

A Real-Time Indoor Position Tracking System Using IR-UWB

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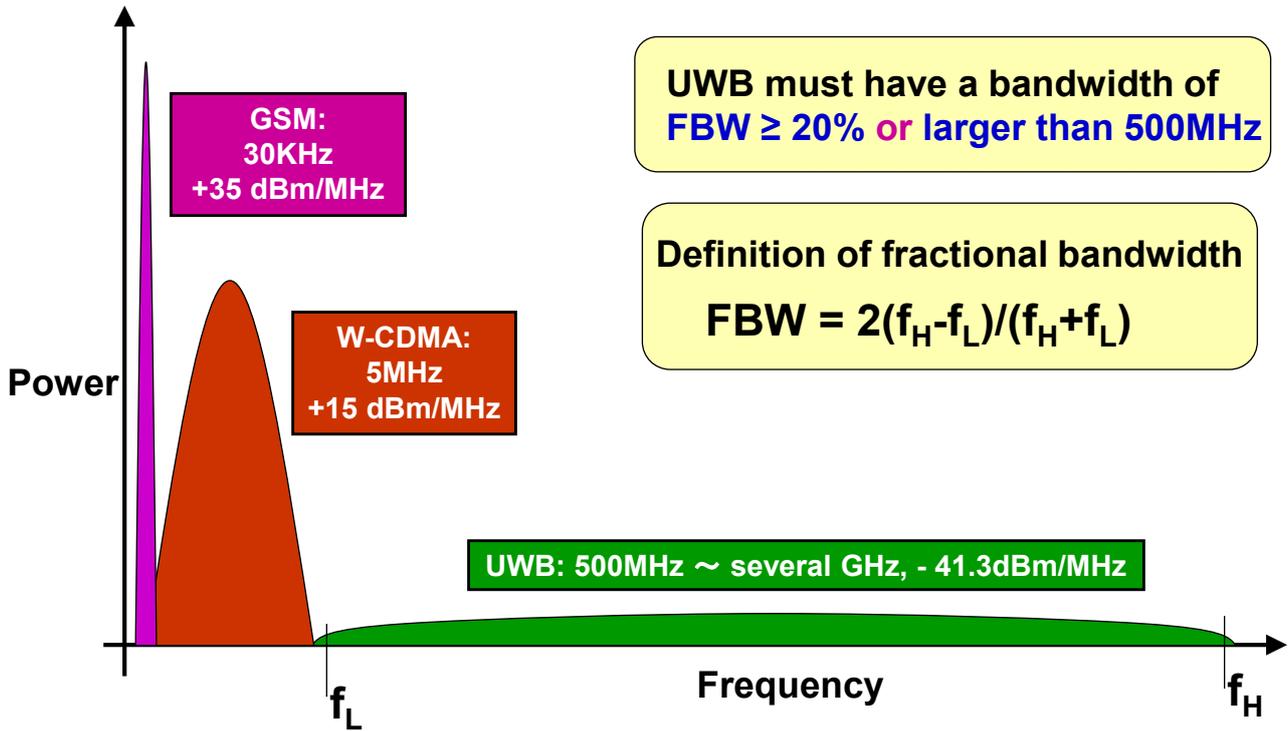
Outlines

- Features of indoor position tracking system based on IR-UWB
- Deployment and application of the position tracking system in warehouse
- Deployment and application of the position tracking system in shopping mall
- Conclusion remarks

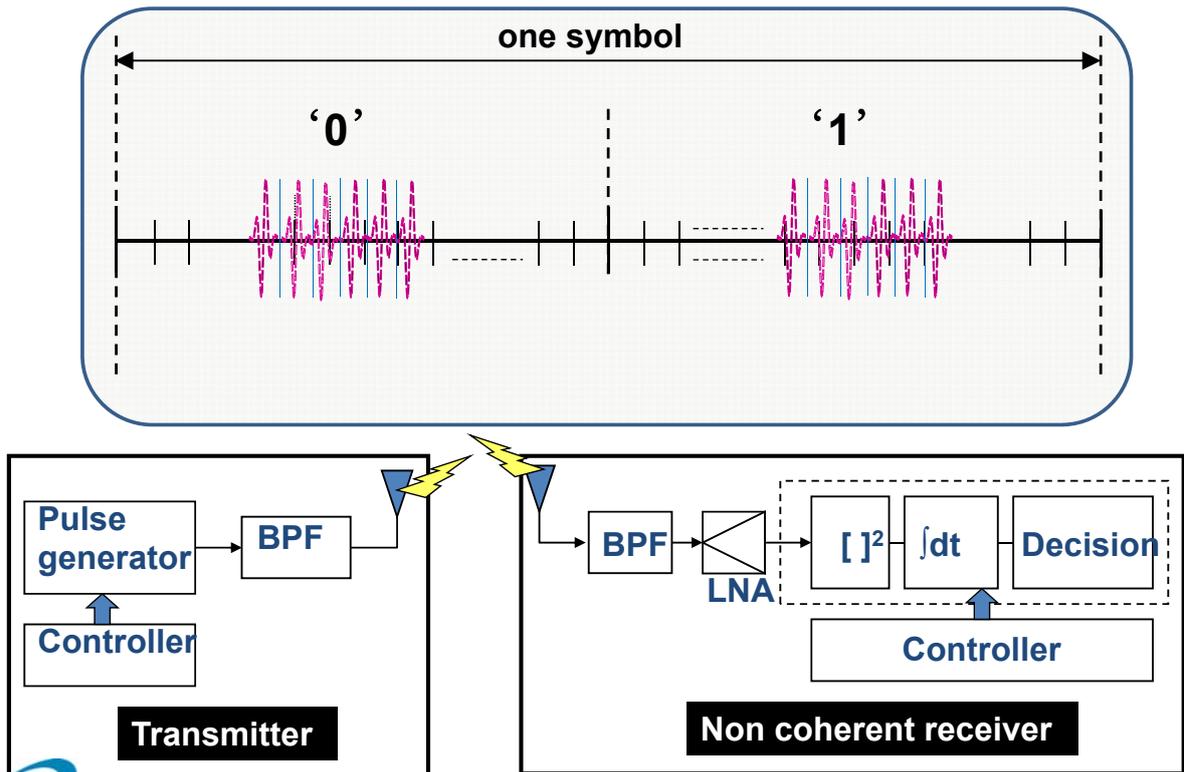


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Definition of UWB



Typical IR-UWB Modulations

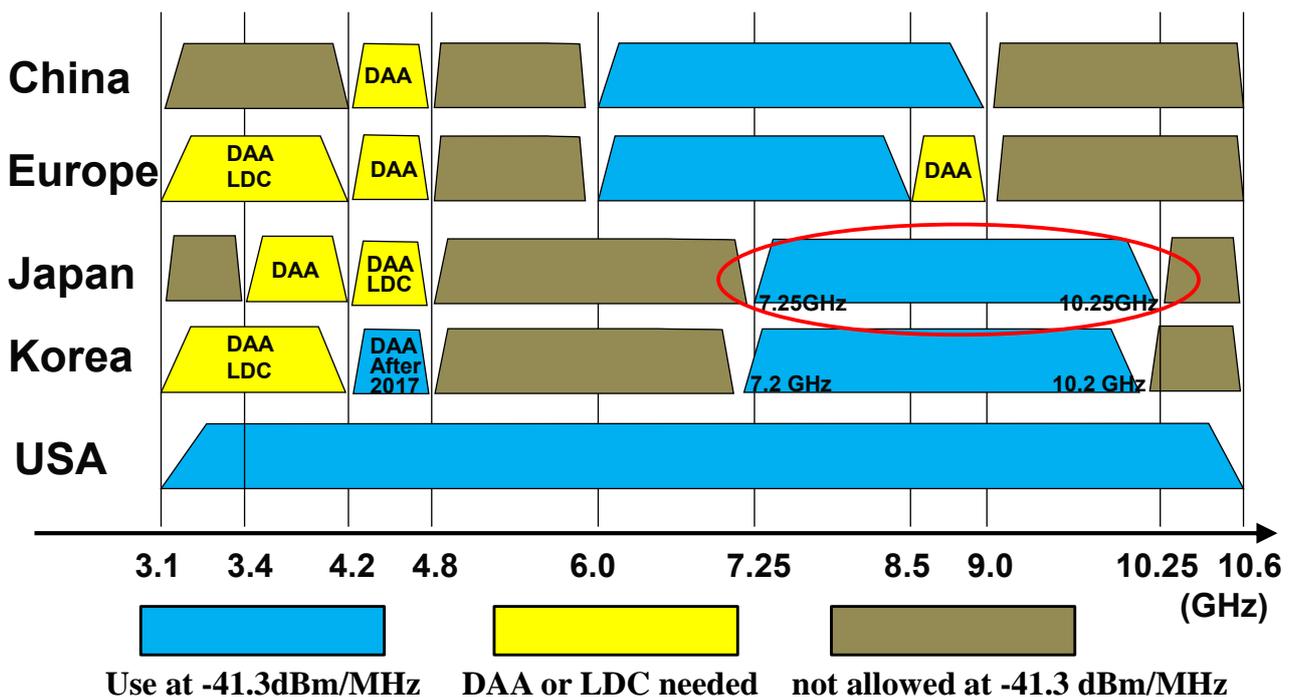


The Advantages of IR-UWB

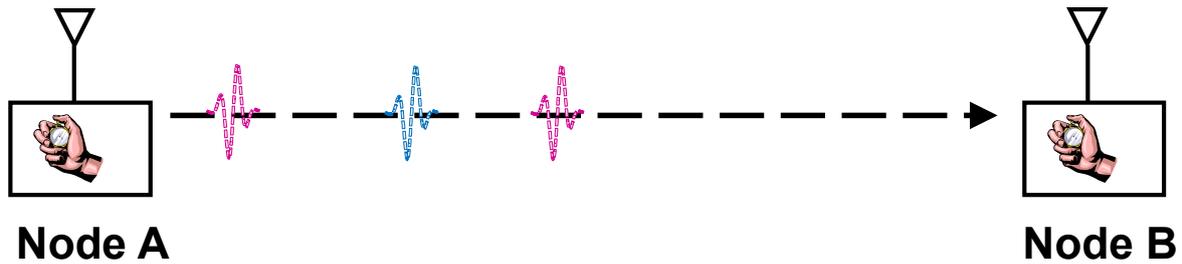
- IR-UWB can provide **high precision ranging**, that is desired in applications of **positioning** or **radar**.
- Because of the extremely low emission power density, the **effect to human body is very limited**.
- Because of the extremely low emission power density as well as the high frequency, the **transmission distance is limited**. That is good for **co-existence**.
- IR-UWB is **inherently low power consumption**. That is favorable for devices to operate on battery.



Regulations on UWB



Time-Of-Arrival Using IR-UWB

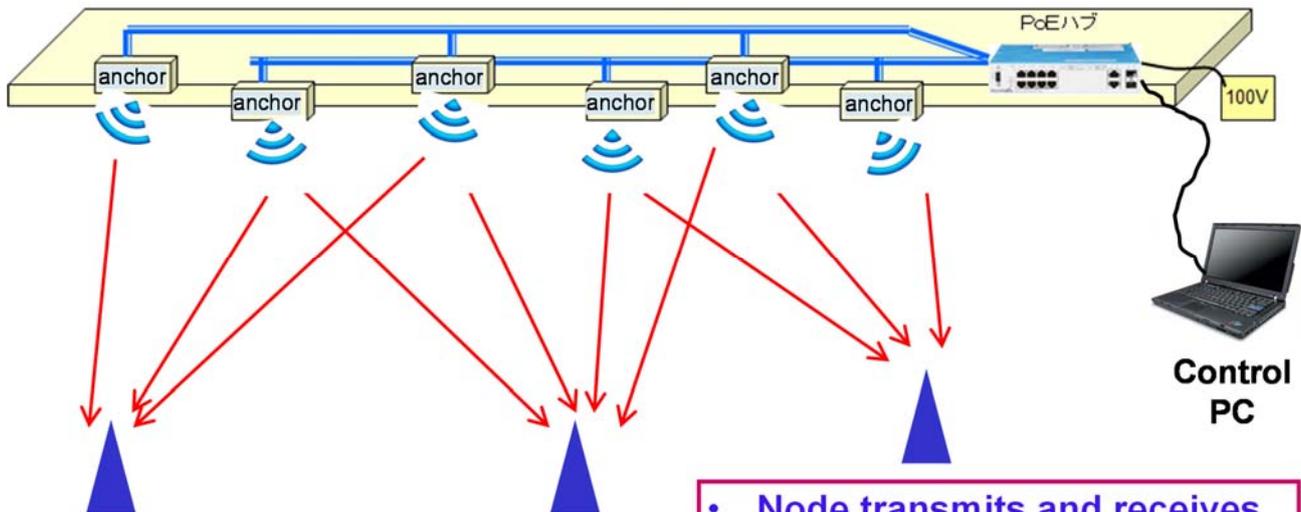


- By measuring the **Time-Of-Arrival (TOA)** of UWB pulse, high precision of distance measurement can be achieved.
- TOA gives much higher precision than **Signal Strength Ranging (SSR)** method.



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Structure of Positioning System



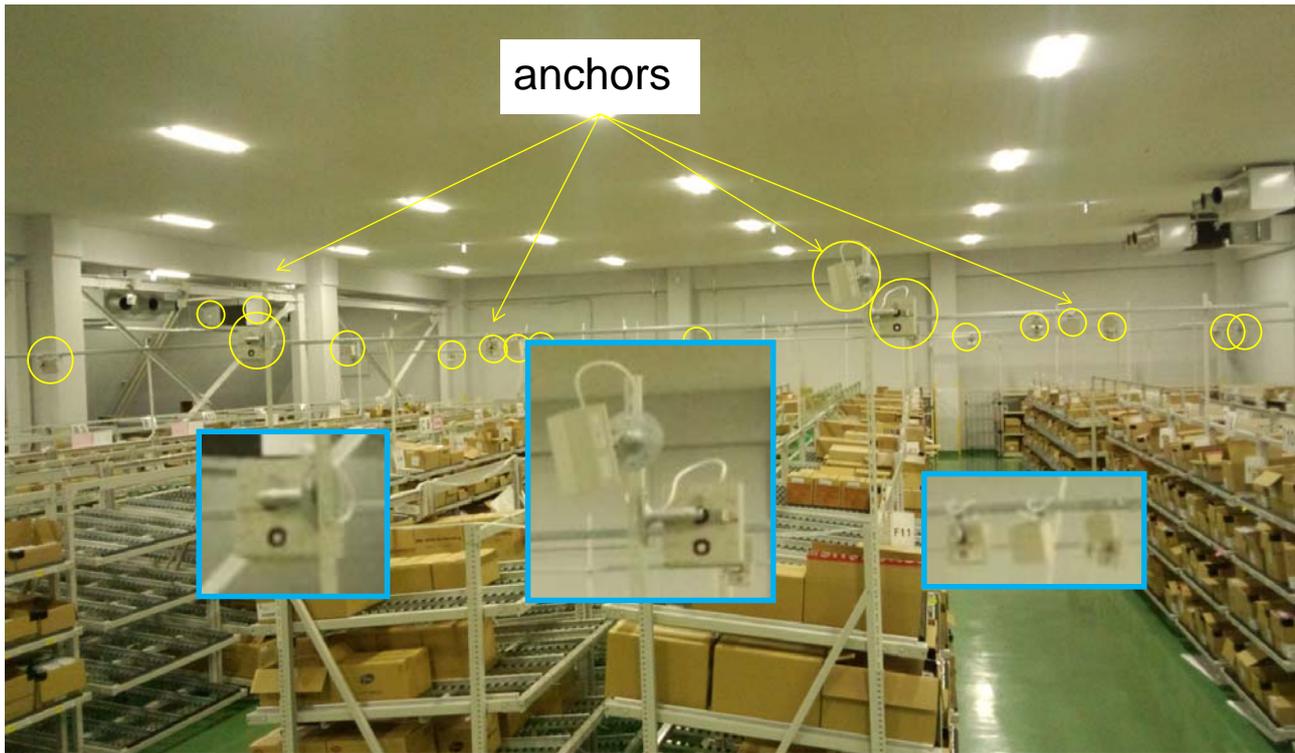
TOA (Time Of Arrival)

- Node transmits and receives
- Round time between anchor and node is measured.
- Synchronization among anchors is not required.

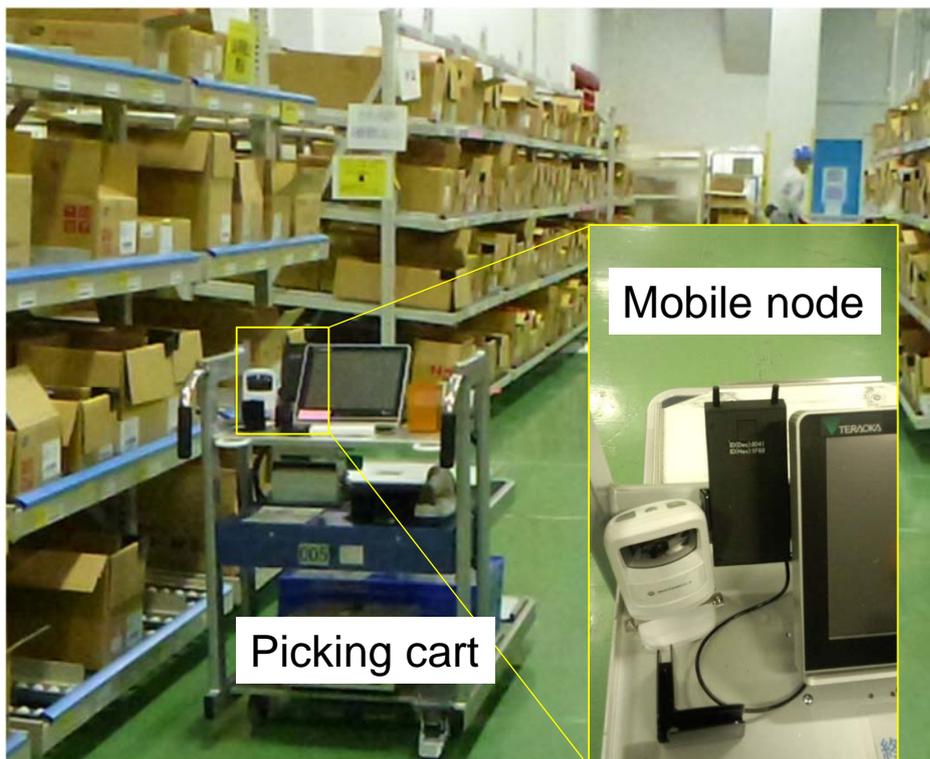


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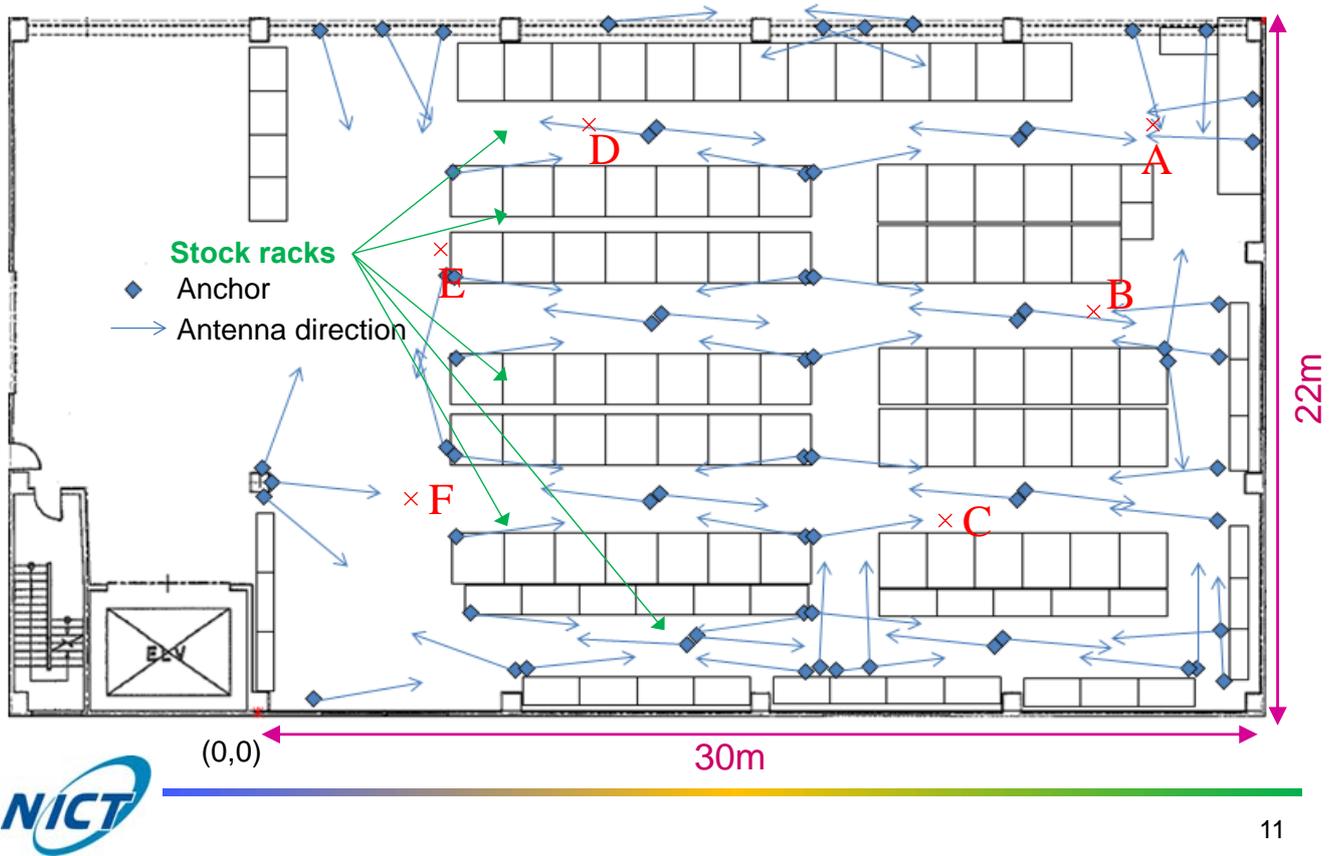
Deployment In a Warehouse (1)



Deployment In a Warehouse (2)



Configuration of Anchor Nodes

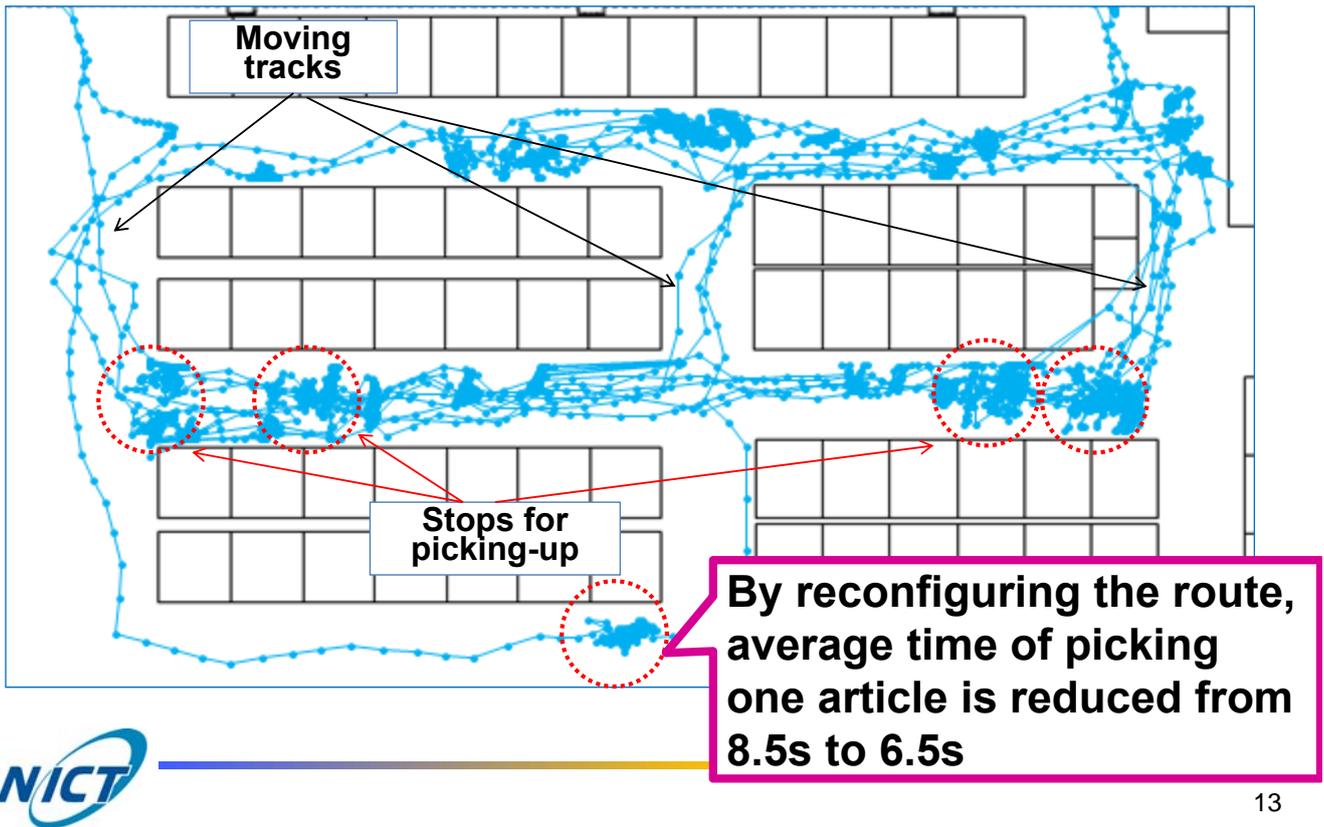


Positioning Precision Analysis

Position	Axis	Min.	Average	Max.	Dev.	Dispersion range	Number of data
A	x	28801	28842	28923	13.2	122	2095
	y	19028	19063	19101	11.0	73	
B	x	26832	26873	26911	11.1	79	2095
	y	12853	12937	13058	21.9	205	
C	x	22086	22108	22132	7.1	46	2095
	y	6722	6751	6783	8.7	61	
D	x	10013	10137	10215	17.9	202	2069
	y	18785	19087	19140	40.0	355	
E	x	5112	5208	5302	19.2	190	2069
	y	12943	13017	13102	31.1	159	
F	x	4285	4460	4654	50.3	369	2069
	y	7047	7142	7269	48.2	222	

(unit: mm)

Example of Picking-card Tracking



Deployment In a Shopping Mall (1)



Northport Mall in Yokohama
(One minute walk from a subway station 'Center North')

Deployment In a Shopping Mall (2)



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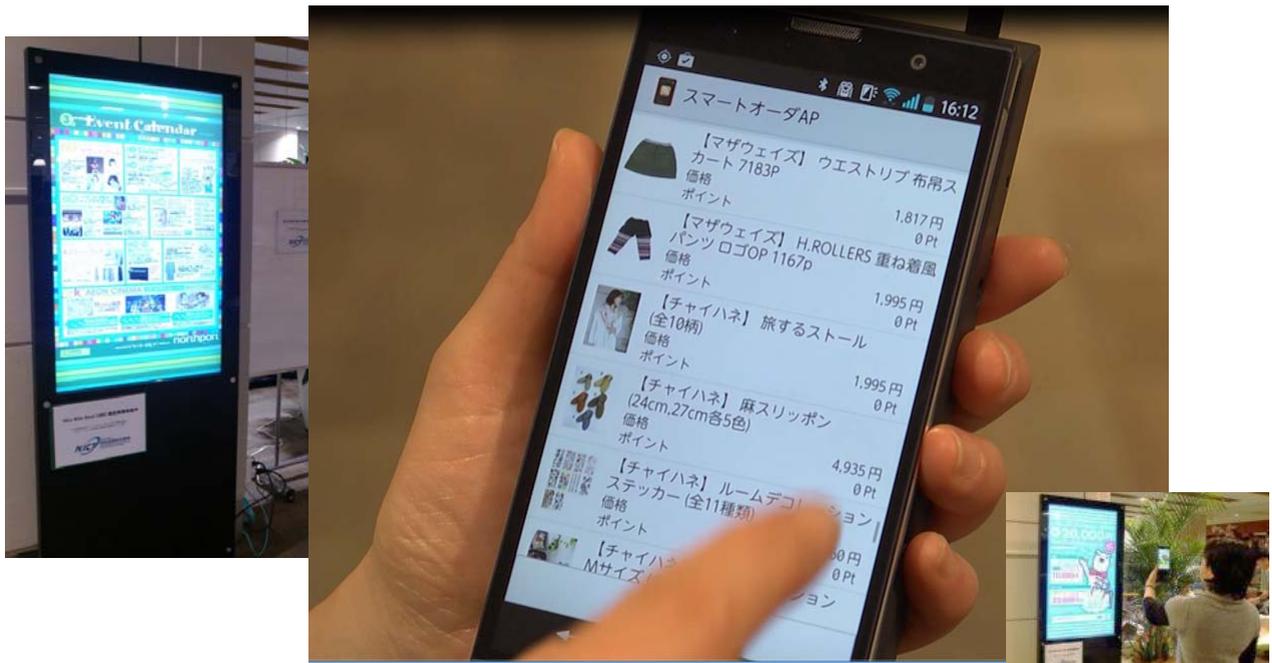
Navigation in Shopping Mall

- Real-time navigation is made by providing both distance and direction information while the user moves through the space
- Push notifications are triggered when the user is near a destination
- Automatic location updates are available when the user is moving
- Voice assistance is provided for hands-free navigation



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Example of Smart Order



When detected an approaching registered customer, the signage shows recommended articles for this particular customer. The customer can draw-in those information to personal terminal and order articles directly.



Accumulated Tracks (Heat Map)



Conclusion Remarks

- IR-UWB is inherently of high time resolution. Real-time position tracking system using IR-UWB at UWB high band are developed.
- Deployment in an in-operating warehouse achieves precision around 40cm. The results are used for increasing operating efficiency.
- Deployment in a shopping mall provides a number of applications that may benefit both shop operators and customers.



Thank you for your attention!

