TE5: TI evaluation of unified intra prediction simplifications
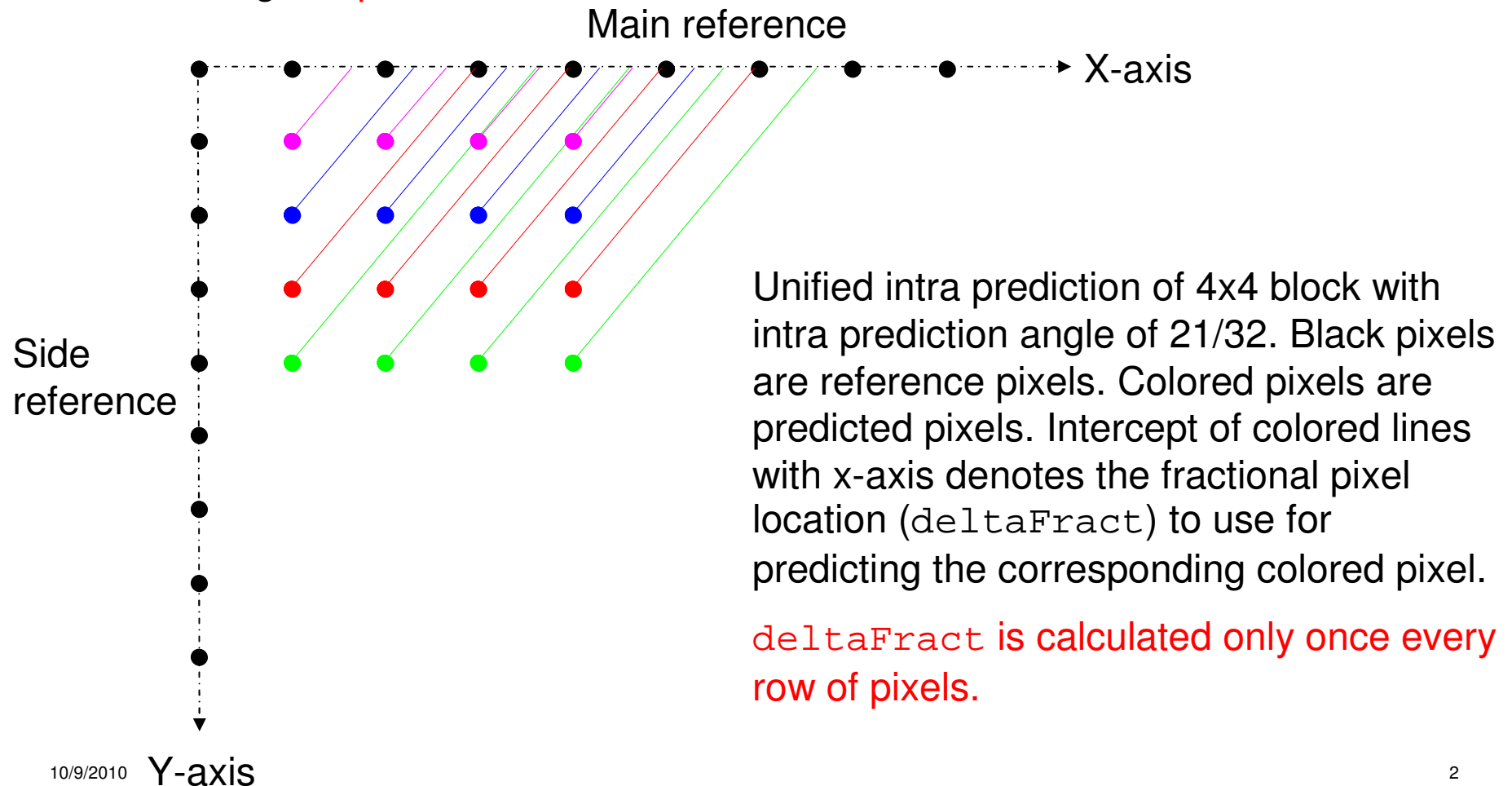
(JCTVC-C061/m18084)

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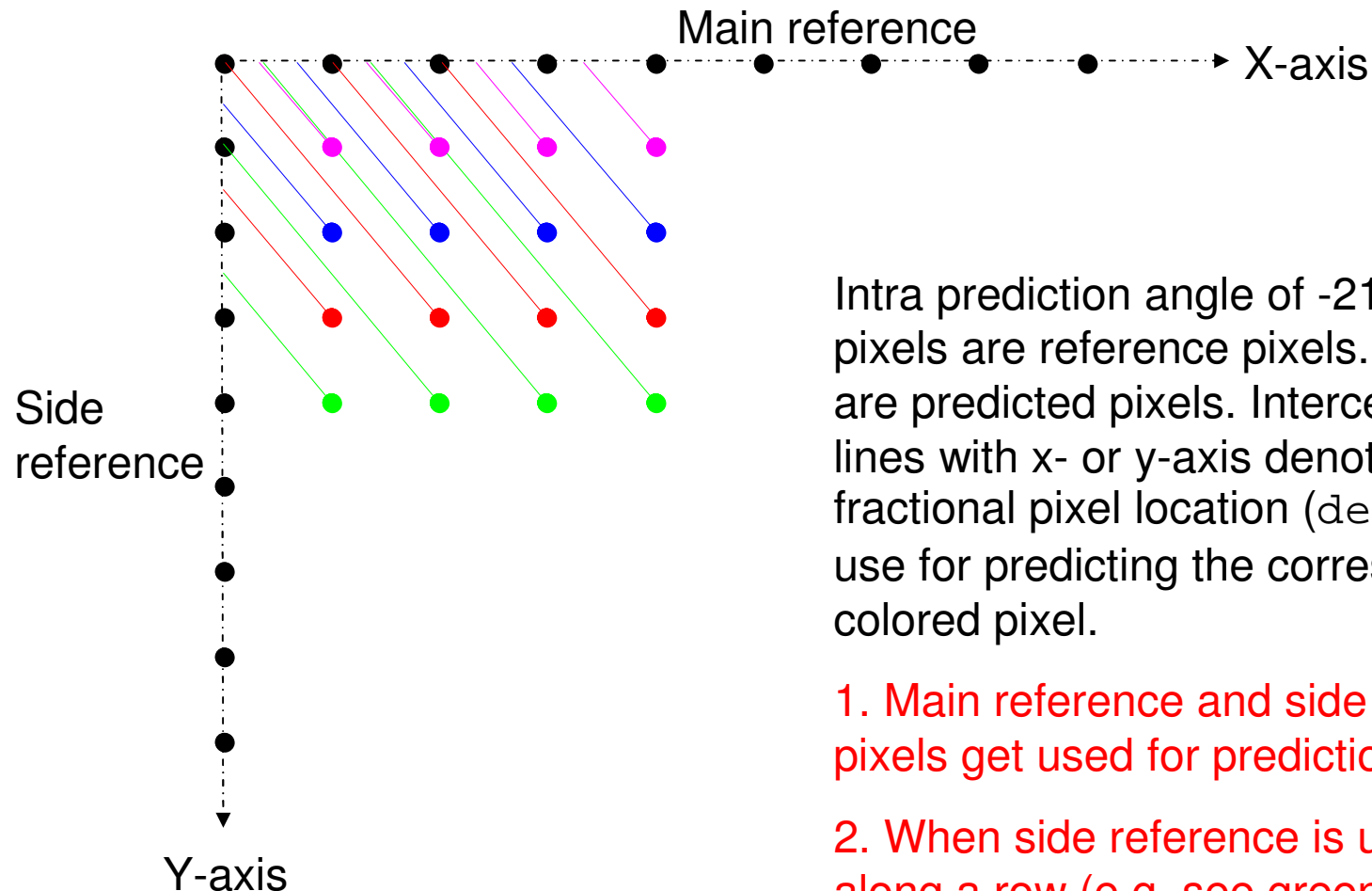3rd Meeting: Guangzhou, CN, 7-15 October, 2010

TEXAS
INSTRUMENTS

Unified angular intra prediction (1)

- TMuC uses intra prediction angles of +/- [0,2,5,9,13,17,21,26,32] / 32

- When angle is positive:

Main reference

X-axis

Side reference

Y-axis

Unified intra prediction of 4x4 block with intra prediction angle of 21/32. Black pixels are reference pixels. Colored pixels are predicted pixels. Intercept of colored lines with x-axis denotes the fractional pixel location (`deltaFract`) to use for predicting the corresponding colored pixel.

`deltaFract` is calculated only once every row of pixels.

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Unified angular intra prediction (2)

- When angle is negative:

Main reference

X-axis

Side reference

Y-axis

Intra prediction angle of -21/32. Black pixels are reference pixels. Colored pixels are predicted pixels. Intercept of colored lines with x- or y-axis denotes the fractional pixel location (`deltaFract`) to use for predicting the corresponding colored pixel.

1. Main reference and side reference pixels get used for prediction.

2. When side reference is used, pixels along a row (e.g. see green pixels) use different `deltaFract`.

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TEXAS INSTRUMENTS

Unified angular intra prediction (3)

- When angle is negative:

```
// loop over rows
for (k=0;k<blkSize;k++){
  Calculate deltaInt        // integer pixel offset
  Calculate deltaFract      // fractional pixel location
  // loop within a row
  for (l=0;l<blkSize;l++){
    refMainIndex = l+deltaInt+1; // index into refMain
    if (refMainIndex >= 0) {
      Interpolate from Main reference at refMainIndex.deltaFract
    }
    else {
      // Interpolate from the side reference
      deltaIntSide   = (32*32*(l+1)/absAng) >> 5;
      deltaFractSide = (32*32*(l+1)/absAng) % 32;
      refSideIndex   = k+1-deltaIntSide;
      Interpolate from Side reference at refSideIndex.deltaFractSide
    }
  }
}
```
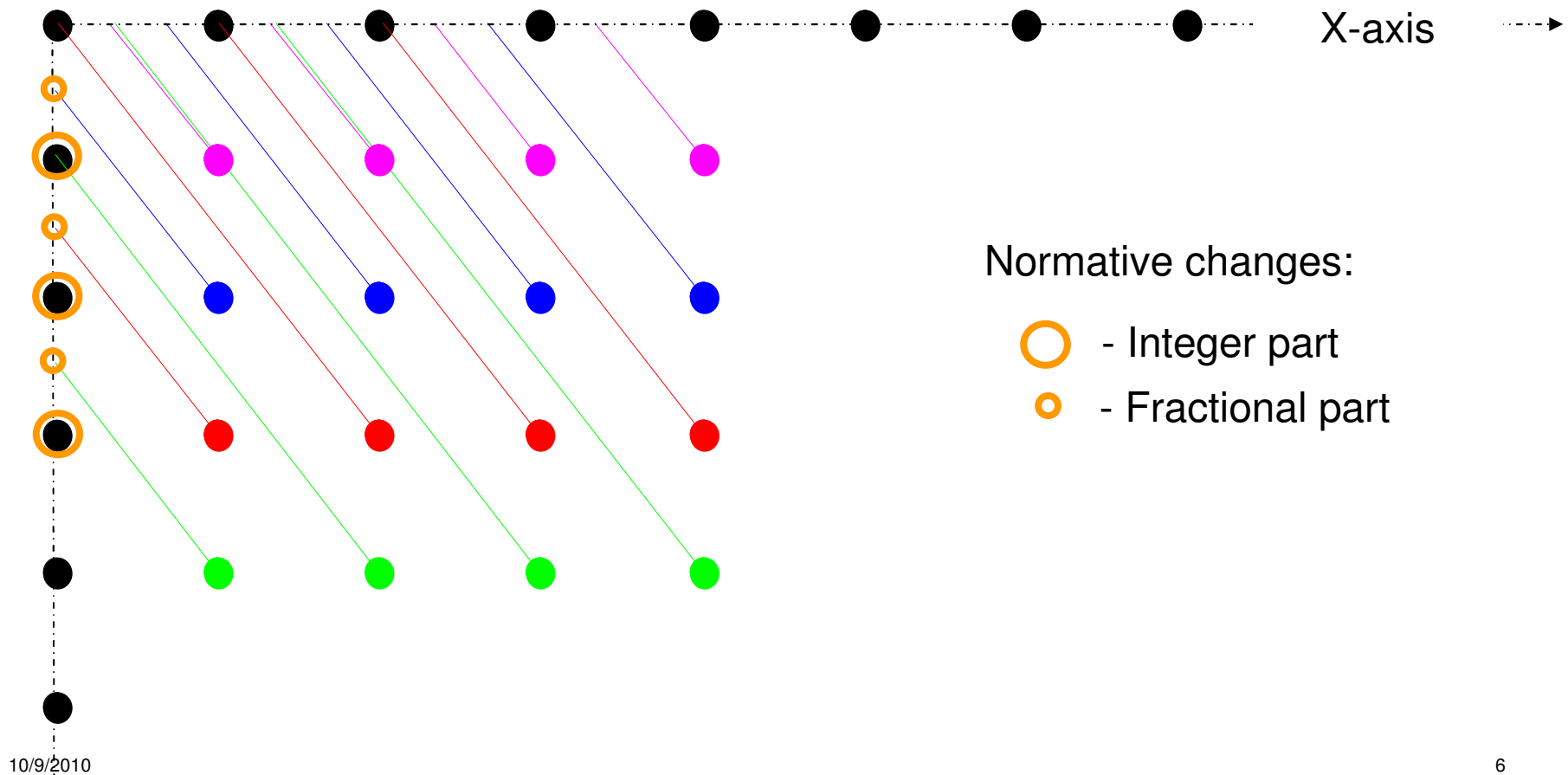
Division

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INSTRUMENTS

Unified intra prediction simplifications

- Two proposals were made at the last JCT-VC meeting to simplify intra prediction from side reference

    - JCTVC-B118 (TI) Angular intra prediction simplification
    - JCTVC-B093 (DOCOMO) Simplified angular intra prediction (SAP)

TEXAS
INSTRUMENTS

JCTVC-B118 (TI)

- Division elimination by table lookups
  - Table of size 9 with entries requiring a maximum of 9 bits

X-axis

Normative changes:

○ - Integer part

○ - Fractional part

Y-axis

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INSTRUMENTS

Coding efficiency impact for JCTVC-B118 (TI)

- Modifications included in TMuC-0.7

- JCTVC-B300 common conditions

	Intra			Intra LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	0.0	0.0	0.0	0.0	0.0	0.0
Class B	0.0	0.0	0.0	0.0	0.0	0.0
Class C	0.0	0.0	0.0	0.0	0.0	0.0
Class D	0.0	0.0	0.0	0.0	0.0	0.0
Class E	0.0	0.0	0.0	0.0	0.0	0.0
All	0.0	0.0	0.0	0.0	0.0	0.0

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TEXAS INSTRUMENTS
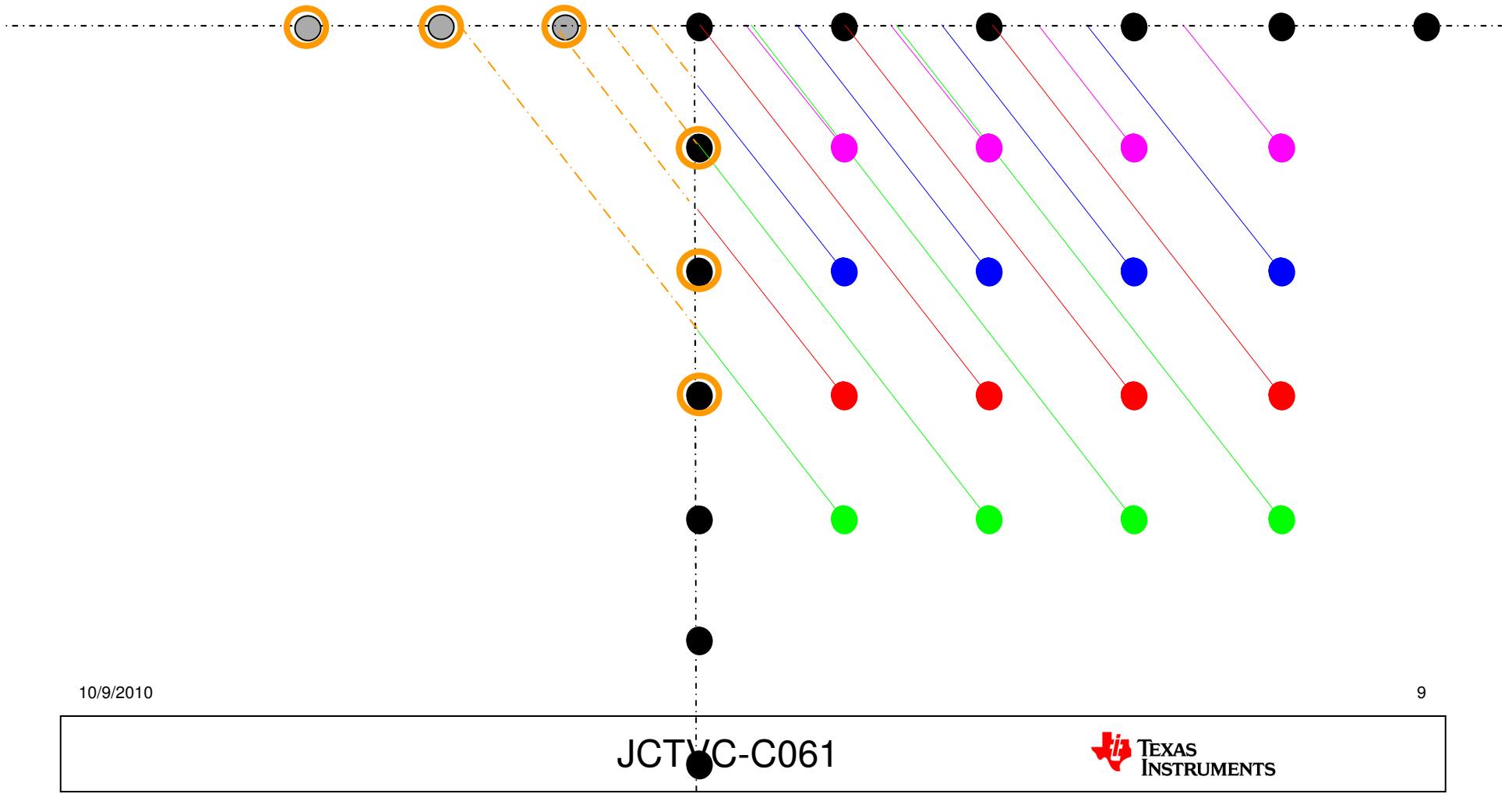
JCTVC-B093 (DOCOMO) (1) – SAP

- Step 1: Division elimination by table lookups
  - Table of size 9 with entries requiring a maximum of 12 bits
  - Step 1(b): Also copy side reference into main reference

First normative change:

○ - Integer part
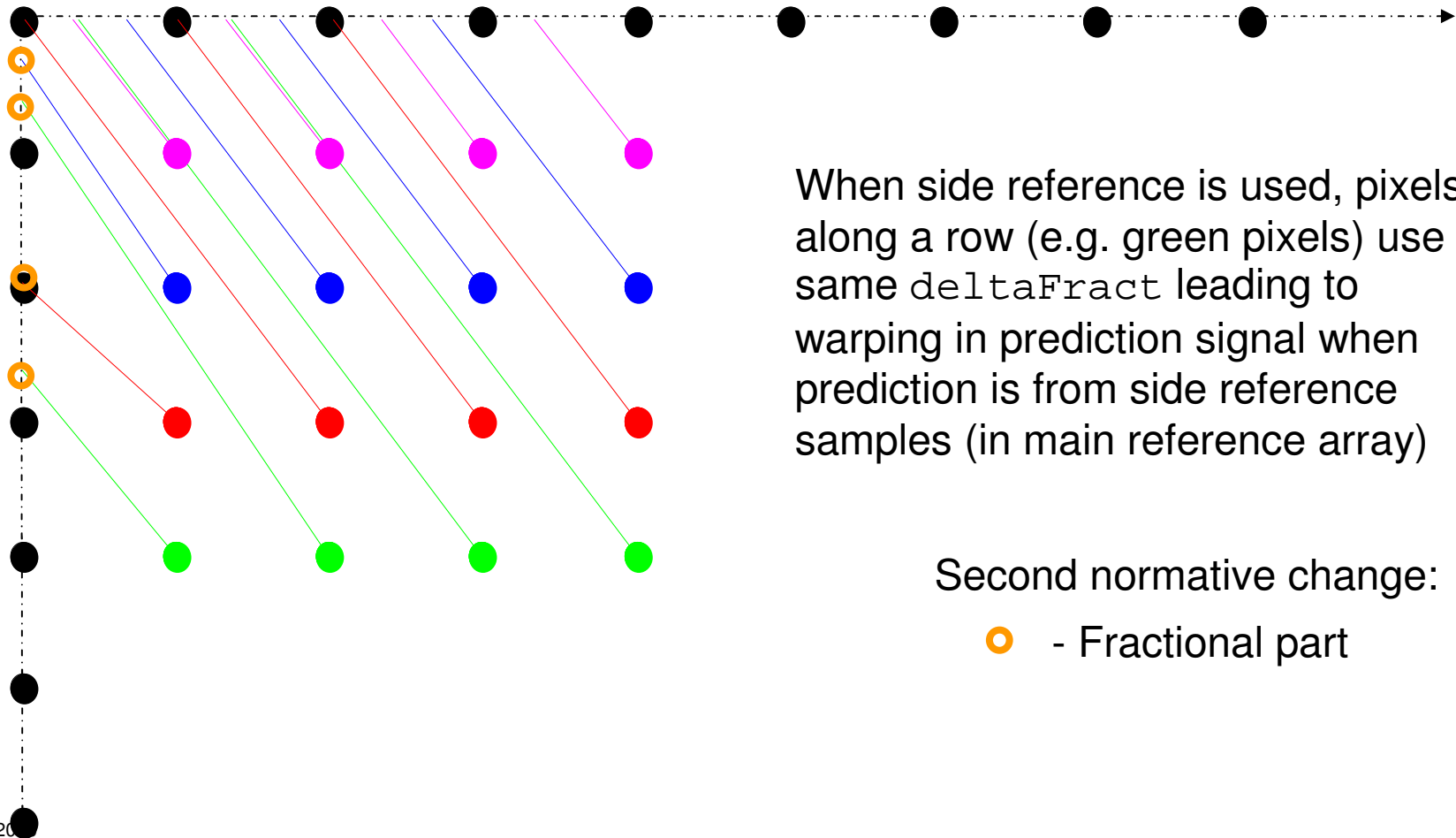
Y-axis   1

TEXAS INSTRUMENTS
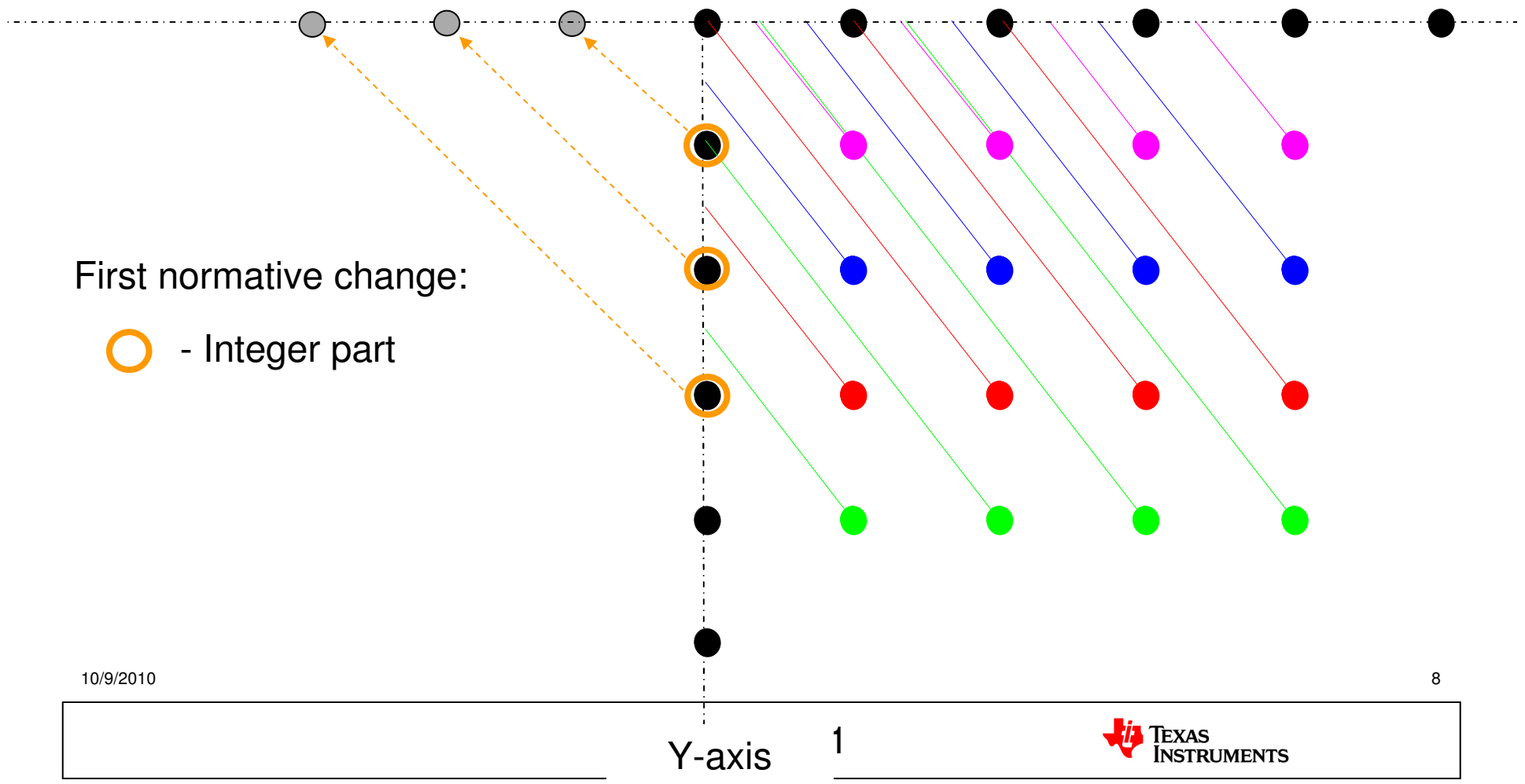
JCTVC-B093 (DOCOMO) (2) - SAP

- Step 2: Use modified main reference to carry out interpolation
  - Same deltaFract value used for all pixels in a row

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INSTRUMENTS

JCTVC-B093 (DOCOMO) (3) - SAP

- Effect of using same deltaFract value for all pixels in a row

When side reference is used, pixels along a row (e.g. green pixels) use same `deltaFract` leading to warping in prediction signal when prediction is from side reference samples (in main reference array)

Second normative change:

○ - Fractional part

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TEXAS INSTRUMENTS

Cross-verification of coding efficiency impact for JCTVC-B093

- JCTVC-B300 common conditions

	Intra			Intra LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	0.0	0.0	-0.1	-0.1	0.0	0.0
Class B	0.0	0.0	0.0	0.0	0.0	0.0
Class C	0.1	0.1	0.2	0.1	0.2	0.2
Class D	0.0	0.0	0.0	0.1	0.0	0.0
Class E	0.0	0.1	0.1	0.0	0.0	-0.1
All	0.0	0.0	0.1	0.0	0.0	0.0

    – Warping does not seem to result in significant bit-rate increase

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Conclusions

- Simulation results indicate that JCTVC-B118 and JCTVC-B093 do not result in significant difference in coding efficiency compared to the TMuC 0.7

- JCTVC-B118 and JCTVC-B093 both eliminate division using a lookup table

- It is recommended that the division elimination (JCTVC-B118, JCTVC-B093) and deltaFract optimization (JCTVC-B093) be added to the TMuC and Test Model (TM)

- For future work, study warping issue more closely

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TEXAS INSTRUMENTS