TFT-LCD技术进展与产业发展趋势

京东方科技集团
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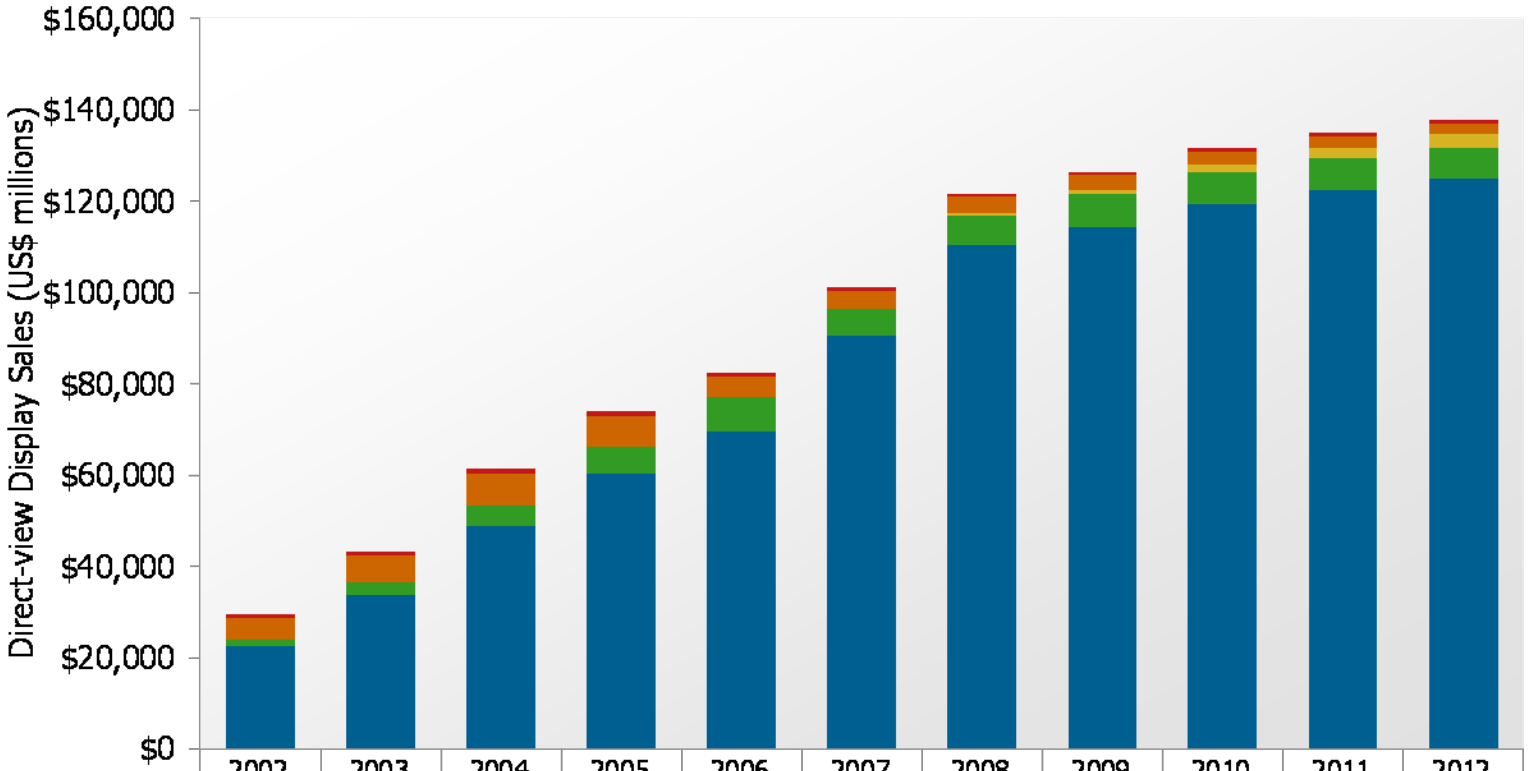
2008.9.7

Main Contents

- **LCD Market Trend**
- **Progress of LCD Technology**
- **Introduction of BOE Chengdu Project**
- **Summary**

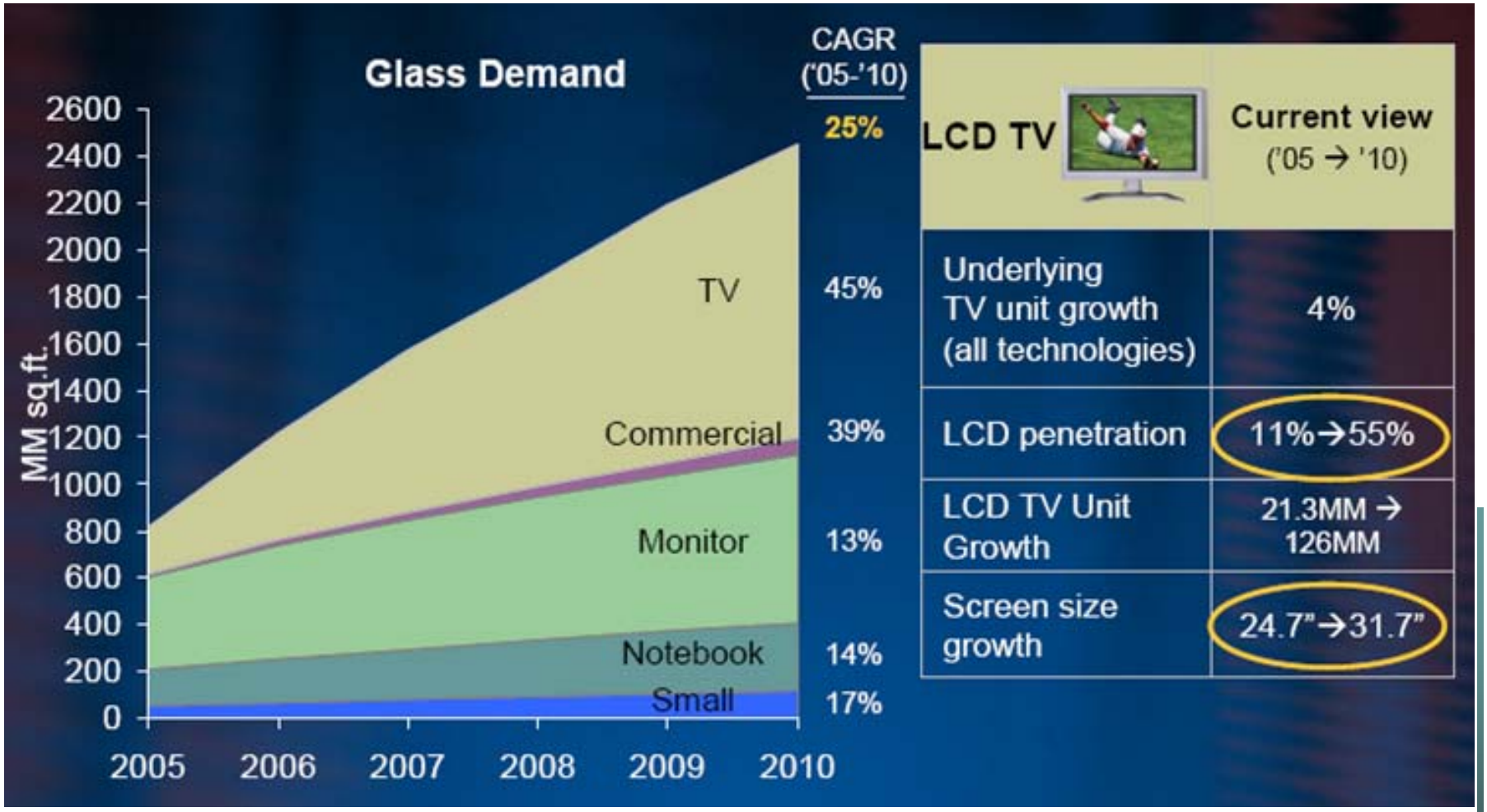
FPD Sales Development by Technology (US$ millions, %)



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Other	$912	$999	$1,222	$1,161	$871	$786	$723	$759	$783	$792	$795
PMLCD	$4,763	$5,904	$6,955	$6,583	$4,619	$3,786	$3,566	$3,155	$2,878	$2,630	$2,377
AMOLED	$0	$1	$8	$7	$17	$117	$451	$948	$1,636	$2,348	$3,032
PDP	$1,424	$2,755	$4,262	$6,032	$7,527	$5,787	$6,560	$7,151	$7,063	$6,884	$6,587
AMLCD	$22,555	$33,680	$49,029	$60,232	$69,513	$90,677	$110,480	$114,478	$119,342	$122,524	$125,105

Source: DisplaySearch Q1'08

TV Driving Growth in LCD Industry



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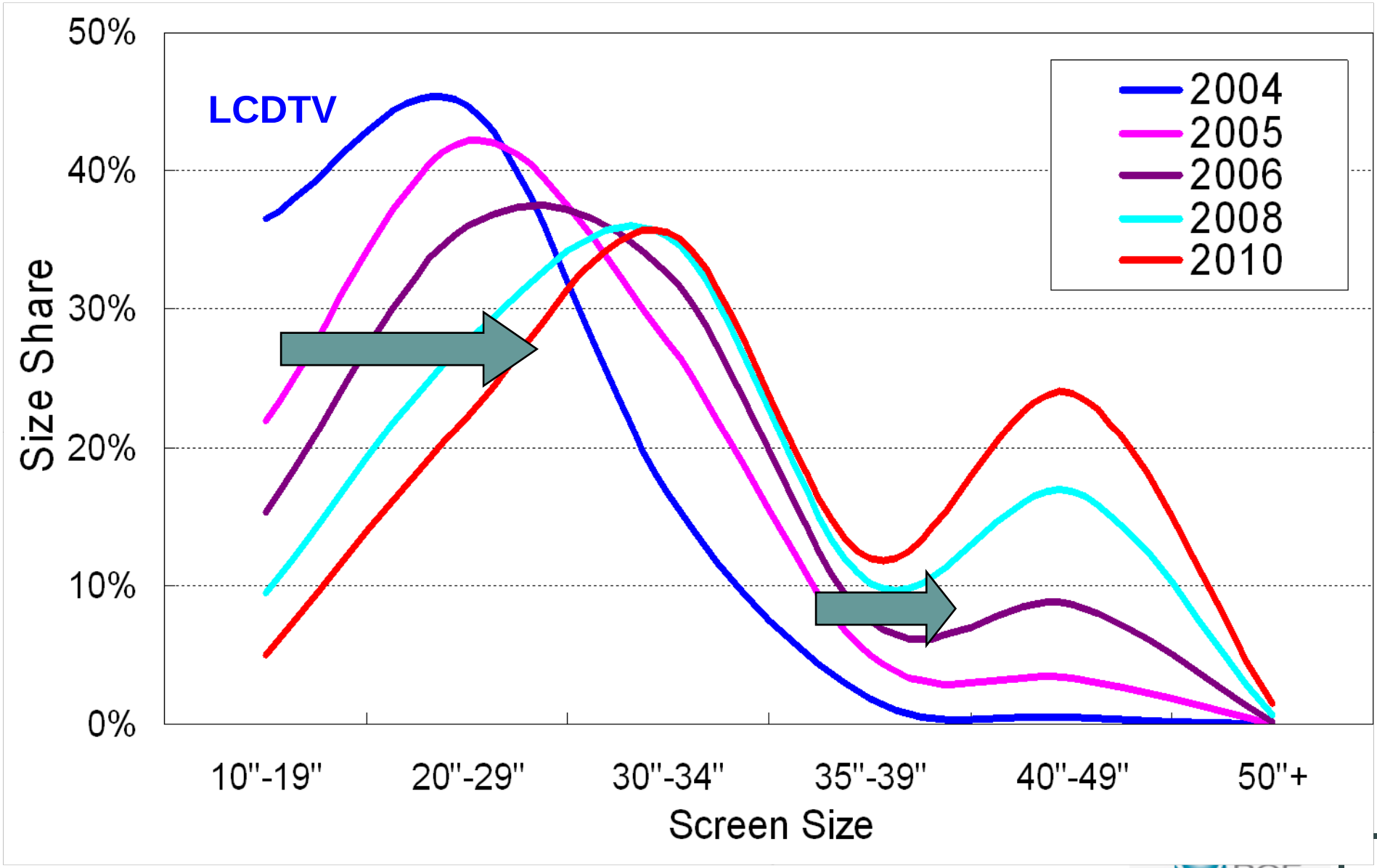
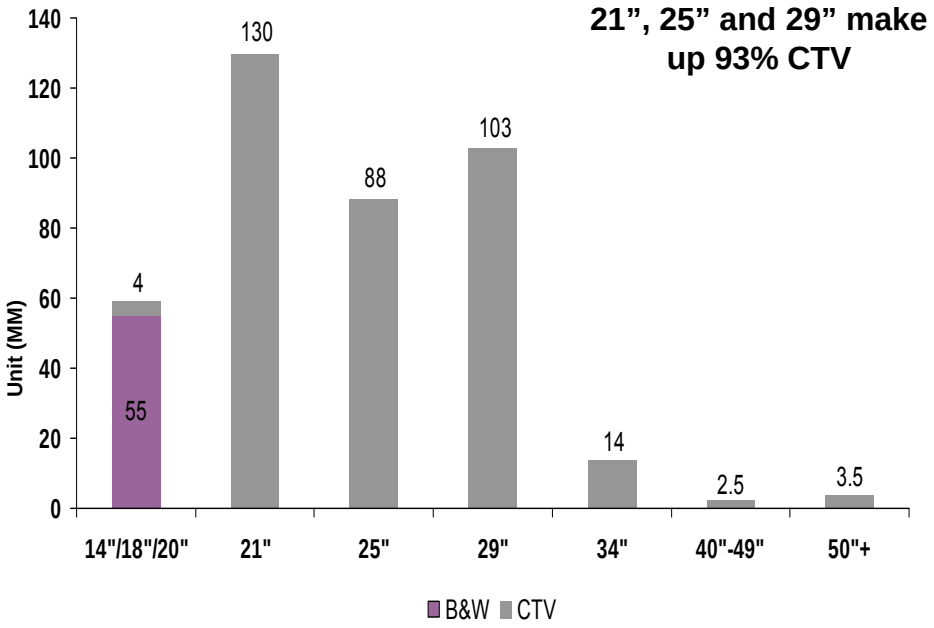
LCD TV Size is moving to “Twin Peaks”



China CRT TV
The biggest TV country in the world: 400MM installed base of which 120MM is 29”+

China TV Installed Base
(400MM by the end of 2005)



* Majority of B&W TV installed base is 18” and 20”

Data source: National Statistics Bureau/ZYK, China

- **China TV industry:**
  - **14% of the total electronics industry**
- **China TV market:**
  - **38MM units, compared to Europe of 39MM units and North America of 33MM units**
- **China TV installed base:**
  - **400MM units, of which 345MM was CTV**
- ***Key driver for flat panel TVs:***
  - ***93% of the CTV was 21”, 25” and 29”, potential for 32”, 37” and 40”/42” flat panel TVs replacement***

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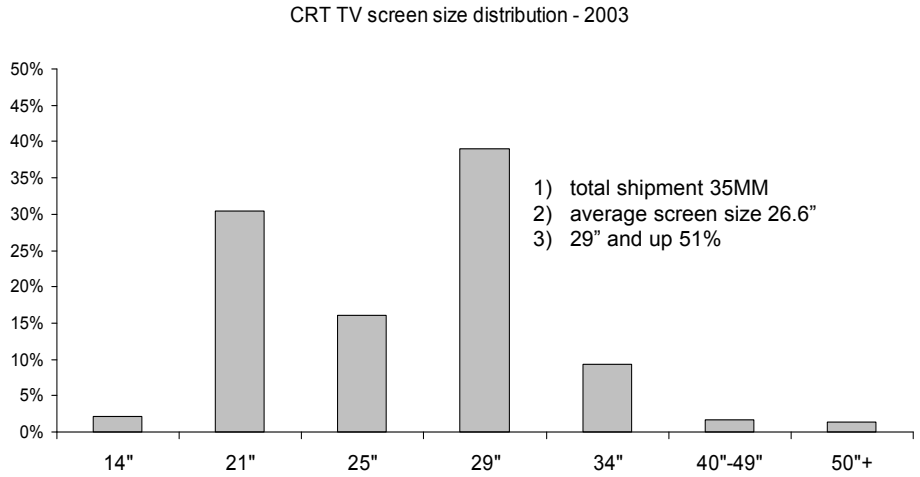
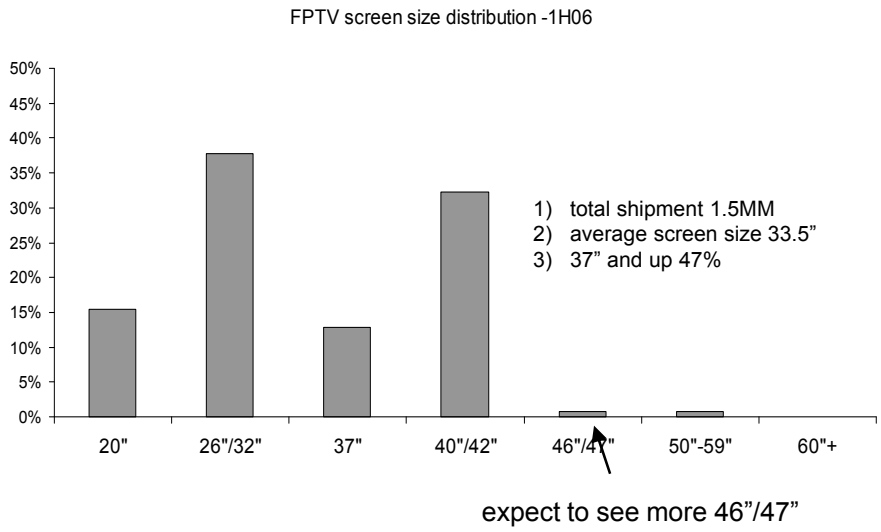
Driver - CRT to flat panel : Similar screen size distribution in China market





expect to see more 46”/47”

- **China has the second largest average screen size in the CRT space**

CRT TV 2003	ave. screen size	% in 27” and up
North America	27.3”	57%
China	26.6”	51%
Europe	23.5”	46%
Japan	21.9”	29%

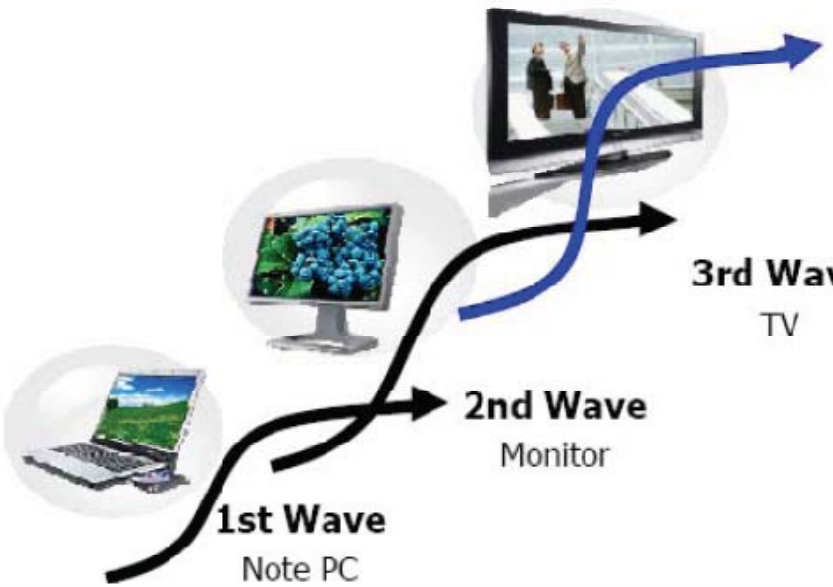
- **It has become the leading region in terms of average screen size in the flat panel space**

FPTV 1H06	ave. screen size	% in 37” and up
China	33.5”	47%
North America	30.2”	34%
Europe	28.8”	23%
Japan	27.5”	23%

- **As market transitions from CRT to flat panel, we are seeing % of 37”+ in the flat panel space approaching 50% range, similar to 29”+ in the CRT space**

Next wave of LCD

Display anywhere, Display anytime



What is 4th Wave ?

- **Public display**
- **Advanced TV**
- **E-board**
- **Premium IT Display**
- **Personal digital board**

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Evolution of LCD-TV Size

Task: **Cost-down**

Display Quality improvement

New function parts incorporating

Environment Friendly Concept

65” Sharp,2004

108” Sharp, 2007

H: 135cm

W: 234cm

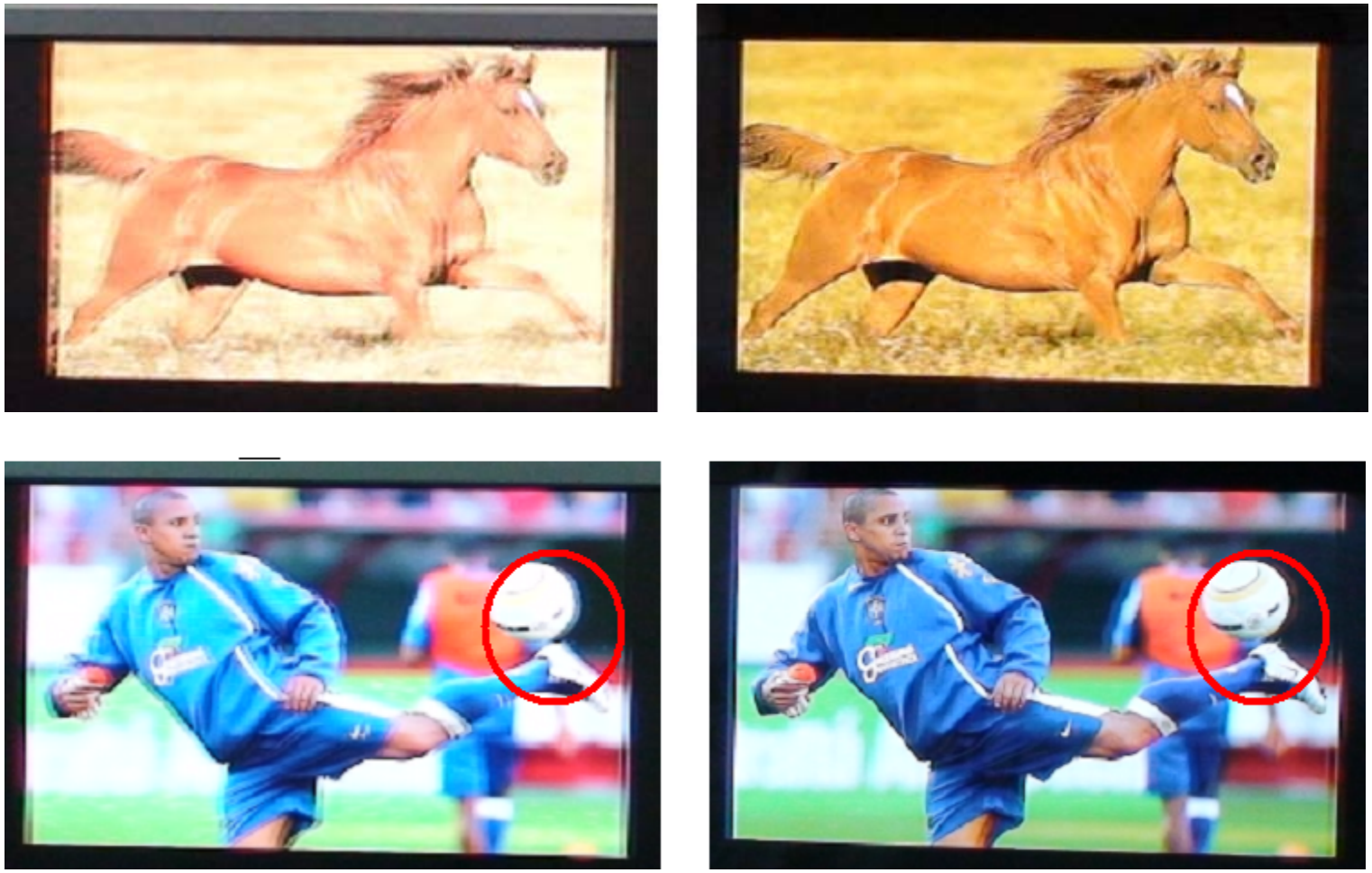
100” LG, 2006

82” Samsung,2005

Technology innovation for cost-down

- Simplify process with new technology
  - Mask reduce: 5 mask →4 mask→3 mask →?
  - Slit coating : PR in array and CF process
  - Inkjet application: PI →Spacer →CF
    →Metal line → Semiconductor?
  - Laser Application: Repair →Scribe →Ablation（mask reduce)
  - Photo Alignment
- Simplify panel Structure with new technology
  - Improvement of B/L (High efficiency design, Integrated Optical film)
  - Integrated driving circuits (GOA ,Smart TV)
  - CF less
  - In-cell polarizer

Moving Picture Quality Issue

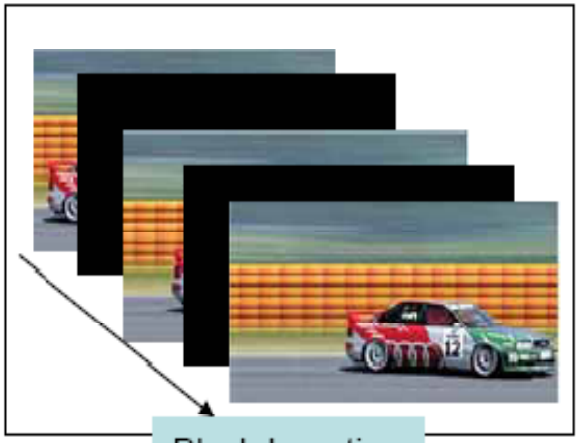


(LCD w/ response time of 8 ms,

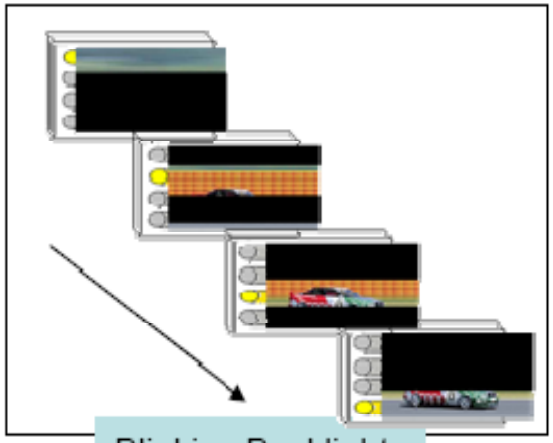
Source: 06'China FPD, Minsun Yoo)

Solutions for Motion Blur

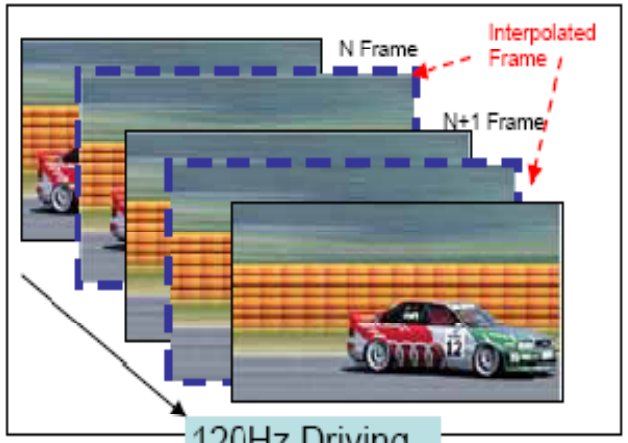
Technology	Black Insertion	Blinking Backlight	High speed driving
Method	Black frame insertion or black band cycling	Impulsive effect through backlight blinking	Create interpolation image with previous and next images base on double frame rate (ex: 120Hz) panel
Difficulty	Moderate	Easy/Moderate	Difficult
Effectiveness	Good	Better	Best
Drawbacks	Brightness down Flickering Less Driving margin	Brightness down Flickering and Ghost Higher inverter cost	New pixel Design Not easy to create accurate interpolated frame data Less driving margin



Black Insertion

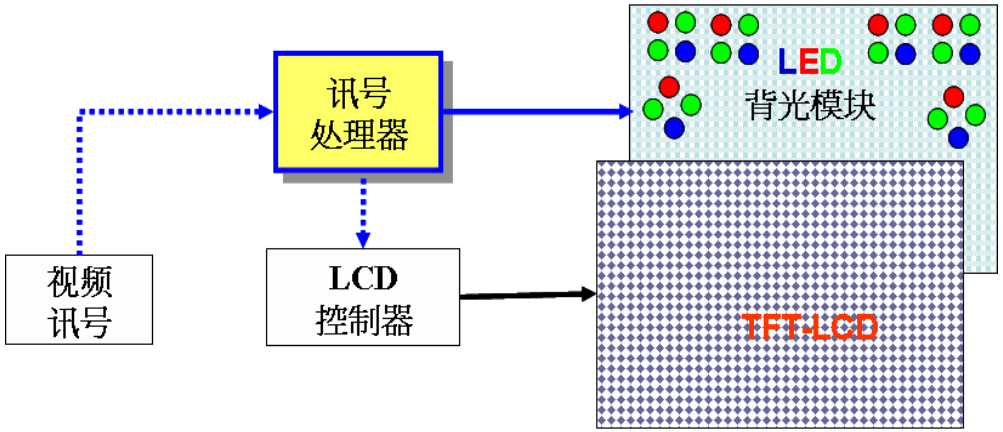


Blinking Backlight

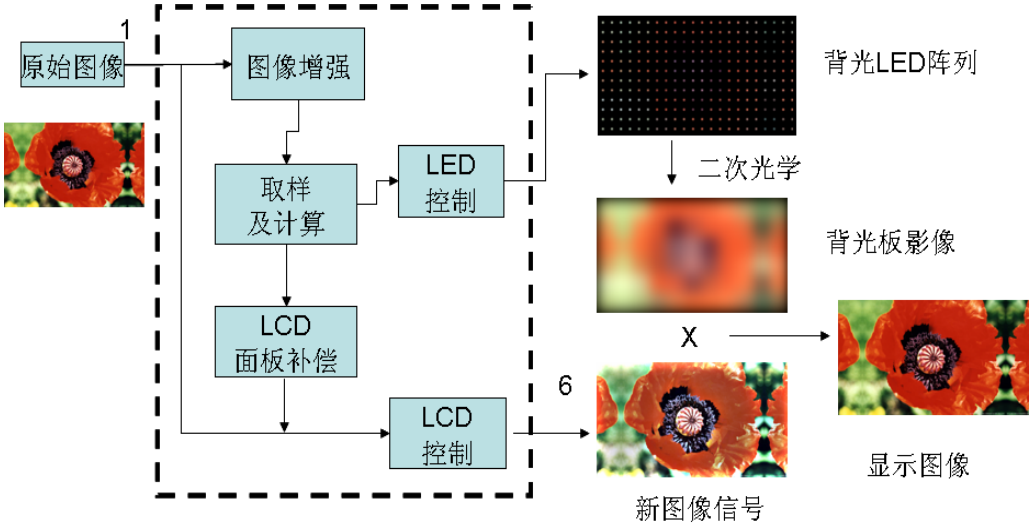


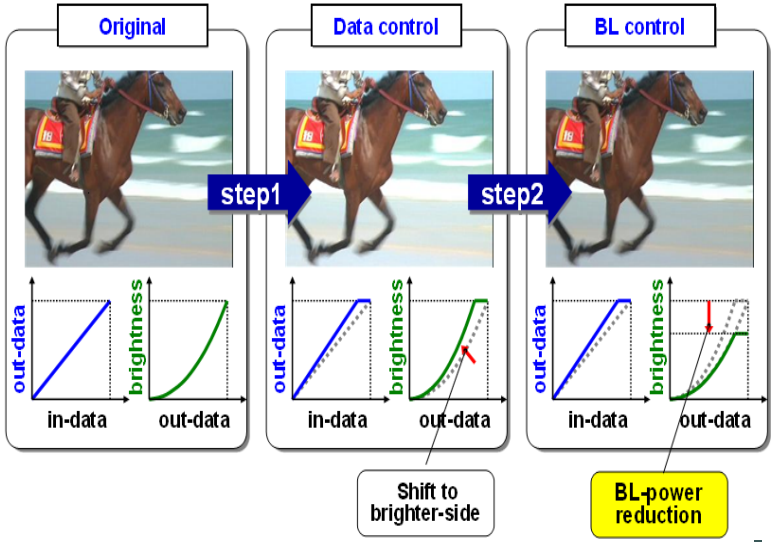
120Hz Driving

LED B/L - high quality and low power



- High gamut
- High Contrast
- Low power
- Environment friendly





LED B/L developed in BOE

47” LED B/L TV

32” LED B/L TV

19W LED B/L vs. CCFL B/L

17” LED B/L vs. CCFL B/L

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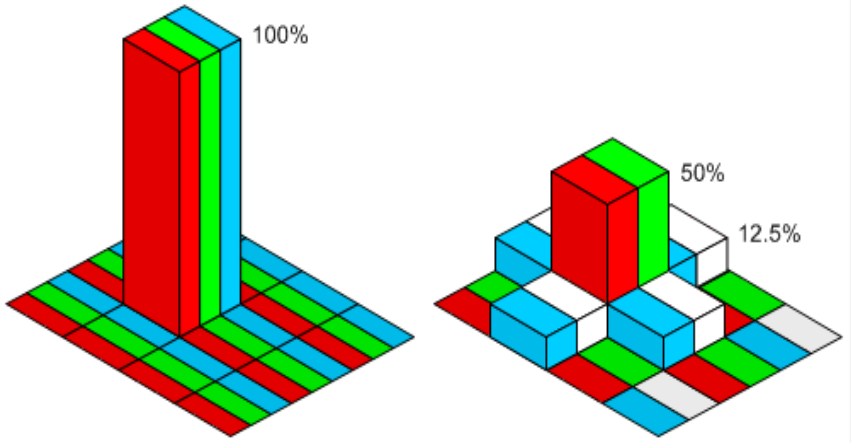
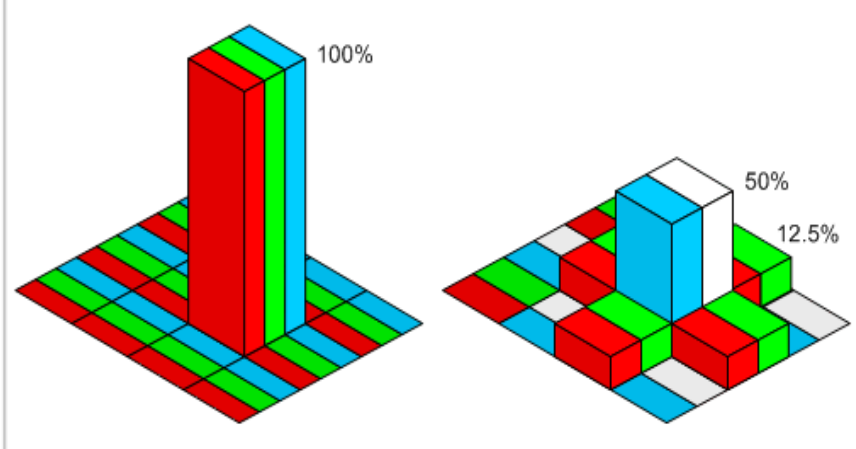
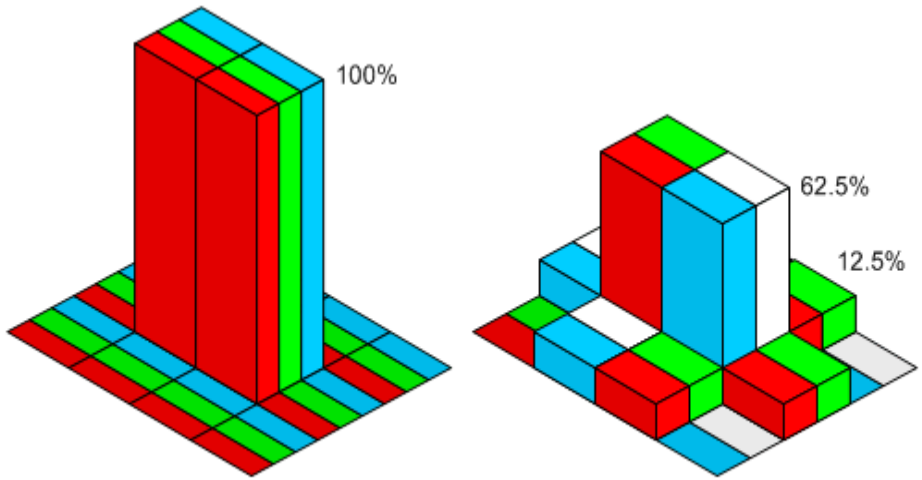
RGBW-with low power



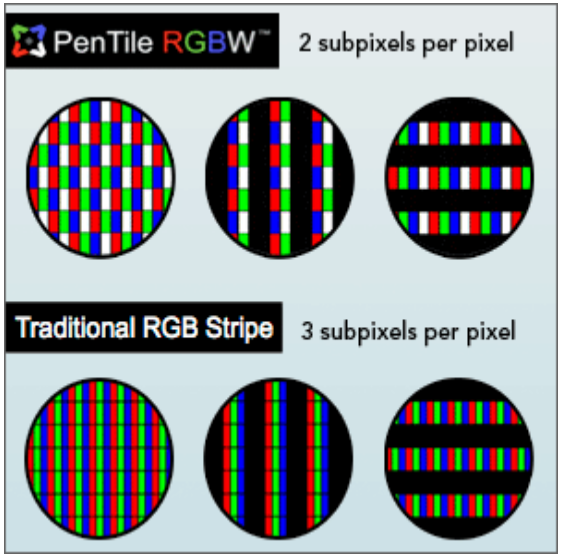
Row 2 Column 2 RGB pixel fully lit versus corresponding RGBW sub-pixels



Row 3 Column 2 RGB pixel fully lit versus corresponding RGBW sub-pixels

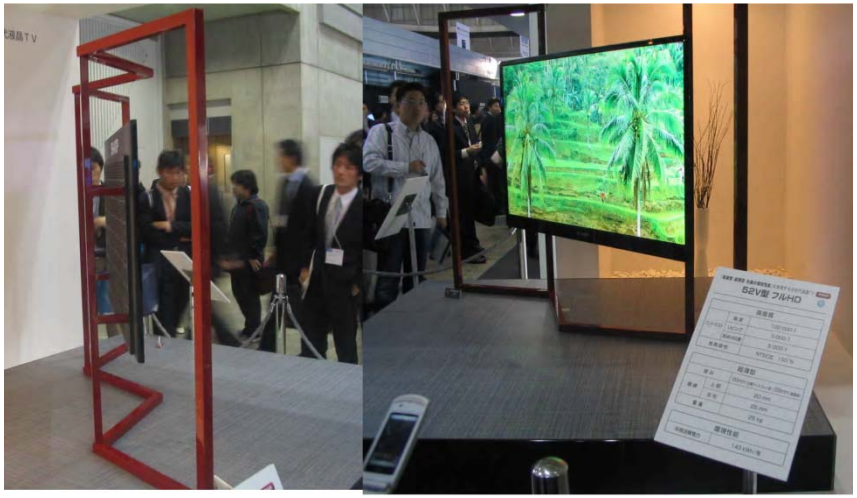


Two adjacent RGB pixels fully lit versus corresponding RGBW sub-pixels



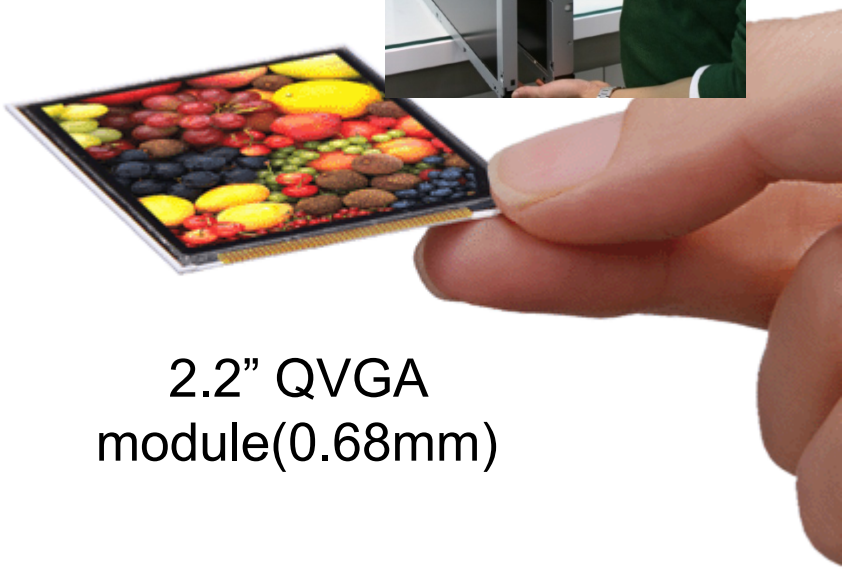
Ultra thin device

- Either small size or large size, ultra thin device is pursued steadily



Sharp 52 " LCD-TV 20mm

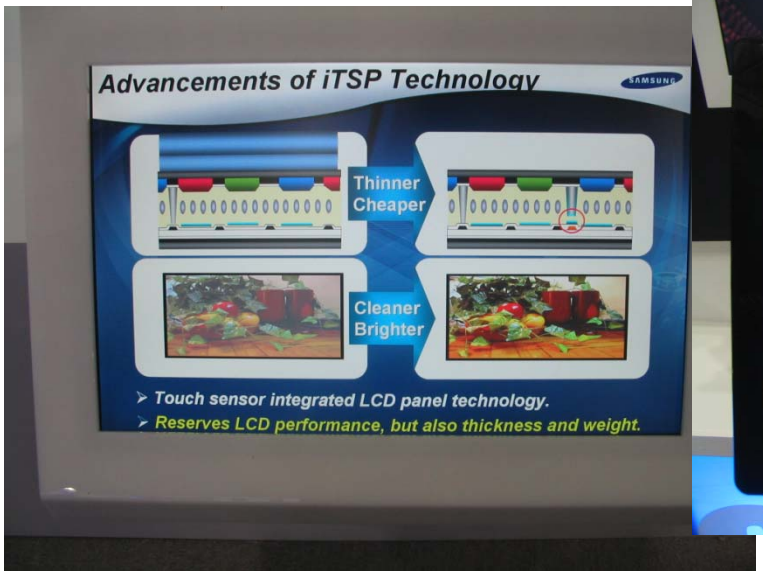
42” FHD module (19.8mm)

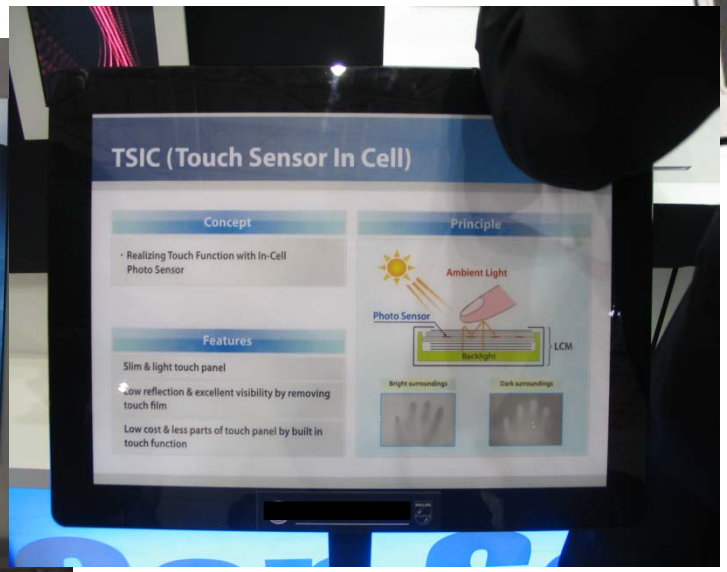


2.2” QVGA module(0.68mm)

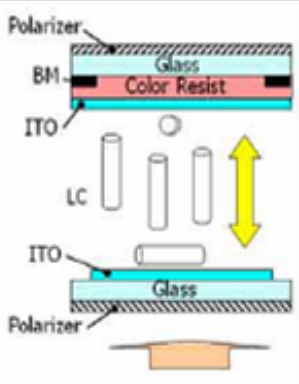
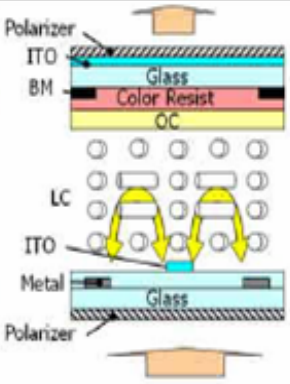
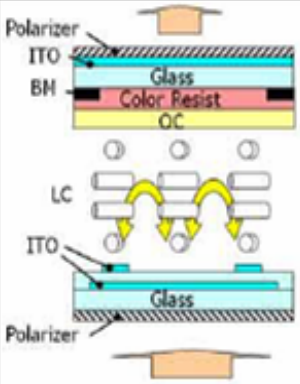
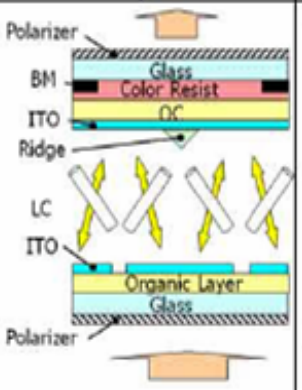
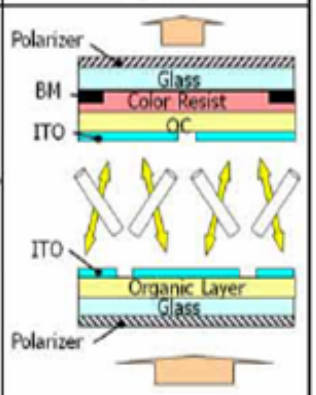
In cell touch sensor

- touch panel built in technology is emerging
  -> Keep display quality
  -> reduce thickness and weight



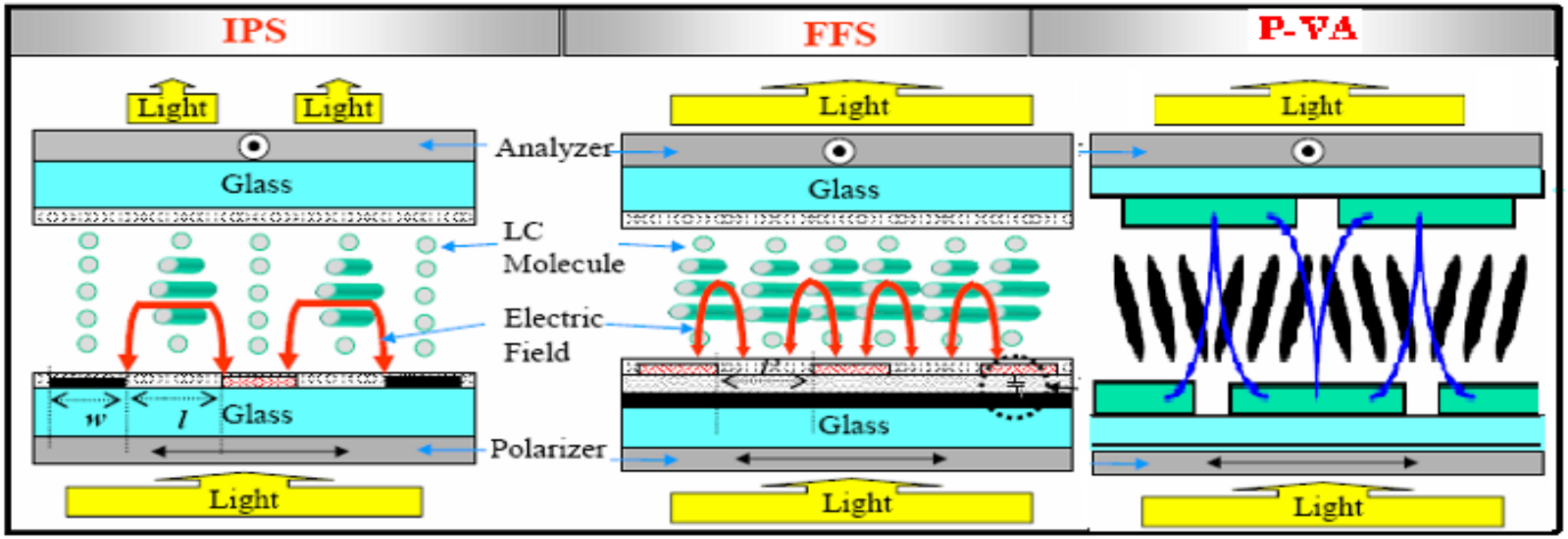


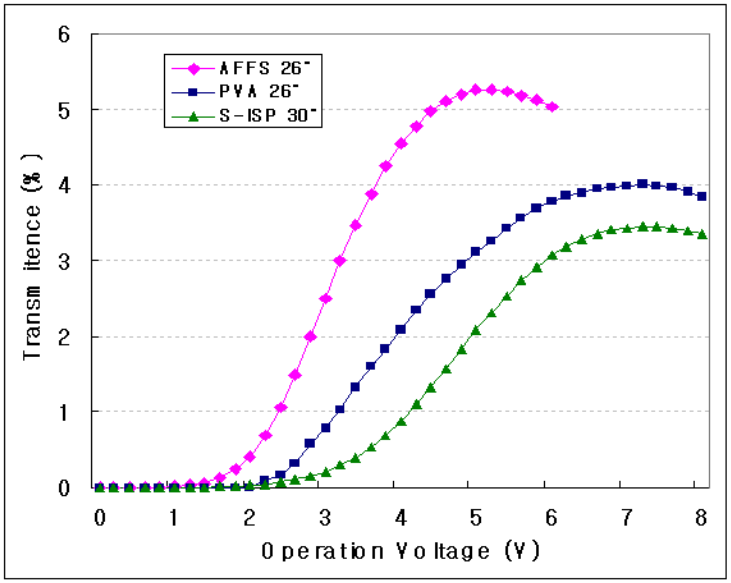
Wide View Technologies

LC Mode	TN	IPS		VA		
Device	TN	S-IPS	FFS	MVA	A-MVA	S-PVA
Cross Section (On-State)					
Domain	1	2	2	4	8	8
TFT per Pixel	1	1	1	1	2	2
Array PEP	Normal	Normal	(+ITO)	(+Organic Layer)		
CF PEP	5	5	5	6(+Ridge)		6(+ITO)
Rubbing	Need	Need	Need	Not need		
LC dielectric anisotropy	Posi-Type	Posi-Type	Posi-Type	Nega-Type		
G or D Driver	(1)	(1)	(1)	(1)	(2)	
Transmittance (20°)	(7%)	6.5%	(>6.5%)	4.0%		(4.0%)

- TN = Twist Nematic, MVA = Multi-Vertical Domain, PVA = Pattern VA, IPS=In-Plane-Switching
  FFS: Fringe Field Switching

FFS vs. IPS vs. VA



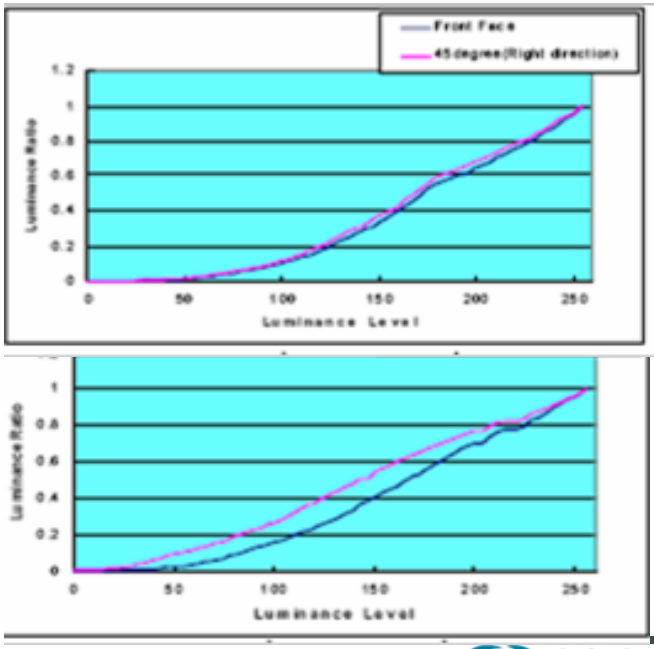


FFS:

Higher TR

Less shift

Wider View



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Introduction of BOE – Milestones

- Apr. 1993, Founded Beijing Oriental Electronics Group Co. Ltd.
- Jun. 1997, Beijing Oriental Electronics Group Co. Ltd IPO on Shenzhen Stock Exchange B board.
- 2001, Beijing Oriental Electronics Group Co. Ltd was renamed as BOE Technology Group Co. Ltd.
- 2003, Entered TFT-LCD field and Constructed 5G TFT-LCD production line in Beijing
- 2008, Constructed 4.5G TFT-LCD production line in Chengdu.

- Registered Capital: 2.87 billion RMB Employee: over 10,000.

Introduction of BOE – BOE Family

BOE Beijing Factory

Medium & Large-size TFT-LCD Panel, Module, Large-size Backlight,Display System & Solution's Design & Manufacture.

BOE Chengdu Factory（in construction）

Small & Medium-size TFT-LCD Panel, Module, Backlight's Design & Manufacture.

BOE Gu' an Factory

Below 10″ TFT-LCD Module, Display System & Solution's Design and Manufacture.

BOE Suzhou Factory

Backlight's Design & Manufacture.

BOE Shaoxing Factory

VFD & LED's Design & Manufacture.

BOE Xiamen Factory

Backlight's Design & Manufacture.

5G TFT-LCD Line – Construction Milestones

Construction Begin	Sept., 2003
Equipments Move-in	Sept., 2004
Initial Capacity	1100 x 1300mm，Glass substrates 60 K/M
Capacity Enhancement	4th Quarter, 2006，Glass substrates 85K/M
	July,2008,Glass substrate 100K/M(move in)
1st Qualification Product	Dec., 2004
Mass Production	May, 2005
Products structure	Monitor: 15″, 17″ , 19″,19″W, 22W, 18.5W(16:9)
	Notebook: 15.4″ , 15.6(16:9), 14.1″
	TV: 20.1″, 26″

4.5G TFT-LCD Line – summary

Total Investment	3,110M RMB
Registered Capital	2,200M RMB
Production line	4.5G TFT-LCD Line (including Array、Cell、Module、C/F、Glass Slimming)
Glass size	730×920mm , 0.5t
Capacity	30Ksh/month
Portfolio	Mobility : Cell & Module Application : Module NB : Module
Technology: Array	4Mask，TN/FFS
Cell	ODF, PS/BS, Conventional PI
C/F	Pigment Dispersion ,PS/OC reserved
Total Construction area	67,200m^2
Construction Period	18 months

Launching Ceremony on March 26,2008

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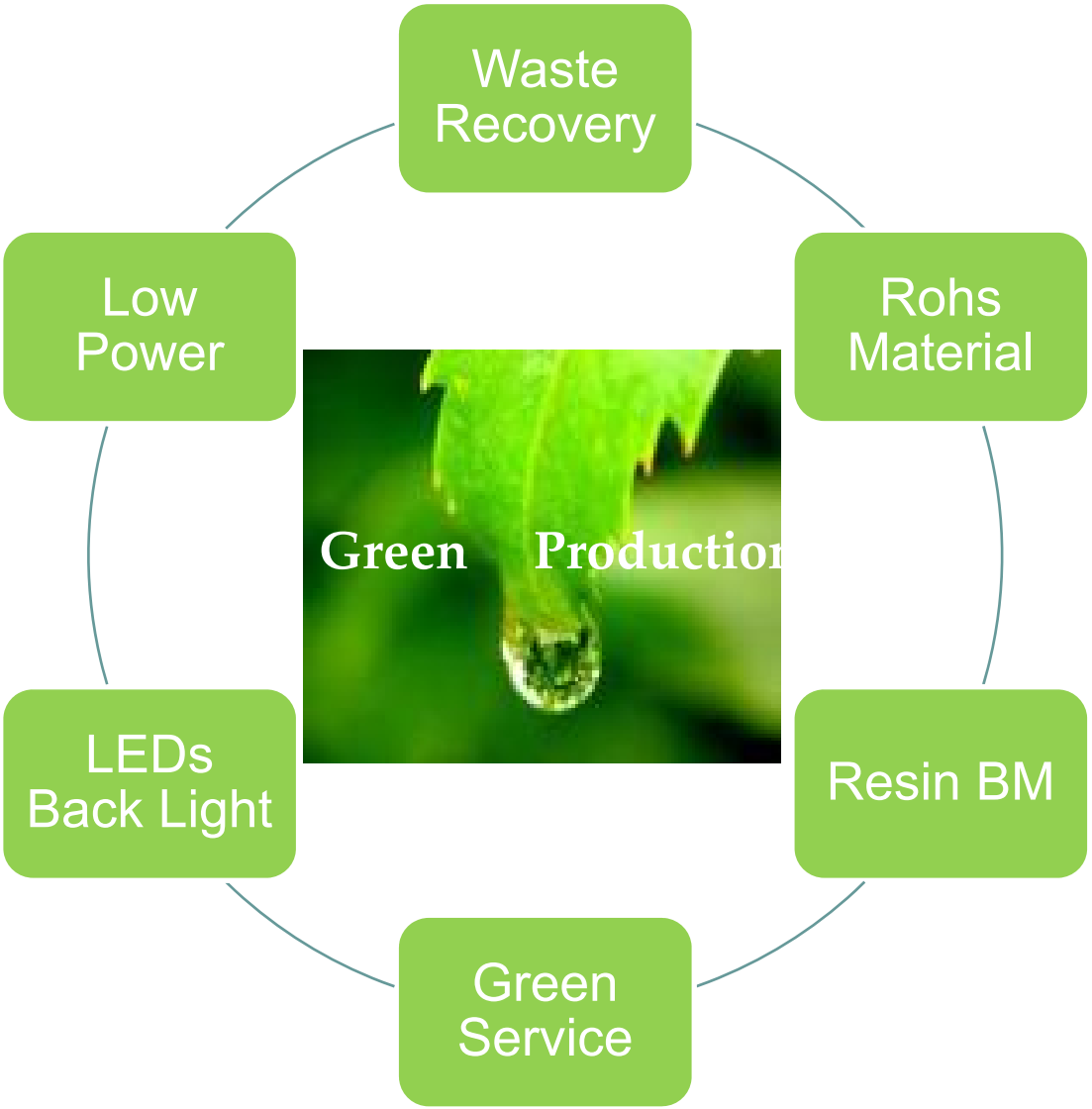
Green Solutions



Summary

- Market: LCD-TV will keep quick growth and take largest share of market in the coming years. 32” and 40/42” will be the mainstream product of LCD-TV.
- Technology: Cost-down, display quality improvement and green productionwill be the main tasks of R&D works.
- BOE: has achieved its first goal in LCD business, and will contribute more to china LCD industry with its outstanding innovation technology.

End

Thank you for your attention !