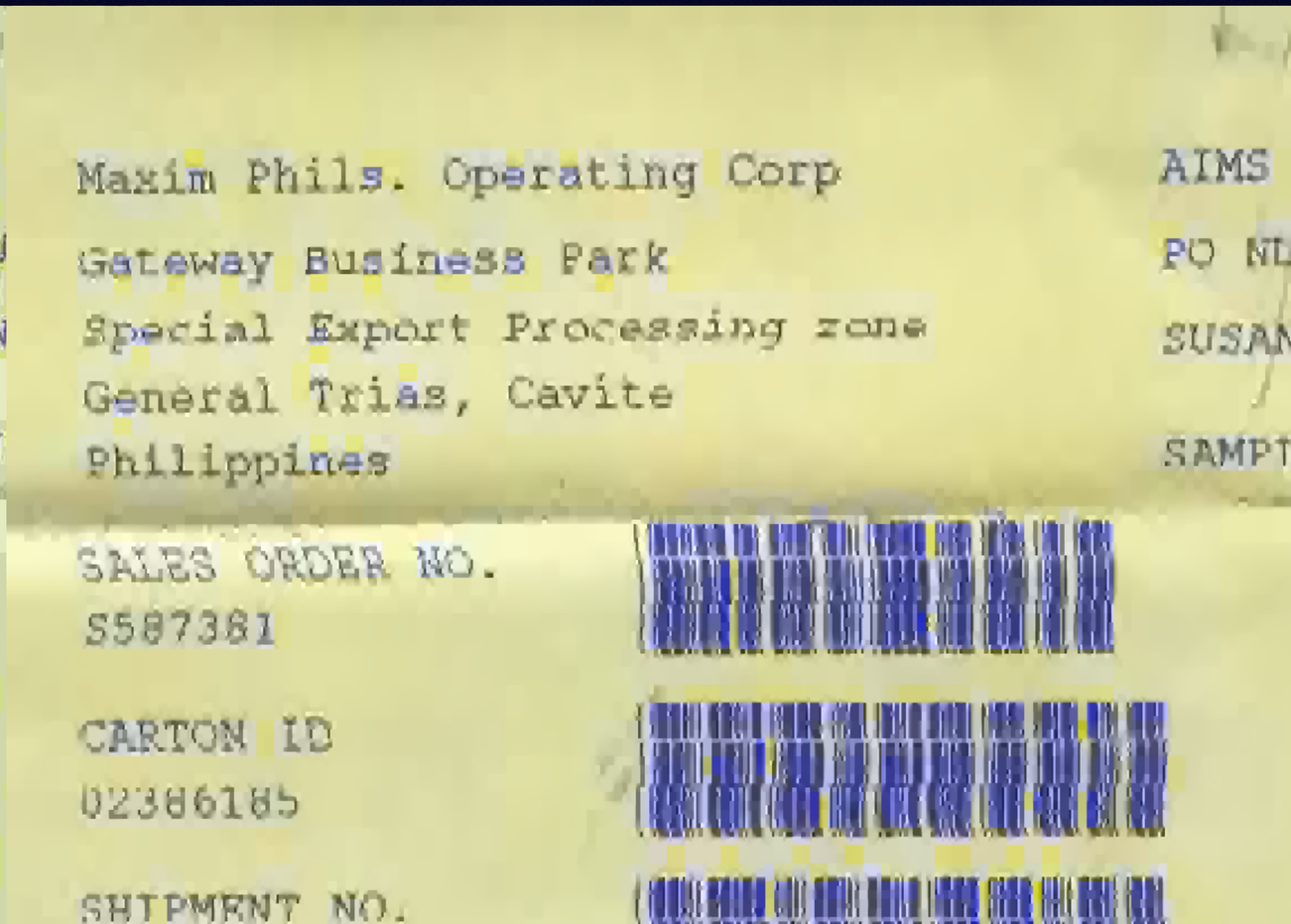
- Combining ideas from JPEG, lossless WebP, and FLIF
- 20:1 to 50:1 typical compression ratio!
- Up to 4100 channels, direct RGB + Alpha + 4096 extra channels
- High maximal resolution: 2^30-1 (1,073,741,823)
- Layered tiles, for HiDPI, responsive Web
- Variable, perceptual metric adjusted quality regions
- High bit depth, wide gamut, HDR
- Any kind of content: photos, illustrations, renders, scans, medical
- Backwards compatible w/ JPEG w/o re-quantization, 20% smaller PNG24, PNG8 & GIF, no additional loss, always smaller than input!

Less visible artifacts

JPEG: 161kb



JPEG-XL: 30kb !!



What is High Dynamic Range ?

High Dynamic Range

- historically just more dynamic range, e.g. 10, 12, 16 Bits
- X-ray, satellite, photography / art
- now all the new motion pictures
- SDR maximum luminance level of around 100 nits
- HDR increases this to around 1,000–10,000
- more than 100% white-point luminance
- metadata for mapping

Feature comparison

	jpeg	jpeg2k	webp	heic	avif	jpeg-xl
compr. photo	+	++	+++	++++	++++	++++
compr. synthetic	-	+	+++	+	++	++++
compr. lossless	-	+	++	+	++	++++
encode perf.	++++	++	+++	++	+	++++
decode perf.	++++	++	++++	++	++	++++
HDR	-	✓	-	✓	✓	✓
progressive	+++	++++	-	-	-	++++
size	65,535	2^32	16,383	8193x4320	8193x4320	2^30
precision	8	38	8	10	10	32
channels	4	16,384	4	5	5	4100

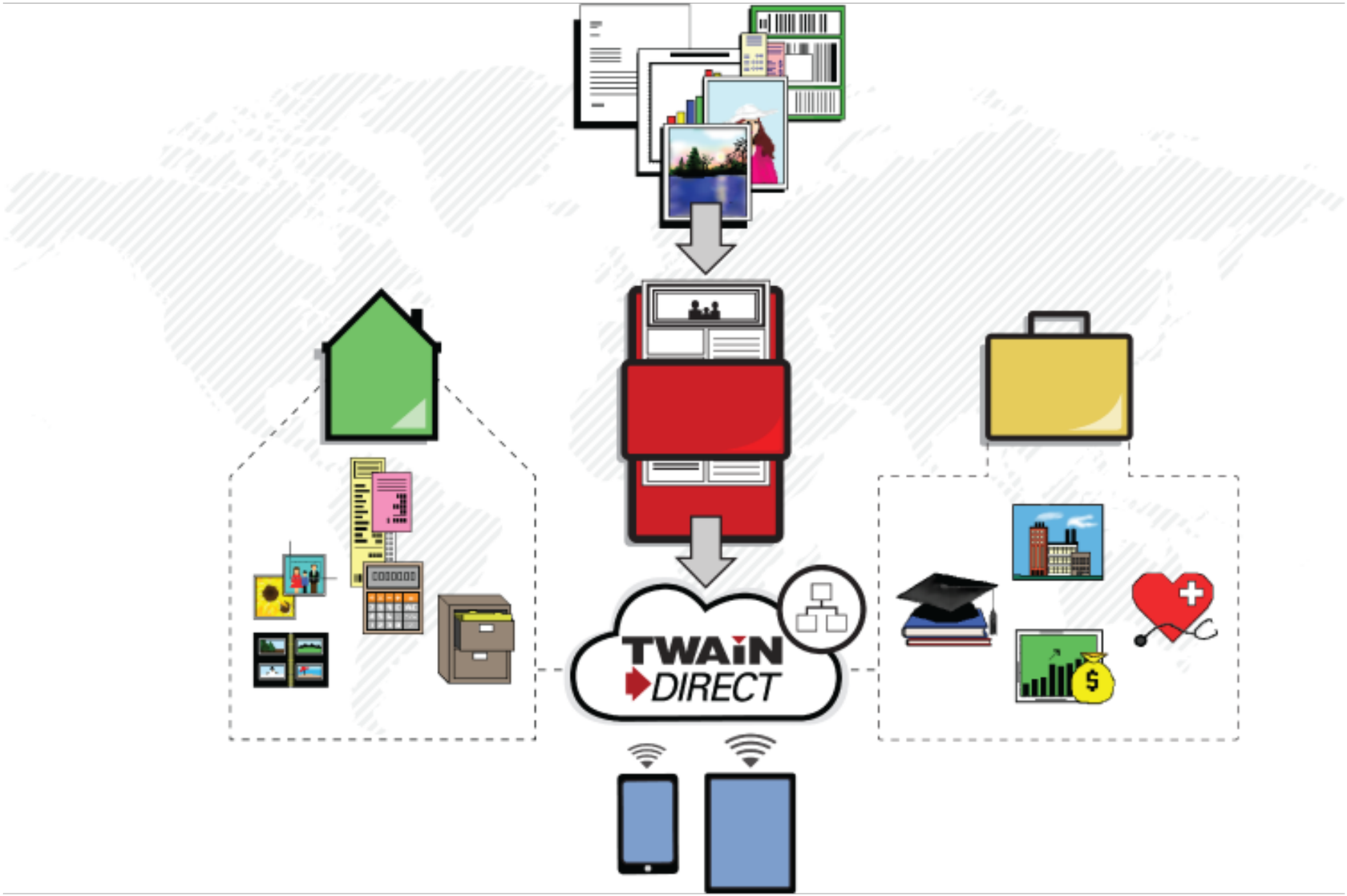
How to add to PDF?

- simply new XObject filters ?
- we had /DCTDecode, /JPXDecode, .. so:
- /JPXLDecode, /AVIFDecode, /BMFFDecode?
  ISO “Base Media File Format”
- how to handle extra channels, HDR, …?

Benefits

- up to ~5x smaller PDF images
- faster transfers: e-mail, Web: 4G, 5G, Satellite, roaming
- smaller DB / SAN archives
- HDR: more than 8, 10 bits per sample
- some codecs already GPU hardware accelerated
- directly embeddable from some modern smartphones

Use in TWAIN Direct / Cloud



Use in TWAIN Direct

- speed up networked, WiFi and cloud scanning
- directly space efficient long term storage
- hardware compression off-loading in modern SoCs and GPUs

Q & A

More information online at:

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