

**For discussion
on 22 January 2007**

Legislative Council Panel on Economic Services

**Proposal to Replace the High Performance Computing System
of the Hong Kong Observatory**

Introduction

This paper briefs Members on a proposal to acquire a replacement high performance computing (HPC) system at an estimated non-recurrent cost of \$48.5 million to support weather forecasting and warning services of the Hong Kong Observatory (HKO).

Background

2. Numerical Weather Prediction (NWP) is the basic forecasting tool in modern weather centres. It is a technique of simulating the evolution of the atmosphere on HPC systems. Such simulation requires very intensive computing resources to solve the complex mathematical equations involved. The existing HPC system of the HKO was acquired in 1999. It has a peak performance of 0.02 TeraFLOPS¹, which is very low as compared with some other meteorological centres². The HKO has configured the existing system to support running NWP models at two horizontal resolutions: a coarser 60-km version over a larger domain and a finer 20-km version over a smaller domain.

¹ TeraFLOPS – a common metric used for measuring the performance of HPC systems, and 1 TeraFLOPS means performing 1 million million floating point operations per second.

² For example, 1.1 TeraFLOPS at the Guangdong Meteorological Bureau, around 6 TeraFLOPS at the Beijing Meteorological Bureau (planned acquisition in 2007), 18.5 TeraFLOPS at the Korea Meteorological Administration and 21.6 TeraFLOPS at the China Meteorological Administration.

Justifications

Limitation of the existing HPC system

3. The existing HPC system has already reached the end of its serviceable life (which is normally about five years) and is relatively outdated compared to current HPC technology. NWP model outputs generated from the existing system lack the quality of resolution required to adequately capture spatial differences and differentiate the detailed topography of Hong Kong. As a result, the HKO's ability in providing forecasts on regional weather condition and short-lived weather phenomena with dimensions of a few kilometers (such as rainstorms) is quite limited. Moreover, the existing system only allows NWP models to be run optimally at 3-hourly intervals. This update frequency is not adequate to deal with fast developing weather situations. Overall, the existing HPC system has constrained the HKO from providing more timely and detailed weather forecasts and warnings.

The replacement proposal

4. New NWP models taking advantage of the advances in computing technology have been developed in the past few years to offer (a) a suite of refined models with enhanced horizontal resolutions to resolve spatial differences; (b) more frequent model runs to capture rapid changes of inclement weather; and (c) more advanced data analysis techniques to provide meteorological information of a better quality. With a view to providing more timely and detailed weather forecasts and warnings, the HKO commissioned an HPC Technical Study in 2006. Taking into account the anticipated operational requirements applicable to Hong Kong in terms of model resolution, update frequency and dimensions of forecast domain, the consultant recommends replacing the existing system by an enhanced system with a peak performance of three to five TeraFLOPs, configured to run a suite of high resolution NWP models with horizontal resolutions ranging from 2 km to 20 km.

5. With the proposed replacement, the HKO’s capacity in applying the latest NWP technology will be strengthened and its forecasters will have more timely and detailed objective guidance for formulating weather forecasts and time-critical warnings of inclement weather. Specifically, the HKO would be better equipped to simulate and issue warnings of short-lived and localized weather phenomena, such as rainstorms; and provide more refined forecasts to facilitate weather-sensitive aviation and maritime operations, as well as planning of outdoor sport activities and public functions. Moreover, the higher processing power of the proposed HPC system would provide room for meeting possible future needs, such as research on wind distribution. Such new capabilities would enable the HKO to provide members of the public with more detailed and timely weather forecasts and warnings as well as value-added weather information services, for enhancing public safety and better protection of property.

Financial Implications

Non-recurrent cost

6. On the basis of the findings of the HPC Technical Study, the HKO proposes to replace its existing HPC system by a new one with a peak performance of three to five TeraFLOPS. Based on the latest market information as provided by the consultant and the Architectural Services Department, the estimated non-recurrent cost of the proposal is \$48.5 million, with the following breakdown –

	\$ million
(a) HPC hardware and software	35.00
(b) Upgrading of power capacity at the HKO Headquarters	4.42
(c) Site design and preparation	3.08
(d) Contract staff and professional services	2.00
	<hr/>
Sub-total	44.50
(e) Contingency	4.00
	<hr/>
Total	48.50

7. On paragraph 6(a), the estimate of \$35 million is for the hardware, software and associated peripherals of the new HPC system, and expenses in relation to system delivery, installation, testing and training.

8. On paragraph 6(b), the estimate of \$4.42 million is for providing adequate power supply for the operation of the new HPC system, which involves construction of a new transformer room and emergency generator room, and installation of a new transformer, an additional emergency generator and high voltage panels.

9. On paragraph 6(c), the estimate of \$3.08 million is for the preparation of a computer room with the necessary support utilities including cooling systems and uninterruptible power supply.

10. On paragraph 6(d), the estimate of \$2 million is for the employment of two contract information technology staff for a period of 12 months to assist in project implementation, and for the professional services of an HPC specialist to tune and optimize the performance of NWP models on the new HPC system.

Recurrent cost

11. The additional recurrent expenditure arising from the project is estimated to be \$0.5 million for 2008-09 and \$4.03 million from 2009-10 onwards –

	2008-09	2009-10 onwards
	\$ million	\$ million
(a) Light and power	0.45	0.94
(b) Specialist supplies and equipment	0.05	0.12
(c) Repair and maintenance		3.75
	0.50	4.81
(d) Less: Annual savings		(0.78)
Total	0.50	4.03

12. On paragraph 11(a), the expenditure is for the power consumed by the new HPC system and other support utilities including cooling systems and uninterruptible power supply.

13. On paragraph 11(b), the expenditure is for the purchase of tape cartridges for archival of model-generated data.

14. On paragraph 11(c), the expenditure is for the maintenance of the new HPC system and other support utilities including cooling systems and uninterruptible power supply.

15. On paragraph 11(d), the savings represent the recurrent costs of the existing HPC system and will be ploughed back to cover part of the recurrent costs of the new system.

16. The Economic Development and Labour Bureau and the HKO will absorb from within their existing resources the additional recurrent expenditure arising from the project. No additional staff will be required as existing HKO staff will be deployed to operate the new HPC system.

Implementation Plan

17. We plan to implement the proposal according to the following schedule –

Activity	Target completion date
(a) Upgrading of power capacity at the HKO Headquarters	March 2008
(b) Tender invitation and award of contract	March 2008
(c) Site preparation	July 2008
(d) System delivery, installation and acceptance test	November 2008
(e) Trial runs of new NWP models on the new HPC system and commissioning of the system	November 2009

Next Step

18. Subject to Members' views on the replacement proposal, we will seek the funding approval of the Finance Committee on 9 February 2007.

Views Sought

19. Members' views on the proposal are invited.

Economic Development and Labour Bureau
Hong Kong Observatory
15 January 2007